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CONTENTS

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Problems of Human Nutrition

OF the two factors which together mould the individual, heredity and environment, modern knowledge is attributing more and more importance to the latter ; in fact, as Sir Frederick Gowland Hopkins pointed out in his Sir Henry Trueman Wood Memorial Lecture delivered before the Royal Society of Arts on February 6, although inheritance must set definite limits to the possibilities before each individual, environmental influences can decide whether, within those limits, the highest level possible is reached, or only a level which may be much lower than this. Among all the demands which the body makes on its environment, that for its food is of outstanding importance, and it is to-day becoming recognised that right nutrition, especially in early life, may profoundly affect the well-being and social value of the individual. Knowledge obtained by scientific inquiry is beginning to take the place of instinct and appetite aided by very slowly growing transmitted experience. There is still to be combatted the idea that the race, having survived through the ages without such knowledge, can continue to thrive without making any practical use of it : but mere survival of a race is no proof that the majority of its members have ever lived in optimal conditions, or have ever displayed to the full their innate capacities.

Briefly, the essential constituents of a diet are proteins of good biological value, fats, carbohydrates, minerals and vitamins. The energy value should be not less than 3,000 calories *per diem* for the average man—probably it would be better to take the higher figure of 3,400 calories as suggested by the Committee of the British Medical Association. The value of a protein depends on how far its constituent amino-acids resemble those of the body in nature and grouping, so that animal proteins are of higher biological value than vegetable. Although fats and carbohydrates are interchangeable as sources of energy, yet both are necessary in the diet. Fats cannot be properly utilised in the absence of carbohydrates, and it is now known that certain fatty acids are as essential constituents of a diet as some of the amino-acids. The relationship of the mineral elements and the vitamins to different diseases is now well known. To sum up, scientific research during the last two decades has shown that nearly forty individual substances must be

present in a food supply to make it completely adequate.

It is not always realised how easily a diet, generally considered satisfactory, can be improved, or how easily experimental alterations in a food supply, carried out without complete knowledge of what constitutes a proper diet, may spell disaster. Corry Mann investigated the effect of adding $1\frac{3}{4}$ oz. of butter or one pint of milk daily to the ordinary diet of boys in an institution. The average weight and height increases for the three groups, on diet alone, diet plus butter and diet plus milk, were, in one year, 3·85 lb. and 1·84 in., 6·3 lb. and 2·22 in., and 7 lb. and 2·63 in., respectively. Again, Christ's Hospital School, by utilising the results of the modern science of nutrition, has been able, during the past twenty years, to increase the height and weight of the boys until they are now several inches taller and several pounds heavier than boys of similar age who have not had the benefit of a sound diet. During the War, when food was short and of poor quality, and substitutes had to be used, the Christ's Hospital records show that liability to bone injuries and fractures rose rapidly and did not diminish until 1922 (*Planning*, No. 44, Feb. 12, 1935). On the other hand, a short time ago, the island of Nauru in the Pacific suffered from a most alarming outbreak of beriberi, especially infantile beriberi: the officials in charge of the island had first of all encouraged the consumption of milled cereals, and then forbidden the consumption of the intoxicating national drink—'toddy'—made from fermented sweet swathe of the coco-nut. Thus the diet was deficient in vitamin B_1. It is dangerous for authority, with inadequate knowledge of problems of nutrition, to control food policy.

What then is a proper diet? Much of the teaching of modern research may be summed up in statements so simple that elaborate scientific efforts may, to some minds, seem to have been superfluous. To convey the essentials of to-day's scientific teaching, it is only necessary to insist that fresh green vegetables and fruits are not luxuries but necessities, and that cereal foodstuffs, and especially cereals artificially fractionated, must not so dominate a diet as to exclude an adequate supply of fresh animal products—if not of flesh, then of the products of the dairy. In this connexion it may be pointed out that a review of the voluminous literature indicates that pasteurisation of milk, when properly carried out —an important reservation—affects its nutritional value to no more than a negligible degree. Nevertheless, it is a sound policy to encourage the practice of giving extra sources of vitamins A, C and D.

Why is the application of these discoveries only slowly taking place? The issue of *Planning* referred to above points out that, apart from the inherent difficulty of changing ingrained habits of thought and living, there is no general agreement on standards of nutrition and so on what constitutes malnutrition. There is an urgent need for a trustworthy standard, based upon objective tests capable of universal and uniform application, so as to yield comparable results in different places and periods.

Education of the public in the facts of nutrition as disclosed by modern research is an essential. Properly presented, public taste will respond to our increasing knowledge of the factors necessary to make a diet completely adequate; in fact, it has already responded to a remarkable degree, considering the number of obstacles—confusion, inertia, lack of co-ordination and vested interests of all sorts—which stand in the way. Thus, compared with the average of 1924–27, our 1932 *per capita* consumption of margarine fell by 20·8 per cent and of flour by 2 per cent (bread remaining unchanged), while consumption of fruit rose by 8·2 per cent, of milk by 15·5 per cent, of eggs by 32·7 per cent and of butter by 40·3 per cent. These changes are not parallel to changes in price: consumption of bread has not increased in spite of the fall in price, and the consumption of milk and eggs has increased considerably faster than prices have fallen.

At the same time, it must be emphasised that our knowledge is far from complete. We do not know the optimum intake of calories for children of different ages, or the optimum supply of the individual vitamins. We do not know what beneficial modifications of a dietary may be desirable at special periods of life, as at puberty, for example, or in the case of a pregnant woman. These are merely instances of knowledge yet to come. There can be no doubt, however, that a general and intelligent application of existing knowledge would lead to betterment in the health of the nation; large and delicate readjustments are called for, which will intimately affect social habits and will touch directly or indirectly the development of many industries and branches of distribution.

Reviews

The Carotenoids

Carotinoide: ein biochemischer Bericht über pflanzenliche und tierische Polyenfarbstoffe. Von Prof. Dr. L. Zechmeister. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 31.) Pp. xii+338. (Berlin: Julius Springer, 1934.) 29.40 gold marks.

IN the last decade, perhaps the most rapid progress in any field of organic chemistry has been in that of the natural colouring matters. The anthocyanins have been mastered by Robinson and the porphyrins and chlorophyll by Hans Fischer; but it is the carotenoid pigments which have provided the most sensational progress, mainly in the hands of Karrer and of Kuhn.

Carotene was discovered by Wackenroder in the root of the carrot in 1831, and lycopene in the tomato by Millardet in 1876, though it did not receive this name until 1903, from Schunck. Before the beginning of this century the carotenoids were chiefly studied by botanists and physiologists; and though their results were of considerable biological interest, little information on the chemical properties of these substances was obtained. Then Willstätter, at the same time as his researches on chlorophyll, investigated the yellow pigments of the leaf, developing methods for their isolation and purification and establishing for the first time their correct formulæ.

It was a tragedy that Willstätter's work was interrupted by the outbreak of the War, and his skilled collaborators dispersed to their respective countries to take up arms against one another. The work on chlorophyll and the carotenoids was never resumed owing to the cost of the material and of the large amounts of organic solvents necessary. Willstätter had established the empirical formulæ of the chief carotenoids; lycopene and carotene were shown to be isomeric hydrocarbons with forty carbon atoms, and leaf xanthophyll to be a dihydroxy carotene. He had also guessed correctly the type of compounds they are, in suggesting for them, as for phytol, the alcoholic component of chlorophyll, the isoprene building stone found in the terpenes and rubber.

So the problem of their structure lay until 1927, when Prof. Zechmeister showed by catalytic hydrogenation that carotene and xanthophyll contained eleven ethylenic linkages and must be bicyclic, while lycopene contained thirteen ethylenic linkages and was an unsaturated aliphatic molecule. At the same time, Kuhn and Winterstein had synthesised the important series of diphenyl polyenes, the colour of which depended on a chain of conjugated double bonds. Theoretical qualms about the possibility of a purely aliphatic hydrocarbon being so intensely coloured were at once dispelled, and it became clear to several chemists that the carotenoids owed their colour also to a chain of conjugated double bonds. Kuhn and Winterstein applied these ideas to the carotenoid bixin from annatto, while Karrer simultaneously applied them to crocetin from saffron. The carotenoids, being built up of isoprene units, are polyene pigments with methyl side chains, or 'polyprenes'.

It had long been observed that a smell of violets is produced when carotene autoxidises, and Karrer and Helfenstein brilliantly seized on this clue and proved the odour was due to β-ionone. Ionone rings were shown to be the cyclic structures present in carotene, and on the basis of oxidation experiments the correct formulæ for carotene and lycopene were suggested exactly one hundred years after the publication of the discovery of carotene.

A feature of these formulæ is their symmetry about the middle of the molecule, one half being the mirror image of the other: this was originally suggested by analogy with the triterpene squalene occurring in fish livers, which was synthesised by Karrer and Helfenstein after they had reinterpreted the structural evidence provided by Heilbron, but is now proved absolutely by direct experimental evidence, due chiefly to Kuhn.

This symmetrical structure of the C_{40} carotenoids has suggested to many a relation to phytol, which was synthesised by F. G. Fischer in 1929, two molecules of which joining together form the essential skeleton of the carotenoids. The evidence from plant physiological sources on the relation between the carotenoids and chlorophyll is contradictory, and remains to be satisfactorily interpreted. Phytol is always found in chlorophyll and is never known to be replaced by any other alcohol. On the other hand, carotenoids develop in bacteria which contain no chlorophyll. It is to be hoped this problem will be attacked again.

Investigation of plants has brought to light three isomeric carotenes and a series of hydroxy carotenes or xanthophylls with one, two, three, four or six hydroxyl groups; the last is the fucoxanthin of brown algæ, and it is likely that new carotenoids remain to be discovered in the algæ. In the petals of a flowering plant as many as five different carotenoid pigments may exist together, and it is obvious that they are formed one from the other, though so far this has not been imitated in the laboratory. A particularly interesting but little understood relationship is that of carotene to lycopene; it has been shown, for example, that tomatoes ripened above 30° C. do not produce lycopene.

Besides the C_{40} carotenoids of general distribution, there exist in plants rarer carotenoids with a smaller carbon skeleton, the ascertained structure of which proves without doubt that they are derived by oxidative cleavage of the C_{40} carotenoids. In saffron, not only is the pigment crocin known, but also Kuhn and Winterstein were able to isolate the other fragment of the original carotene molecule as the glucosidic bitter principle picro-crocin, an extremely elegant demonstration of the course of biosynthesis.

The identification by von Euler and Karrer of carotene as provitamin A, being converted and accumulated in the animal as the almost colourless vitamin A, is a familiar story which need not be repeated here. It is the most important result of the study of the carotenoids. To chemists the interest is the limitation of the activity to carotenoids in which the β-ionone ring is unsubstituted and its failure in derivatives like the xanthophylls, the physiological importance of which is not yet established. A fascinating problem is the source of vitamin A in fish livers, and the discovery of the point in the complicated food cycle on which fish depend at which carotenoid is transformed into vitamin.

To-day the nation is beginning to demand quality in its milk and butter supplies; it is found that the carotene content of butter runs parallel to its vitamin A content, thus serving as an indicator of quality. Winter butter contains much less vitamin than summer butter, and so the practice of artificially colouring butter to appeal to the consumer's eye conceals its poor quality. The irony of the practice is evident when it is realised that the substances annatto and saffron used for artificial colouring are themselves carotenoid pigments, but neither of them possesses vitamin A activity!

Some of the plant carotenoids are absorbed by animals and deposited or excreted unchanged, like carotene in the corpus luteum of the cow and xanthophyll in the yolk of eggs; on the other hand, they may be considerably modified; many animal carotenoids require study, as a reference to Palmer's monograph (1922) reveals. An example is the C_{40} carotenoid which is the red pigment of the lobster; before cooking, the lobster has a blue colour due to an absorption complex of this pigment with protein, which dissociates on boiling to give the familiar red. A similar carotenoid-protein complex has been related to the visual purple of the eye according to a NATURE correspondent.

Not the least useful outcome of the activity in carotenoid chemistry is the developments in contemporary chemical technique to which it has led. Microcombustion analysis made carotenoid chemistry possible, but its prosecution has led to the development of microhydrogenation, a method for determination of methyl side chains, and to the rediscovery and popularisation of a new method of purification of chemical substances, 'chromatographic adsorption'.

Prof. Zechmeister's monograph is the first to record the chemical knowledge of the carotenoids. It gives an excellent and detailed account of the individual carotenoids, the methods of establishing their structure, their distribution and determination in plants and animals, their relation to vitamin A, and it discusses their formation in the plant and their physiological rôle. There is a complete bibliography and a good index. It is to be welcomed as an authoritative work from one who, through his own researches, is well qualified to write on the subject, and whose own contributions to it have been important.

K. F. ARMSTRONG.

Modern Science for the Layman

The Architecture of the Universe. By Dr. W. F. G. Swann. Pp. x+428. (New York: The Macmillan Co., 1934.) 16*s.* net.

MANY are familiar with the lectures on various general aspects of science which Dr. Swann, director of the Bartol Research Foundation of the Franklin Institute, has delivered in recent years. Their publication in the *Journal of the Franklin Institute*, *Science* and elsewhere has secured for them a wider public than that of their original auditors—a fact which, on account of their general excellence, is matter for satisfaction. Dr. Swann has now collected them to form a well-produced volume which can unhesitatingly be recommended to all who are interested in the broad significance of modern scientific thought.

The book includes twelve lectures which, though strictly speaking they are independent of one another, are yet arranged so as to present a rough approximation to continuity. It corresponds closely, the author tells us, to a course of lectures on the philosophy of physics given at Ohio State University during the summer of 1932. Starting with an account of medieval and modern dogmas in natural philosophy and the dawn of the modern era, it takes us through atomic theory, relativity and problems of space, time and the universe, to a concluding discussion, necessarily more speculative than that which precedes, of vital processes and the relations of science with theology.

It is superfluous to tell those who know Dr. Swann's facility in the popularisation of science that the book is trustworthy and interesting, though occasionally (as, for example, in the two references on p. 235 to the star "Krueger" instead

of "Kreuger 60") the author betrays his unequal familiarity with all the subjects treated. Such blemishes, however, are few and unimportant. If we have a controversy with Dr. Swann it is less in his practice than in his theory of popular writing. "I cannot escape the belief," he writes in the preface, "that a great deal of the confusion which is frequently left in the mind of the layman after reading a popular presentation of some of the more abstruse branches of natural philosophy, is a result of . . . an unnecessary subjugation of the philosophical and mathematical ideas." This may be so, but is not an unnecessary exaltation of the mathematical ideas a much greater and commoner evil? How many lay students of relativity, for example, have not been completely misled by talk of 'curvature' of space-time, having been induced thereby to search for a mental picture of something similar to the familiar curvature of a sphere? The whole conception is, of course, primarily a mathematical one. Its application to the sphere corresponds to the familiar notion of curvature, while its application to space-time corresponds to nothing so imaginable. Surely it would have been better if in popular presentation, the 'mathematical idea' had been eliminated and the theory expressed, as it easily can be, in terms of intelligible operations.

On the whole, however, Dr. Swann's exposition calls for little but praise. H. D.

Experimental Optics

Physical Optics. By Prof. Robert W. Wood. Third edition. Pp. xvi+846+18 plates. (New York: The Macmillan Co., 1934.) 31*s.* 6*d.* net.

PROF. R. W. WOOD'S "Physical Optics" was issued in 1905 and revised in 1911, when it was expanded by 150 pages, with nearly a hundred new illustrations. The new edition shows a similar expansion of 132 pages, but includes nearly 500 pages of new material, nine new plates, and more than 150 new illustrations. The photographs thus reproduced were, however, designed for use rather than for ornament, and are disappointing in comparison with the beautiful pictures which are often used to illustrate spectroscopic phenomena.

The book retains its unique character as a record of experimental methods and results, and is of special value as a guide to the contributions to physical optics which have been made in the laboratory of the author at Baltimore. It is difficult to realise that the second edition goes back to a date preceding the development of Bohr's theory of line spectra. Quantum theory was then covered by a couple of pages on the "very recent light-quanta hypothesis of Planck and Einstein", and the remainder of the book was based exclusively upon 'classical' methods of analysis. The new edition therefore provided an opportunity for writing up *de novo* the whole of the work done in applying the quantum theory to optical phenomena. In the hands of so keen an experimenter as Prof. Wood, the narrative takes on an unusual form, since it is founded on observation and consequent theory rather than conversely. The new chapter on "The Origin of Spectra" is therefore exceptionally well-adapted for readers who think more easily in terms of facts than of symbols; and the same features are seen in new chapters on resonance radiation and fluorescence of atoms and molecules, and in the reconstructed chapters on magneto- and electro-optics, in the course of which the spinning electron is introduced as a solution of the problem presented by the 'abnormal' Zeeman effect in light emitted in a magnetic field.

In his original preface, the author expressed the hope "that the perhaps too frequent references to experiments with which he has been more or less directly associated will not be taken as an indication of a lack of perspective". In view of this frank acknowledgment, the reader need not be unduly disappointed when he finds that other topics are dealt with much less adequately. Thus, in the new edition, refractive dispersion in the region of absorption is still discussed in terms of 'damping'; and the sections dealing with absorption are equally inadequate, since a well-qualified colleague has remarked that the author's commendation of Vierordt's spectrophotometer, which "would now be considered a museum specimen", is "about sixty years out of date". Similarly, in a field in which the reviewer is specially interested, an erroneous statement that the anomalous rotatory dispersion of tartaric acid depends on an optically active absorption band in the infra-red, has been deleted; but no new data have been added, and half a dozen measurements, made in 1858 by methods which have been obsolete for more than half a century, are still cited as adequate illustrations of this phenomenon. In this chapter, moreover, the author has abandoned his policy of describing facts rather than theories, since the only important addition is a summary of Werner Kuhn's theory of dissymmetrically coupled electrons, which is already becoming obsolescent in view of more recent work by Born. Readers who wish to learn about modern work in branches of physical optics not of special interest to the author must therefore be prepared to seek information elsewhere; but others will be equally grateful to him for leaving these alien topics to take care of themselves, in order to concentrate on those questions about which he can give so much interesting first-hand information. T. M. LOWRY.

Short Notices

Science Museum, South Kensington. *Handbook of the Collections illustrating Electrical Engineering.* 2 : *Radio Communication.* By W. T. O'Dea. Part 1 : *History and Development.* Pp. 95+35 plates. (London : H.M. Stationery Office, 1934.) 2*s.* 6*d.* net.

THE objects of the Science Museum at South Kensington, with its collections and science library, are to assist in the study of scientific and technical development, and to illustrate the applications of physical science to technical industry. For the guidance of students and others visiting the Museum, a series of handbooks is in existence, illustrating the various collections exhibited. The book under review is one of those dealing with the electrical engineering collections. It is, however, by no means a mere descriptive catalogue of what may be seen at the Museum. It is rather a concise and well-presented history of the development of radio communication from the earliest discoveries of Hertzian waves up to the present-day achievements of telegraphy, telephony, broadcasting and television.

The value of the work is considerably enhanced by the large number of photographs which illustrate the progress made in the plant and apparatus used for radio communication purposes. Many of these items are quite obsolete, and the preservation of a knowledge of them, partly by exhibits in the Museum and partly by the illustrations in this work, is a valuable undertaking. Of the few points in the book which call for criticism, one will be mentioned here. Insufficient recognition appears to have been given to the very valuable technical work carried out during recent years by members of the staff of the British Post Office, which has been very largely responsible for the development of radio-telephonic communication to its present world-wide standard.

Although technicalities have been reduced to the minimum, some knowledge of the technique of the subject is desirable on the part of the reader. To the student, in particular, the book will provide a valuable historical supplement to his more detailed textbooks.

Soil Analysis : a Handbook of Physical and Chemical Methods. By C. Harold Wright. Pp. viii+236. (London : Thomas Murby and Co. ; New York : D. Van Nostrand Co., Inc., 1934.) 12*s.* 6*d.* net.

THE number of analyses conducted every day on soils must be very large, yet apart from Gedroiz's and Lemmerman's works in Russian or German, and Wiley's "Agricultural Analysis", vol. 1, there was until now no textbook on the subject. Most workers have had to get their information from sections in general textbooks or in the "Chemists' Year-Book", or from the original literature. In the inevitable phrase, then, Wright's "Soil Analysis" supplies a long-felt want. Moreover, it does so exceedingly well. Without being cumbrous, it is comprehensive ; and—a matter of particular importance in a subject where methods are revised and new conceptions are introduced as rapidly as in soil science—it is right up to date.

There is a full array of chemical determinations, including those, such as ammonia and nitrate, useful to the microbiologist. In addition, the book describes methods of determining physical constants, and making physico-chemical measurements, paying particular attention to soil reaction and base exchange. In footnotes and in tables of factors the author brings his own experience to the aid of workers who may be using a method for the first time. The number of illustrations might usefully have been increased, but the book is well produced and commendably free from errors.

Textbook of Abnormal Psychology. By Roy M. Dorcus and Prof. G. Wilson Shaffer. Pp. xiii+389. (London : George Allen and Unwin, Ltd., 1934.) 16*s.* net.

THIS is a most instructive and valuable work. It is written by two psychologists who bring to their work a critical faculty and logical training that one does not always find in books dealing with abnormal, or for that matter normal, psychology.

When viewed from a medical point of view, however, there is a superficiality and vagueness which leaves a feeling of uneasiness. The statement that . . . "Swingle and Pfiffner . . . have discovered an aqueous extract of the adrenal cortex which has proved astonishingly valuable in the treatment of cats . . ." may sound thrilling, but what *were* the cats suffering from ? We would have liked to see some discussion of the relationship between the adrenal glands and emotion.

The writers might have emphasised that in true paranoia there is an absence of hallucinations, and that mental deterioration does not occur. The adjective corresponding to paranoia is paranoiac, not paranoid. Despite shortcomings which can all be corrected in the next edition, the book is on the right lines, and we welcome it.

Soviet Russia fights Neurosis. By Dr. Frankwood E. Williams. Pp. xix+251. (London : George Routledge and Sons, Ltd., 1934.) 8*s.* 6*d.* net.

DR. FRANKWOOD WILLIAMS went to the U.S.S.R. as a psychiatrist to see for himself the state of affairs. He found many strange and inexplicable conditions and views. Possibly the position is best summed up in the reply to a criticism of his ; instead of answering the criticism the reply was evasive and turned at once to 'Yes, but have you seen the museum of the Revolution, the park of Culture and rest, a factory, a public kitchen ?' The planning is all there but the execution is another matter ; the Russian citizen seems to blind himself to those things he does not wish to see. Is not the U.S.S.R. suffering from a mass obsessional neurosis ?

Respiration of Fruits*

Mechanism of Respiration

DURING respiration, the entrance of oxygen and its distribution through the tissues to the individual cells of a fruit, also the reverse processes involving the giving off of carbon dioxide, take place by diffusion. There is a fine network of channels ramifying through the tissues to aid such gaseous interchange. The diameter of the pulp cells of the full-grown apple is about 150μ, and of the channels about 5μ. The surface of interchange is very large, being a square metre for a single fruit. The intercellular space is 10–20 per cent of the whole tissue. In such a system as this, there must be gradients of gaseous concentration; though it can be shown that such gradients are very small.

The peel of the apple plays an important part in regulating gaseous interchange between the fruit tissues and the atmosphere. The cells of the peel are smaller and more compact than those of the parenchyma beneath, and their outer walls are covered with a thick cuticle which is comparatively impermeable to gases. But the peel is broken by a system of pores, which constitute a path of gaseous interchange. That the peel constitutes a resistance to the path of gaseous interchange can be shown by setting up two apples with 100 per cent atmospheres of carbon dioxide at their centres, one apple with the skin removed and the other with the skin intact. The escape of carbon dioxide observed will be much greater in the former. Owing to the resistance to diffusion offered by the peel, the composition of the internal atmosphere differs considerably from that of air. Conditions can easily arise which lead, through a conjunction of low skin porosity and high respiratory activity, to concentrations of carbon dioxide inside the fruit which are directly injurious. So much has been definitely shown, but so far no thorough study of the internal atmosphere in relation to the variables affecting it during growth and storage has been carried out.

Changes in Respiratory Activity

Throughout its life-history, the apple shows distinct changes in respiratory activity. These may be correlated with the five morphological and physiological stages which occur during the development of this fruit. First, there is the stage of *cell division* which lasts from fertilisation until about three or four weeks afterwards, when the fruit is about the size of a walnut. This goes on until about a hundred million cells are formed in a typical fruit, after which the number of cells does not appreciably increase. The *enlargement* of these cells constitutes the second stage. Then the fruit *matures* and produces aroma and flavour. This is the third stage. Now the fruit is ripe, and under natural conditions it falls from the tree. The fourth stage follows as a longer or shorter period of *senescence*. The fifth stage is the functional breakdown culminating in *death*.

Respiratory activity is greatest at the beginning of fruit formation; at the end of cell division (first stage) it has fallen to about one fifth of its original value. During cell enlargement (second stage), respiration continues slowly to decrease. During the process of maturation (third stage), a critical change in respiratory activity occurs in that there is a sharp rise. This may be called the *climacteric*. Senescence (fourth stage) sees a slow decline from the peak of respiratory activity reached during the climacteric. Finally, at death (fifth stage) there is a sudden rise followed by a fall to zero.

Chemistry of Respiration

The most important substances connected chemically with the respiration of the apple fruit are sugars (fructose, glucose and sucrose), acids (mainly malic acid), starch and proteins.

During the first stage, the proteins are the chief constituent of the practically non-vacuolate cells. During cell enlargement, sugars accumulate from about 1 per cent to about 9 per cent fresh weight. Vacuoles appear and occupy about 80 per cent of the cell volume. In these, most of the sugars collect. It is significant that fructose and sucrose are the sugars the concentration of which rises, while glucose remains relatively low and steady in concentration. Starch accumulates in the cytoplasm up to about the middle of this stage, after which it diminishes to zero.

Tissue oxidations are associated with enzyme catalysis, determined by (1) enzyme content and (2) content of respirable material. So, to be more exact, the standard of reference should not be unit fresh weight as heretofore used, but unit *living matter*, thus omitting vacuole and cell wall. Considered thus, the fall during the first period is smaller and may be related to a decrease in enzyme activity. In the second stage an increase in respiration occurs, due to the accumulation of the necessary fuel sugars.

If fruit is gathered during the second stage of growth, respiration rapidly falls. Then there is a pause, followed by a continuation of the decrease. The respiratory activity then settles to a steady

* Substance of the Friday evening discourse delivered by Dr. Franklin Kidd at the Royal Institution on November 9, 1934.

decline. This is followed in due course by the climacteric rise, the senescent decline, and the final burst of activity falling away to zero (Fig. 1).

The chemical changes in fruit gathered at this stage and stored are as follows: As soon as the fruit is gathered, the starch content declines and glucose content naturally rises. But, surprisingly, fructose, and sucrose also, rise. The end of the pause in initial fall of respiratory activity marks the final disappearance of starch.

As soon as starch is no longer present, the sucrose begins to disappear, the total fructose content remaining steady, while the total glucose content falls. Unlike starch, however, sucrose does not completely disappear. These changes are considered to complete the phase of adjustment to starvation conditions (Fig. 2).

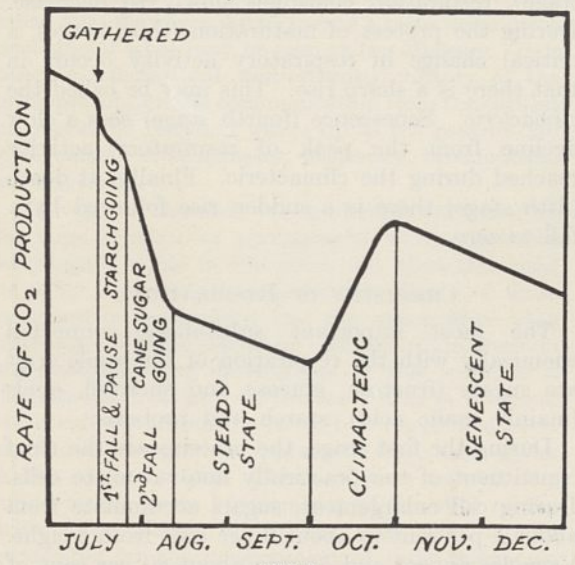

FIG. 1.

There follows a period the only marked features of which are a slow decline in the total glucose content and the sucrose content. At the climacteric, fructose begins to disappear for the first time. At the same time, sucrose rises; thus paralleling the increase in respiration. The concentration of cane sugar and the rate of respiration reach a maximum together at the peak of the climacteric and thereafter decline together.

In explanation of these changes, the heterogeneity of the cell system and the probability that respired sugars are not equally distributed must be taken into account and also the fact that, after gathering, the cells are changing from a state of growth, and of supply and accumulation, to one of cessation of growth and of supplies. The theory advanced is that the sugar respired is active or γ-fructose. Other things being equal, the rate of respiration is determined by the concentration of this active sugar in the cytoplasm. The principal reactions determining concentration of active fructose are:

(I) Glucose $\rightleftarrows$ active fructose $\rightarrow$ inactive fructose or other normal hexose (vacuole).

(II) Glucose + active fructose $\rightleftarrows$ sucrose (vacuole); and the seat of these reactions is thought to be at the interface between the cytoplasm and the vacuole. It is further suggested that prior to the climacteric, sucrose and normal fructose do not as such penetrate from the vacuole into the cytoplasm. When the fruit is on the tree, glucose arrives at the cell wall and passes across the cytoplasm through a declining diffusion gradient. At certain points in the cytoplasm any excess of glucose above a certain concentration is condensed to starch. At the interface between cytoplasm and vacuole the conversion of some of the glucose into active or γ-fructose takes place, and the formation of cane sugar occurs.

The theory accounts for the accumulation of sucrose and fructose in the vacuole during growth and supplies an answer to the questions: Why, after gathering, are the cells unable to maintain a high concentration of cane sugar? Why, nevertheless, does the concentration of cane sugar rise after gathering so long as starch is present? Why, finally, does a steady low concentration of cane sugar occur instead of a complete disappearance as in the case of starch?

With the onset of the climacteric, it is supposed that the interface between vacuole and cytoplasm becomes permeable to normal fructose. This change in permeability is connected with the inner surface of the cytoplasm and possibly with the attainment of a critical hydrogen ion concentration in the vacuole. The acidity of the vacuole is due to the organic acid present. Whether the apple remains on the tree or is gathered, the acidity of the vacuole steadily falls from the beginning of the cell enlargement stage at approximately the same rate. This explains why the climacteric rise occurs very nearly at the same time, irrespective of date of gathering, since the acidity falls in any case, at about the same time, to a certain critical level at which the climacteric occurs. Other evidence has been obtained that the acidity of the vacuole is the main factor in determining the onset of the climacteric.

Storage of Fruits

The climacteric marks the beginning of the production of odour and flavour. Experiment has shown that a substance is evolved during this stage—a substance toxic to seeds and destroyed by bromine. This substance is produced in such small quantities that its identification is not easy; but there are reasons for believing that it is the gas ethylene. The biological effects of the vapour

from ripe apples and of ethylene on other plants are the same. Both, for example, cause an immediate rise in the respiratory activity of other unripe fruit, and this rise bears every resemblance to the true climacteric rise of ripening. Thus unripe fruits exposed to the vapour of ripe fruits begin ripening at once. Such 'autocatalysis' can be prevented by treating air passing from the ripe fruit with ozone.

Among other substances produced at the climacteric is a dense, slowly diffusing vapour which causes the browning of the skin of the apple. Such deterioration can be avoided by very rapid ventilation with fresh air. A more practical way, however, is to wrap the apple, *during the climacteric*, in tissue paper impregnated with an odourless mineral oil.

The production of such gases during the climacteric is also responsible for increased susceptibility in apples to low temperature injury when kept in cold storage. How far the origin of these toxic substances can be traced to fructose is not yet known.

Intermediate Stages of Respiration

Fruit can produce carbon dioxide in the absence of oxygen by respiration. Blackman and Parija have shown that the initial rate of such fermentative breakdown in a ripe apple is a function of the oxygen supply prior to its removal to anærobic conditions (nitrogen atmosphere). They therefore concluded that the first stages of sugar breakdown are anærobic in any case, and that oxygen has a stimulating effect on the supply of this sugar. But this theory, though it explains the decline in respiration after removal of the fruit to anærobic conditions, does not explain why such decline is *not to zero* but to a constant level of activity. Thus, although oxygen stimulates supply of respiratory sugar, it is not essential to it.

Trout, realising that acetaldehyde is given off by ripe apples, and that this substance is also a recognised intermediate product during the fermentation of sugars, examined the effect of supplying acetaldehyde artificially to fruits. When supplied slowly, the added aldehyde quickly became oxidised. On the other hand, when supplied quickly there was a definite rise in aldehyde content and at the same time ethyl alcohol appeared in the tissues. The two processes of oxidative and fermentative breakdown appeared to be proceeding together with a consequent increase in rate of sugar loss. From this, Trout suggested that the fermentative process takes place as far as the acetaldehyde stage irrespective of oxygen present. After that, if much oxygen be present, the aldehyde is oxidised to carbon dioxide and water ; or, on the other hand, if no oxygen is present, it reacts with methyl glyoxal, formed in the first splitting of the sugar. The former process must be the more rapid one, and therefore in the presence of oxygen the concentration of aldehyde in the tissues is low. When it is artificially raised, the reaction with methyl glyoxal occurs and the results obtained are to be expected. If this hypothesis be correct, glycerol must be formed ; but, since it is known not to accumulate, we must assume, following the Blackman theory of oxygen-anabolism, that glycerol is the substance which is re-synthesised to sugar.

Experimental evidence suggests that the removal of oxygen from apples in the post-climacteric state is the elimination of the factor which produces the

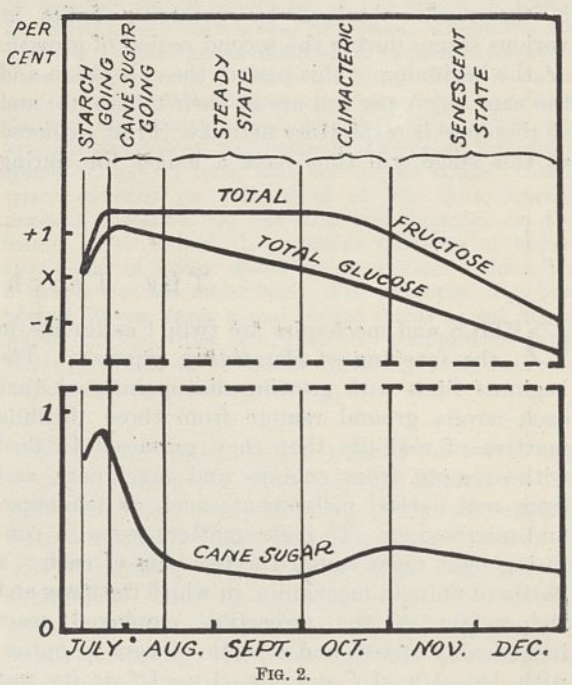

FIG. 2.

climacteric rise, that is, the entrance of fructose from the vacuole. It is therefore suggested that Blackman's theory of the activation of sugar by oxygen during respiration applies only to the vacuolar fructose, and that activation is really the entry into the cytoplasm for which the presence of oxygen is essential. If this is the case, then the climacteric rise should not occur in the absence of oxygen. There is evidence that such is the case.

During senescence, a slow decline in respiration occurs. Aldehyde and alcohol increase during this period, and it is suggested that this is due to diminishing activity of the system for the oxidation of aldehyde by molecular oxygen. Indeed, ageing apples become increasingly sensitive to lack of oxygen. Quite a small decrease in amount of oxygen in the atmosphere causes fermentation in apples which are in an advanced state of senescence.

Respiration and Life Duration

Fruits of a short life-cycle, such as the strawberry, exhibit a higher respiratory activity than fruits of a longer life-cycle such as the apple. Variation occurs, however, even within a species. For example, in apples, the variety Bramley's Seedling respires at about two-thirds the rate of the Worcester Pearmain. The life duration of the latter is about one and a half times that of the former. Respiratory activity also varies with the nutrition of the fruit during growth. Therefore, if respiratory activity during cultivation of the fruit be increased by increasing the nitrogen content of the soil, life during storage is shortened, and vice versa. A more striking example, however, is the result obtained by gathering fruits at various stages during the second period of growth. At the beginning of this period, the cytoplasm and the cane sugar per cell are at their minimum, and so therefore is respiratory activity. Fruit gathered at this stage will thus have a longer life during storage than fruit gathered at any subsequent stage.

A young apple, in spite of the fact that it contains little carbohydrate when gathered, loses more carbon before death than does a full-grown fruit. A full-grown fruit does not usually lose more than 0·2–0·4 per cent of its carbohydrate and acid prior to death. It appears likely that it is the 'rate of living' which kills and that the machine breaks down from wear and tear and not from lack of fuel.

From these observations, three new agencies have come into use for the purpose of controlling the span and speed of life in fruits, namely: (1) use of ethylene as an accelerator of ripening; (2) use of carbon dioxide as a depressor of respiratory activity, thus retarding ripening and lengthening life; (3) the use of atmospheres poor in oxygen, thus reducing respiratory activity, delaying the climacteric and retarding ripening.

The possible use of ozone in controlling ripening is still in the experimental stage.

The Teaching of Optics*

OPTICS and mechanics are twin Cinderellas in the teaching of elementary physics. The beginner finds with growing disappointment that each covers ground remote from those thrilling matters of real life that they promised to deal with—remote from engines and machinery and from real optical instruments such as telescopes and microscopes. To make matters worse, a confusing fight rages round the teaching of each: a battle of units in mechanics, in which the mass and the weight of the projectiles employed seem inextricably mixed, and a battle of signs in optics, with $1/v-1/u=1/f$ and $1/v+1/u=1/f$ as its war cries. Mechanics has been rescued by the toy manufacturers—if we may call admirable constructional apparatus such as 'Meccano' toys—and the mathematical studies of mechanics which seem so artificial if attacked too early are left until the later school stages when they can bring a real delight unspoiled by disappointed hopes of romance.

Optics may follow a similar path with constructional sets of lenses and mirrors as Christmas toys to provide the practical delights that formal teaching often misses; and for several years such sets have been on sale, with optical components and adjustable framework for making a variety of working optical instruments. We grudge no toyshop such excellent wares, yet we cannot help feeling that elementary optical teaching is at fault and should itself capture and use some of the thrills that belong to actual instruments, before attempting to build a formal structure—an attempt long ago condemned in other branches of teaching. Many teachers, feeling this, now begin optics with a course that is not merely simplified but wholly changed in order and emphasis; yet even they must feel the drag of examination demands, textbook styles and the weight of tradition. So it is pleasing indeed to find that the Physical Society's Report urges that "The early approach to lens and mirror optics is best made along experimental lines, and every effort should be made to implant a sound conception of the main physical phenomena of image formation before mathematical formulæ are introduced", and suggests that an *experimental* start, free from mathematics, might be made with, "for example, elementary illumination and photometry, and the action of simple instruments such as the telescope, microscope and projection lantern". The Report says regretfully, "In only too many cases the beginning and end of optical instruction in schools seems to be bound up with $1/v - 1/u = 1/f$", a type of formula which, as one of the authors says later in the Report, is not much used in real optical work!

While the Report expresses these hopes for the future of elementary teaching, its main concern is with the conventions of signs in optical formulæ.

* Report of the Committee appointed by the Physical Society to consider and make Recommendations on the Teaching of Geometrical Optics. Pp. v+86. (London: Physical Society, 1934.) 6*s*. net.

At present six or more different conventions are in use in textbooks in English. Most teachers, and presumably all examiners, must wish that some competent authority would choose one convention and enforce its universal use. But each wishes the chosen rule to be the one he uses himself, so the only chance of effecting a successful choice is for the pronouncement to come from a body of such high authority as to compel the agreement of teachers, examiners and authors alike. This Report gives just such a pronouncement. It is the result of five years work by a distinguished committee which included representatives of a wide range of optical and educational interests. It carries such a weight of authority that its recommendations, though they can only be made as suggestions, ought to be accepted as law.

The Report considers the current conventions of sign relating to formulæ such as $1/v \pm 1/u = 1/f$. From the half-dozen actually in use the Committee chooses two—the members themselves were unwilling to reduce their choice to one. Reasons are given for this preference, and it is urged that one of these two should be adopted in future in elementary optical teaching, and so far as possible, in advanced teaching. The Committee is unanimous in recommending that teachers in schools and universities should be asked to employ the practical opticians' convention which gives a positive power to a 'converging' lens, negative to a 'diverging' one. As most school teaching at present uses the opposite convention, neither of the two general sign conventions recommended is in use in any school textbook, but both are as good and clear and easily grasped as those now in use. So in schools the recommended changes will be slightly unwelcome to all at first, but ultimately very welcome.

The recommendations include the following :

(1) Converging lenses should be assigned positive power ; diverging negative. Focal lengths should have the same signs as powers, as far as possible.

(2) That 'power' (equal in elementary cases, in air, to $1/(f$ in metres)) should be used in preference to focal length, where convenient.

(3) That an instrument (without erecting mirrors or prisms) should be assigned positive power if it produces an inverted image of an infinitely distant object ; negative if the image is erect.

(4) That the numerical value of the power of a system be measured by the small angle subtended by an infinitely distant object divided by the length of its image. (A corresponding definition gives the focal length, and the Report suggests that this be made the basis of a laboratory method for estimating —but most school laboratories lack the space and the measuring microscopes necessary for accurate use of this method.)

(5) That in more advanced work when refractive indices are inserted, all formulæ should be made homogeneous in μ or μ'. For mirrors we should write $\mu/v + \mu/u =$ power, and power $= \pm 2\mu/r$.

(6) That the convention of signs be changed, in the course of time, to either of two recommended rules, described below as Group I (i) and Group II (i).

GROUP I (i) Distances measured from the lens or mirror are assigned *positive* values when measured in the *same* direction as the incident light and *negative* values when measured in the *opposite* direction. For example, if a lens placed 20 cm. from a real object forms a virtual image 30 cm. on the other side, then $u = -20$ and $v = +30$. To obtain the signs for power required by the convention mentioned in (1) above, we must use $1/v - 1/u = 1/f$ for a lens, and $1/v + 1/u = 2/r$ for a mirror.

GROUP II (i) Distances are measured *along a ray* (instead of along the axis ; but this makes little numerical difference in elementary practice and need not complicate the teaching) and are assigned *positive* or *negative* values according as the object or image to which they relate is *real* or *virtual*. Distances are positive if light has travelled along them and negative if it only appears to have done so. Thus u has a positive value if the object is real and v has a positive value if the image is real, wherever it is. This convention emphasises the distinction between the image space of, say, a lens, and the object space. Each space extends on *both* sides of the lens, having positive distances on one side and negative on the other. For a lens the positive portions of object space and of image space are on opposite sides, for a mirror on the same side. For example, if a lens placed 20 cm. from a real object forms a real image 30 cm. on the other side, then $u = +20$ and $v = +30$. We must use $1/v + 1/u = 1/f$ for a lens and the same formula for a mirror.

Both conventions apply equally to wave, ray or other treatments. Both provide criteria for the signs of angles, magnification, etc. I (i) requires only a change of sign from the form common in school teaching ; but II (i) promises certain extra attractions, since it uses the same formula for lenses and mirrors, seems to be able to carry a beginner through the thick and thin of an optical system at least as easily as I (i), welcomes the beginner's wish to call both u and v positive when he first experiments with a lens forming real images, and even allows him to forget which is which. On the other hand, II (i) requires a rewriting of texts, and some students may not find it so easy in advanced work.

We feel that the change to at least some measure of uniformity in optical teaching must be made—school teaching and the whole of commercial and ophthalmic practice cannot both have their own way unless the present diversity is to continue—and these recommendations provide the chance to make it. They deserve the support of all future textbooks, and even, so far as possible, advanced treatises. The revising of existing textbooks to conform with them would give trouble to publishers rather than to authors. Every publisher of scientific textbooks should keep a copy of the

Report, for the benefit of authors as regards new textbooks, and for his own benefit, as regards reprinting existing books. Examining bodies could help by expressing, with increasing firmness, their preference for the new conventions. But the real demand for willing help must fall on the teacher, and we hope that all concerned with the teaching of elementary optics will be willing to welcome the change when the opportunity for it reaches them, and even, if they feel they can, to initiate it themselves meanwhile. All such teachers should examine this Report. At first glance it seems to sweep with dismaying rapidity through a mathematical optics that is quite beyond a school syllabus, but on careful reading it shows its authority and its value even for the most elementary teaching. The appendixes should be read together, and not taken as restricted each to its own convention. Each develops methods and proofs applicable with any convention. The examples seem rather ill-chosen for illustrating the use of signs in elementary work, but on closer examination do reveal the working of the rules, and as solved independently by two experts they are really entertaining.

The Committee does not wish to restrict the liberty of the teacher as regards methods of approach and treatment of the subject. The only restrictions it wishes to impose are concerned with routine matters such as conventions of sign. There has been ample opportunity for discussion of rival conventions, and now that a pronouncement has been made it is to be hoped that in the course of time all will comply with these recommendations. Not to do so would seem to be to deny the readiness of scientific workers to accept a simplification of unnecessarily complicated affairs. E. M. R.

Obituary

Dr. Michael Grabham

In the death on January 28 of Dr. Michael Grabham at the great age of ninety-five years, the island of Madeira has lost its most influential personality and the world an enthusiastic naturalist. Dr. Grabham, who was educated at King's College, London, and the University of London, qualified in 1861 at St. Thomas's Hospital and served there as house surgeon. He married Mary Blandy, one of the well-known family of merchant shippers, in 1865, and took up permanent residence as a practitioner on the island of Madeira. In that favoured island he produced a book dealing with its every aspect—natural and sociological—a treatise that is still of outstanding value despite the changing times.

Dr. Grabham usually paid a flying visit to his home country every summer, where he was recognised by many distinguished bodies. He received the degrees of M.D. and LL.D. from the University of Aberdeen; F.R.C.P. from the Royal College of Physicians, which he represented at the Geological Society's centenary meeting in 1907. In 1921 he delivered the Bradshaw lecture before the College. He delivered discourses at the Royal Institution and read papers on the climate and natural history of Madeira before the British Association, of which a few years ago he became the senior member. His last paper before the latter body was read in his eighty-eighth year and dealt with the subtropical deep sea food fishes of Madeira.

The Zoological Society of London some years ago established a collecting station in Madeira and to-day can show an unrivalled series of 'Madeira tanks' in its aquarium, each displaying some aspect of the wonderful fauna which exists in the island's coastal waters. For this exhibition Dr. Grabham is partly responsible, since he was first to suggest making Madeira a base of operations. Dr. Grabham, although not a professional marine biologist himself, was an enthusiastic aider and abettor of all who made marine biology their peculiar interest.

Among Dr. Grabham's numerous activities were music and the collection of clocks. In the former art he proved himself specially gifted, and when visiting London had on more than one occasion the privilege of giving organ recitals in St. Paul's Cathedral. His collection of chiming clocks numbered more than two hundred, and the writer well remembers his sensations on first spending a night at his host's home at Quinta do Val, when the numerous timepieces solemnly announced the midnight hour for fully sixty minutes before and after Greenwich had agreed with his own watch as to the precise moment of that event.

Dr. Grabham leaves two sons and one daughter, one of the former, Mr. Walter Grabham, being the Government geologist in the Sudan; his daughter, Mrs. E. B. Carter, has her own home in Madeira at Santa Cruz, where she spends her holidays and supervises the collecting operations on behalf of the Zoological Society.

Dr. Grabham had many friends, and the loss of his charming and energetic personality will be deeply felt by a large circle of friends both in Great Britain and in his island home. E. G. Boulenger.

Mr. Herbert G. Ponting

The death of Herbert G. Ponting on February 8, at the age of sixty-four years, removes from us perhaps the greatest of all polar photographers, a pioneer in the application of artistic photography to the purpose of a scientific expedition.

The early part of Ponting's life was spent in a diversity of occupations; and he took to photography from the unusual atmosphere of agriculture and mining in the western United States. He rapidly made a name for himself by his pictures in Japan

and China, and he was already well known in photographic circles when, at the age of forty years, he joined Capt. Scott's last expedition. Here he mixed, possibly for the first time, with a number of men of science who, aware of his reputation, besieged him with special work on their behalf. His reaction to these requests was typical of the man. His kindness of heart would urge him to take exactly what was required of him, though his artistic sense would rebel against banal subjects that he was set to record. Nevertheless, he would take hours endeavouring to make a real picture from such unpromising material as a cliff face or stratification in a glacier.

Ponting always maintained that he was not a photographer but a camera artist, and this was truer of him than it could be of most who claim the latter name. He was a merciless critic of his own work, and would destroy all negatives which did not come up to the high standard he set himself. The noise of breaking glass in his dark room was not uncommon, and usually heralded his reappearance, laden with cameras once more, to go and take his subject over again. His cinematograph work was at that time in advance of that done by any previous film traveller. The world has only seen a small fraction of the footage taken by him, and he probably spent more actual time with his cinema than with his still camera. Here again, however, his work could not be called scientific in the purest sense, largely because the artist in him quarrelled with the man of science, and usually won.

Although Ponting was devoted to his work, and had few interests outside it, he recognised its commercial value, and this brought him into touch with the financiers of the film world, a milieu unsuited to his temperament and one in which his experience was not always happy. On visiting him at his London flat, one was sure to find him either in the depths of despair at some plans gone awry or full of enthusiasm at some new venture, usually connected with the exhibition of the Scott films.

Ponting had a simple and generous mind and he suffered very deeply at the loss of Scott and Wilson. He devoted himself for many years to the task of perpetuating their memory through his still pictures and his films. Those who have enjoyed them will acknowledge his success, and many of his camera studies will endure for all time as perfect examples of his art.

PROF. O. D. CHWOLSON

PROF. O. D. CHWOLSON, of the University of Leningrad, who died on May 11, 1934, is well known as the author of a textbook of physics, originally published in Russian and later translated into German, French and Spanish. It was one of the first textbooks written for high-school students and enjoys a deservedly high reputation. Its success has been due to the masterful treatment of the subjects by a highly gifted lecturer and teacher. The first four volumes were written by Prof. Chwolson himself; the last volume consists of chapters written at Prof. Chwolson's request, and on the lines he indicated, by specialists, his pupils, in various branches of modern physics.

Prof. O. D. Chwolson was born in 1852 as a son of a well-known Hebrew scholar. He matriculated at the age of seventeen and took up his studies at the University of St. Petersburg. He graduated with honours in 1873. The next year he spent in research at Leipzig, but in 1875 he was back again in Russia. He took his 'master's' degree in 1876 and his doctorate in 1880. His early research work dealt with various questions of electricity and magnetism, as well as with actinometry. The work on actinometry was preceded by some investigations on the mathematical theory of conduction of heat, and the result was an actinometer which for a long time served as a standard type instrument in Russian meteorological observatories.

After 1876 all Prof. Chwolson's work was devoted to teaching, and among the numerous students of fifty years, there was scarcely one who was not fascinated by his lectures. He knew how to address the beginners as well as advanced students, his lectures being carefully prepared.

Prof. Chwolson took an active part in the teaching of physics in secondary schools and especially in the training of teachers. In 1907, he organised a committee for the investigation of the provision for physical laboratories and demonstration rooms in secondary schools, and in 1913, a meeting of teachers in physics, chemistry and geophysics in secondary schools. He was elected permanent honorary president of the section of teaching of the Russian Physical and Chemical Society.

The great gift of popularisation of scientific achievements added considerably to Prof. Chwolson's activities. Most of his lectures were afterwards published and make very pleasant reading. His books appeal to the average man just as well as to the scientific worker. Only a few years ago Prof. Chwolson published a book on "Modern Physics", dealing with the latest achievements in physics. Some 300,000 copies were published, so great was the demand for it in the U.S.S.R.

It is scarcely possible in a brief obituary notice to give an appreciation of Chwolson the man, modest, hard-working and with true enthusiasm for scientific knowledge. The world has benefited from his philosophical conceptions and from his ideas about the influence of science on social life. Several generations of physicists, not only in the U.S.S.R. but also in other countries, will keep his name in grateful remembrance.

WE regret to announce the following deaths :

Dr. James Clark, emeritus rector of Kilmarnock Academy and formerly principal of the Central Technical Schools for Cornwall, Truro, on February 19.

Dr. Axel Wallén, director of the State Meteorological Hydrographic Institute of Sweden and president of the Meteorology Association of the International Union of Geodesy and Geophysics, on February 23.

News and Views

Lord Bledisloe and New Zealand

ON many occasions since Lord Bledisloe became Governor-General of New Zealand in 1930, we have referred to stimulating addresses delivered by him on applications of scientific knowledge to agricultural and other industries, and to economic and social problems. In all his addresses, the great importance of research has been emphasised and the results of investigations carried out in Great Britain and in other parts of the world have been brought before the people of the Dominion. This has been particularly the case with agriculture, on which subject Lord Bledisloe is himself a high authority. It is gratifying, therefore, to learn from a message from the Wellington (N.Z.) correspondent of *The Times*, that more than 54,000 dairy-farmers have subscribed to an address from their industry recording his thorough understanding of their problems and his assistance in solving them. Scientific societies and the newspaper Press in the Dominion have similarly expressed grateful appreciation of his wise counsel and practical guidance.

Lord Rutherford's Portrait for New Zealand

DURING his term of office, which closes on March 15, Lord Bledisloe has lost no opportunity of emphasising the important part which science has played, and must continue to play, in the development of the country. The most distinguished scientific worker which New Zealand has produced is unquestionably Lord Rutherford, whose name will always be associated with the advance of atomic physics, and Lord Bledisloe proposes to mark the conclusion of his five years of office by presenting to the Dominion a portrait of Lord Rutherford, to be hung in the new National Art Gallery at Wellington. By a fortunate coincidence, a distinguished portrait painter who is also a New Zealander, Mr. Oswald Birley, was available for the task. Mr. Birley painted a portrait of Lord Rutherford which was presented to the Royal Institution by fellows of the Royal Society some three years ago. Lord Bledisloe therefore commissioned Mr. Birley to paint a replica, which has been sent to New Zealand. The presentation will be made at a civic reception to Lord and Lady Bledisloe to be held in the Town Hall, Wellington, on the eve of their departure for England. By this public-spirited action, Lord Bledisloe has given New Zealand a striking picture, by one of her own artists, of a son who has achieved an international reputation in the field of science.

Death of Lady Dewar

THE death on January 7 of Lady Dewar, widow of Sir James Dewar, was reported to the members of the Royal Institution at a recent general meeting. Lady Dewar's long and intimate association with the Institution began in 1887 when her husband, already the Fullerian professor of chemistry, succeeded Tyndall as superintendent of the House. From that time until Sir James Dewar's death in 1923, she was the hostess of the Institution, and the regard in which her memory is held by a wide circle of members and friends is expressed in the words of Sir William Bragg at the general meeting. Sir William said that her death "had broken a precious link connecting the present times with those of the past in which Sir James Dewar had made the Royal Institution such a powerful agent of research and exposition. Not only had Lady Dewar been the true helper of Sir James in his work: she had, as many would gratefully remember, been a most able and kindly hostess to the scientists and others who flocked to see her husband and the Institution over which he presided. The members of the Institution would gladly acknowledge their debt to Lady Dewar, and for ever keep her name in appreciation and affectionate remembrance."

Lady Dewar's Bequests for Science

A BEQUEST by the late Lady Dewar is announced of ten thousand pounds to the Royal Institution. The gift is free of duty, and is made on the condition that the income is to be used for the purpose of furthering scientific research in the Institution and as a permanent memorial to the work there of her husband, Sir James Dewar. Lady Dewar has also left to the Royal Institution her husband's medals and diplomas and his scientific papers and apparatus, together with a sum of money to provide accommodation for them. A large part of his apparatus, in particular that used in his low temperature researches, has remained at Albemarle Street since his death, and in recent years has been displayed in the Institution's collection. The papers and objects now presented are additional material likely to be of great historic value to the Institution in relation to the period of Dewar's professorship. Lady Dewar's other bequests include £4,000 to the Royal Society's Mond Laboratory at Cambridge and £3,000 to the Royal Academy of Music. The residue of the estate is left for the furtherance of research in chemistry and physics at one of the Universities of Edinburgh, St. Andrews, Glasgow or Aberdeen, or for the assistance of bacteriological research in connexion with the Royal Infirmary of Edinburgh and the Glasgow Royal Infirmary.

Archæological Discovery in Honduras

AN important discovery in the ruins of Copan, the ancient city of the Maya in Honduras, is reported in *The Times* of February 21. An expedition of the Carnegie Institution of Washington, now working at Copan under Dr. Gustav Stronsvik, in exposing a large stone staircase, has found an extensive system of canals and sewers connecting a massive series of buildings, which is now underground. The buildings thus revealed include amphitheatres in which are monoliths and large statues in stone. A statue of a warrior is described as of gigantic size. Other

discoveries are cruciform rooms, of which the floors are covered with red paint; and among the artefacts are a number of bead-collars. Of even greater importance for the archæologist is a pair of solid gold boots, nearly two inches high, of exquisite workmanship. With two doubtful exceptions, objects of worked gold have not been found hitherto in that period of the Maya civilisation to which the ruins of Copan are assigned. Unless further and more intensive study should point to a foreign origin, these boots of gold must be accepted as evidence that the Maya added no little skill in this technique to their artistic accomplishment, and that a neglect of gold-working, which has always seemed somewhat surprising, has been attributed to them in error. Further details of the stone statues and monoliths will be awaited by archæologists with the greatest interest, as owing to the conditions of discovery, they should throw further light on the development of the Maya art of stone carving, for which the site of Copan is already remarkable among Maya remains.

COPAN, situated in the modern State of Honduras, lies in what was the southern area of Maya occupation, and was the fourth city to be founded after they had entered the country. It belongs to the 'Old Empire' or early Maya period and was occupied in at least the period from 195 A.D. until 540 A.D. This minimum period is derived from Mayan dates carved on stelæ found on the site, which are correlated with the Christian era according to a generally accepted interpretation. Copan is one of the most extensive and important of Maya sites. Its ruins consist of a vast complex of buildings which were reconstructed time and again in the course of occupation. Structural remains cover nearly the whole of the Copan valley. Recently, however, the site has suffered much from the effects of earthquake, and the river has begun to encroach on important parts of the ruins. In the circumstances, the Mexican Government has asked for the assistance of the Carnegie Institution's Expedition, which has had its headquarters at Chichen Itzá in Yucatan for some years and has had much experience in the restoration and preservation of Maya structures. Of this co-operation the present discovery is an outcome. Dr. Stronsvik reports, according to a communication issued by Science Service, Washington, that a part of the bank has collapsed into the river, and a beautifully carved chamber excavated fifty years ago by the late A. P. Maudslay, the well-known British archæologist, has fallen in. The landslide has left a vertical section of the ruins about a hundred feet in height on the eastern side. Dr. Stronsvik is of the opinion that the Maudslay chamber can be reconstructed, but the material carried away by the river is irrecoverably lost. As a minor mitigation, however, the landslide has revealed an instructive cross-section of the city's development.

Pygmy Man in India

A REMARKABLE report has come from Bombay of the discovery of the fossilised remains of a pygmy man in Baroda State. According to the account from the correspondent of *The Times* in the issue of February 21, the discovery was made at Vadnagar in the Mehsana district of Baroda. The remains were said to have been found in a prehistoric step-well, 150 ft. long, and were those of a man 15 inches high. With them was a cow 18 inches high; nearby was a stick 10 inches high. The correspondent of *The Times* went on to point out that the discovery might call for a new orientation of theories concerning the cradle of the human race and the origin of civilisation which would no longer be traced to Java, or the valley of the Nile or the Indus, but rather to the valley of the Narmada. He also referred to Homer's story of the battle of the dwarfs and cranes and the report of Ctesias in the fifth century B.C. of the existence of a dwarf race in the heart of India. Even if the report were taken seriously—it has been stated to be a hoax—the discovery of a single specimen of so remarkably an aberrant character would be scant foundation "to prove the existence of an extinct race of pygmies more diminutive than that in Africa". Most ethnologists postulate a negrito strain in the Indian peoples which may have been derived from a diminutive race, not of some unknown extinct form, but analogous to one of the pygmy peoples, which extend, with intermissions, from West Africa to New Guinea; but these peoples are a highly specialised rather than a primitive type and their stature does not, as a rule, fall much below four feet six inches. Ethnological theory, for the moment, remains unshaken.

High-Altitude and Long-Distance Flights

THE Air Ministry has recently authorised the construction of two new experimental aeroplanes, one for high-altitude and the other for long-distance flights. The high-altitude machine will presumably be used for exploring the question of flight in the stratosphere, which is usually taken to mean that region in space above a height of 28,000 feet. There are plenty of aircraft in existence capable of reaching heights greater than this; the present record is 47,356 ft. held by the Italian pilot Donati, but no attempt has yet been made to deal with the possibilities of economical flight at such heights. The ultimate possibilities in this respect are much greater speeds owing to the reduced resistance of the rarified air. It will be necessary to carry superchargers to supply the required oxygen for the combustion of the engine fuel, appliances for breathing and heating, air-tight cabins or special suits for the occupants, and propellers the pitch of which can be changed to suit the different air conditions. These extras will have weight, which will reduce the fuel-carrying capacity of the machine, and it is not impossible that this requirement alone will limit the practical utility of stratosphere flying.

THE time taken to climb to such heights will be considerable, which will possibly make the proposition not worth while except for long flights, where again lack of fuel capacity will place a limit on it. Such flights are not likely to have any immediate application to air transport, but their importance in the experimental sense is obvious. The long-range

experiments have a more definite application both to civil and service flying, where the question of the proper balance between quantity of fuel carried—to the exclusion of useful load—and the necessity for landing for further supplies, is essentially a practical one, peculiar to the geographical conditions in different parts of the world. These experiments should also further the development of the compression-ignition heavy-oil engine, the smaller specific fuel consumption of which makes it particularly applicable in this case.

Future of Lighter-than-Air Craft

THE announcement that the Secretary for the U.S. Navy will oppose any further construction of airships to replace the wrecked *Macon* presages the end of large rigid airship activities in that country. Germany is now the only country, so far as is known, to continue experiments with these craft in increasing sizes, the new larger Zeppelin, to be called the *Hindenburg*, being now near completion. It is significant that Dr. Eckener of the Zeppelin Company has succeeded where others have failed, probably because with faith and perseverance he has acquired that kind of knowledge and experience in design, and assembled a staff skilled in the technique of construction, maintenance and handling, which can only result from practical experience. Germany has now been building large airships continuously since 1910, and even up to 1914 claimed to have flown 80,000 miles and carried more than 37,000 passengers. The present *Graf Zeppelin*, launched in 1928, has crossed the Atlantic 62 times without serious mishap. The only large airship in the United States that is still in an airworthy condition, the *Los Angeles*, is a Zeppelin type built at Friedrichshafen.

IT is claimed nowadays that for long-distance commercial flying the airship is threatened by the large flying boat, which unquestionably has superior speed, but has not yet attained a comparable range. The latest projected flying boats only claim to be able to fly the Atlantic non-stop with a favourable wind. As a naval scout, if it can be protected from attack, the airship is still unrivalled. It can patrol trade routes far outside the range of aeroplanes, and its vision must be greater than any surface cruisers. It is also reasonably independent for action of the movements of its own surface vessels, a decided drawback of aeroplanes carried by the fleet.

Fundamentalism Undefeated

A CABLE message dated February 20 from New York which has appeared in *The Times* states that on the previous day the House of Representatives of Tennessee defeated a motion to repeal the State law which prohibits the teaching of any theory that man is descended from a lower order of animals. The vote against repeal was 67 to 20, and the opposition to the repeal was led appropriately by the oldest member of the House, who opened his case by reading the first chapter of Genesis. It will be remembered that about ten years ago a young teacher of biology, J. T. Scopes, was convicted and fined at Dayton under this law. The case aroused great controversy in the United States, and was outstanding because of the eminence and the oratory of the counsel employed on each side. Perhaps it was outstanding also as a picture of the simple faith which holds that truth can be decided by lawyer's arguments, and that scientific fact can be settled by majorities. Fundamentalism is by no means dead in Great Britain, but with the growth of knowledge it is dying.

Musk-Rats in Scotland

SINCE the musk-rat campaign was commenced by the Department of Agriculture for Scotland, in October 1927, the official trappers have killed 945 individuals. To this must be added 60 killed by private persons, a total of 1,085, the progeny of five females and four males which escaped from an enclosure in Perthshire in 1927. Even the artificial pond on Gleneagles Golf Course has yielded five since the beginning of November 1934 (*Scottish Naturalist*, 1934, p. 11). As a rule, the traps were laid at the mouth of a burrow, and a remarkable fact is that they did much more damage to other wild creatures than to the musk-rats themselves. Mr. T. Munro, who supervised the work, records the death in traps set for musk-rats of 1,745 brown rats, 2,305 water-voles, 57 weasels, 36 stoats, 2,178 moorhens, 101 ducks, and a miscellaneous collection of birds, including amongst others 23 seagulls, 13 redshanks, 28 snipe, 15 blackbirds and a solitary kingfisher—a list of misadventures which runs to 6,587 items. It is possible that this very considerable slaughter cannot be avoided, but apart from the brown rats the majority of the wild creatures slain are harmless, if not even useful from the human point of view, so that every effort should be made to confine the work of the traps to the pests they are meant to capture.

Moving Biological Diagrams

MANY of the living processes of organisms can be illustrated most effectively by cinema films taken through the microscope, and with Mr. Walt Disney's technique, diagrams could be shown in the same way for educational purposes. The American Genetic Association has applied this principle in publishing "Biological Movie Booklets" to illustrate cell division, fertilisation and meiosis, and it proposes to deal later with the more intricate processes of heredity in *Drosophila*, crossing-over and so forth (Biological Movie Booklets. Vol. 1 : Normal Cell Division. By Clyde E. Keeler. Pp. 46. Vol. 2 : Maturation of Sperm. By Clyde E. Keeler. Pp. 94. Vol. 6 : Fertilization. By Clyde E. Keeler. Pp. 65. Washington, D.C. : American Genetic Association, 1929. 3 vols., 1.50 dollars). Successively releasing the leaves of the booklets brings these dead diagrams to life, and for those who have not learnt to make the mental translation of diagrams into movement the effect should be improving. For those who have passed this stage the effect is still amusing, provided that the leaves are turned over quickly. Taken separately, however, the figures seem to be drawn, not from life but from an early or popular textbook. The

descriptive text is correct for 1908. The draughtsmanship is not expert and the drawings should have been reduced from a larger size to conceal its defects. If a future generation is to learn its biology this way, it is to be hoped that the publishers will take their task more seriously and remedy these shortcomings.

Acquisitions at the British Museum (Natural History)

RECENT acquisitions by the Department of Zoology include a specimen of the frilled shark (*Chlamydoselachus*) caught by a trawler off the west of Ireland. This is the first occasion on which this species has occurred in British waters. It was first discovered off the Japanese coasts. The frilled shark is of great interest on account of the many primitive characters which it possesses. The mouth is at the end of the snout, instead of being underhung as in most living sharks. There are six gill openings on each side instead of the usual five, and the teeth are of a curious comb-like shape. The body is much more slender and eel-like than in other sharks, and in several ways it approaches some of the very ancient types of fossil shark-like fishes. Through the generosity of the trustees of the Salisbury, South Wilts and Blackmore Museum, the Department of Geology has received a large number of fossil invertebrates and fishes, forming part of the collection made by the late Dr. H. P. Blackmore from the Chalk in the vicinity of Salisbury. A further valuable instalment of 488 specimens of Swiss minerals, representing 59 carefully recorded localities, collected by himself, has been presented by Mr. F. N. Ashcroft to the Department of Minerals.

THE Department of Botany has received a bequest of Mr. T. J. Foggitt's British herbarium. This numbers 4640 sheets of well-gathered and beautifully preserved plants. Mr. Foggitt was a well-known Yorkshire botanist, the son of the T. J. Foggitt who collaborated with J. G. Baker in the formation of the Botanical Exchange Club which brought Thirsk into botanical prominence in the sixties of last century. The herbarium is rich in Yorkshire plants, and is a welcome addition not only for this but also on account of the large number of extremely rare plants it contains. The Siamese collection of Dr. A. Marcan has been purchased. It contains abundant material of 2772 numbers including several co-types. It has been named for the most part by the late Prof. W. Craib and Dr. A. Kerr. The collection forms a valuable addition to the Department which is weak in Siamese plants. A further set of Dr. H. Schlieben's Tanganyika plants numbering 146 has been purchased. The first two fascicles of Lundell and Nannfeldt's "Fungi exsiccati suecici praesertim Upsalienses" has been presented by the Elias Fries Committee. This exsiccata is of especial interest as it consists mainly of fungi collected in the neighbourhood of Uppsala, a region made famous by the classical works of Elias Fries.

Rural Electrification in Russia

ONE of the results of the first five-year plan is to change fundamentally the character of farm work in the U.S.S.R. Instead of a million small holdings, there are now only some thousands of large collective agricultural and pastoral farms. Horse traction and manual labour are rapidly being replaced by the mechanical tractor and electrically driven machines and implements. Electrification is the key-note of the industrial reorganisation of the country. In the *Electrical Review* of February 22, G. Shapiro gives a description of some of the new agricultural and dairy farming methods. Experiments on electrical haulage and electric tractors for ploughing have proved most satisfactory. The electric tractors used for ploughing were usually converted mechanical tractors in which the internal combustion engines had been replaced by electric motors. The results show a considerable saving in working expenses. Excellent results are being obtained with electric threshing, which is developing very rapidly. These machines are produced in Kharkov, and are driven by electric motors. Electrically driven machines have also been successfully experimented on in connexion with vineyards, tea plantations and cotton fields. In dairy farms, electricity will be used for milking, cleaning the animals, preparing food, water pumping, ventilation, butter making, cheese making and lighting. Pig farms and poultry farms also take an appreciable electric load. Researches are being made on the heating of the soil and the influence of light and various rays on seeds, roots and poultry and animal breeding. By the end of the second five year plan (1937), it is anticipated that about 30,000 stations will be threshing electrically and will cover a sowing area of about 30 million acres.

Aerodrome Lighting for Night Flying

OWING to the steady increase in the number of passengers and in the volume of the mails carried by aeroplanes, the proper lighting of aerodromes has become of great importance. In the *G.E.C. Journal* of November, Mr. W. A. Villiers describes the equipment produced by the General Electric Company for this purpose. The problem is to give the pilot of an aeroplane flying on a dark night the guidance he requires to make a safe landing. In many cases at the present time, aerodromes are only a few miles apart; he must therefore be able to identify the place with certainty. This is done by means of a beacon. The light must be visible in all weathers, but must not be dazzling. The colour and character of the light should be different from that given by neighbouring beacons. The beacon is in the shape of a truncated cone about 14 ft. high, formed of six hairpin-shaped neon tubes giving the usual red neon colour. It has low intrinsic brilliancy, but in favourable weather conditions can be seen at a distance of 50 miles. The identification is usually effected by making it flash in Morse characters the initial letter of the aerodrome. The boundary of the landing place is marked out by electric lamps inside orange glass globes. All landings are made against the wind as this direction gives the safest landing. The landing ground should always be flood-lighted, the space being so large that even the fastest aeroplane does not overrun the lighted area. Nine Osram lamps

each taking a kilowatt are used for this purpose. Views are shown of the flood-lighting employed at Croydon air-port.

American Amaryllis Society

THE first year book (1934) of this Society has recently been published under the editorship of Dr. Hamilton P. Traub (Orlando, Florida; 2 dollars). Plants belonging to the genera *Amaryllis*, *Hippeastrum*, *Crinum*, *Zephyranthes*, *Alstromeria* and others are the special objects of the Society, though its interest can reasonably be expected to include such well-known plants as snowdrops, daffodils and snowflake (*Leucojum*). A useful classification for show purposes has been prepared, and the Fischer colour chart has been adopted as the standard of colour nomenclature. Botanical descriptions of the Amarylideæ according to Baker are given, and many pages are devoted to the breeding of the various species. Other sections deal with propagation and culture, whilst insect pests and diseases receive brief mention. Storage, forcing and marketing are also discussed. One of the most noticeable features is the brevity of each contribution, for nearly seventy articles are included in the 102 pages of the volume. The memory of Henry Nehrling, a noted raiser of *Amaryllis* plants, is honoured by dedication of the first year book.

The Observatories Year Book 1932

THIS important publication of the British Meteorological Office (Air Ministry) contains a very large mass of meteorological and geophysical information, obtained at the five observatories of Lerwick, Aberdeen, Eskdalemuir, Valencia and Kew, together with upper-air observations made by sounding balloons (London: H.M. Stationery Office.) Its appearance has been slightly delayed owing to a change in its mode of production: hitherto it has been printed, but in the present issue most of the extensive tabular matter, and part of the text, is reproduced direct from typescript by the Replika process of Messrs. Percy Lund, Humphries and Co., Ltd. There is a certain loss in legibility and appearance, but this disadvantage is on the whole outweighed by the reduction in cost thus achieved; the reduction is passed on to the purchaser, since the "Year Book" now costs two guineas (postage extra) instead of three as for the preceding volumes. The volume provides a very important record of the meteorological and magnetic conditions over the British Isles during 1932.

American Expedition to Tibet

AN expedition of the Academy of Natural Sciences of Philadelphia has recently left Yachow in Szechwan Province, China, for a year's survey of the zoology of eastern Tibet. The party is under the leadership of Brooke Dolan of Philadelphia who, with some of his staff, has had previous experience in the western China area. Its main object is to obtain information and material for habitat groups of typical Tibetan animals, such as the wild yak, wild horse, ammon sheep, snow leopard, Tibetan gazelle and bear; and as an aid to this end motion pictures will be taken of the wild game, which is said to be abundant on the high steppes of Kuku-nor and Tsaidam. Mr. Dolan's party is working in co-operation with the Metropolitan Museum of the Academia Sinica in Nanking. It is gratifying to find that expeditions in out of the way parts of the world are concentrating more upon observation of animal distribution and habits than upon the unrestrained collecting which was often divorced from any sort of ecological observation.

Age of a Stone Curlew

A SHORT note (*Proc. Roy. Zool. Soc. N.S. Wales*, 1933–34) records the presence in a suburb of Sydney of a fine specimen of stone curlew, which has attained a great age for such a bird. He was brought to Sydney in his third year, and by the end of 1934 he will have passed his twenty-ninth birthday; during all the time he has been allowed absolute freedom in the garden. More information regarding this interesting bird would have been welcome. On what has it been fed during these years, for the food of waders is not always easy to obtain? Also, has it ever shown any movements suggestive of a desire to migrate at the proper season?

International Inquiry into Television

THE Rome correspondent of *The Times* states that the executive committee of the Institute of Educational Cinematography has decided to set up an international committee to study the problems raised by television. The committee, which will be composed of representatives of national organisations in Europe and America interested in television, will inquire into the condition of television in the various countries and the questions raised by its practical utilisation; the relations between television and cinematography; and the use of television for cultural and educational purposes.

Scientific Research in Japan

THE report of the National Research Council of Japan for the year ending March 1933 shows that, during the year, meetings of the following divisions of the Council were held: administration, astronomy, geophysics, chemistry, physics, geology and geography, agriculture, medical sciences, engineering and mathematics. Each division has sectional committees which deal with branches of the work, as for example, dyestuffs, industrial research and radio research; and delegates attended the meetings of the International Unions of Astronomy at Cambridge, Mass., and of Mathematics at Zurich. The urgent necessity of encouraging and supporting scientific and industrial research has led to the formation of a "Foundation for the Promotion of Scientific and Industrial Research of Japan" which was incorporated in December 1932 with an annual Government grant of 700,000 yen for current expenses.

Lectures for Students in Secondary Schools

WITH the view of stimulating interest in science and its contacts with everyday life among pupils in secondary schools, the British Science Guild has inaugurated a new series of lectures by eminent men of science to pupils from such girls' schools in London. The first of the series will be by Mr. C. C. Paterson, director of the Research Laboratories of the General Electric Company, who will lecture on "The Electron Liberated: its Industrial Consequences". The lecture will be given to pupils from schools north of the Thames on Monday, March 25, at 5.0 p.m. in the Lecture Theatre of the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2, and will be repeated to the group of schools south of the river on Wednesday, March 27, at the same hour.

Memorial to Sir Edgeworth David

IN order to ensure a memorial worthy of Sir Edgeworth David, the geologist and explorer, who died on August 28, 1934, a meeting has been held in Sydney which included representatives from the business, professional, scientific and academic life of the city, and the following resolution was adopted: "In view of the great work done by Sir Edgeworth David for the science of geology and in view of the outstanding importance of his teaching, research, and contributions to geological knowledge as the first Professor of Geology in the University of Sydney, the Committee resolves (1) that a fund to be known as the David Memorial Fund be raised, that it be handed over to the University of Sydney, and that the income from it be applied in such manner as the Senate thinks will best aid in the advancement of the science of geology; and (2) that the Senate be requested to associate the name of Sir Edgeworth David permanently with the Chair of Geology." Further information can be obtained from the Honorary Treasurers, David Memorial Fund, Science House, Gloucester Street, Sydney.

Announcements

HIS MAJESTY THE KING has been graciously pleased to accord his patronage to the Institute of Chemistry of Great Britain and Ireland. The Institute, which was founded in October 1877, celebrates this year its charter jubilee, having been incorporated by royal charter granted by H.M. Queen Victoria in June 1885.

THE University of Toronto has awarded the Charles Mickle fellowship for 1935 jointly to Dr. Edward Mellanby and Mrs. May Mellanby. The fellowship is endowed under a bequest by the late Dr. W. J. Mickle, and is awarded annually "to that member of the medical profession who is considered by the Council of the Faculty of Medicine of the University of Toronto to have done most during the preceding ten years to advance sound knowledge of a practical kind in medical art or science".

MR. H. J. POOLEY, general secretary of the Society of Chemical Industry, who was the first student to go through a course of chemical engineering at a British university—Liverpool 1894–98—has been awarded the Osborne Reynolds medal for meritorious contribution to the progress of the Institution of Chemical Engineers. The medal, which was first awarded in 1928, is in honour of Prof. Osborne Reynolds (1842–1912), whose researches on heat transmission and the flow of liquids are extremely important to the chemical engineer.

IT is announced that the dates for the May and June soirées of the Royal Society have been altered to Friday, May 3 and Friday, June 14.

THE German Röntgen Society has recently had a memorial tablet erected to Röntgen at Pontresina in the Engadine, where for more than forty years he spent his annual holiday.

AN exhibition of hygiene will be held in Strasbourg on April 6–22 to demonstrate scientific, administrative, industrial and commercial progress in the field of hygiene and sanitary technique, particularly as regards corporal hygiene, school hygiene, housing, clothing, diet and sport. Further information can be obtained from Services Administratifs, Hôtel de Ville, rue Brulée 9, Strasbourg.

THE Association of Special Libraries and Information Bureaux (ASLIB) is to hold its twelfth annual conference at St. John's College, Cambridge, during the week-end beginning Friday, September 20. Particulars may be obtained from the Secretary of the Association, 16 Russell Square, London, W.C.1. Sir Richard Gregory has agreed to accept re-nomination as president of the Association for 1935–36.

ON the initiative of the Italian Society of Criminal Anthropology and Psychology, a meeting was recently held in Paris, attended by the Minister of Justice, numerous leaders of the French medical and legal professions, members of the French society of criminal prophylaxis and various foreign representatives, to discuss a proposal to found an international society of criminal anthropology and psychology. After acceptance of the proposal, it was agreed to hold the first congress of the society in Rome next October.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant secretary to the British Association—The Secretary, British Association, Burlington House, W.1 (March 11). A principal of the Barrow-in-Furness Technical College—The Director of Education, Town Hall, Barrow-in-Furness (March 12). A probationer naturalist (male) on the scientific staff of the Fishery Board for Scotland—The Secretary, 101 George Street, Edinburgh, 2 (March 18). A reader in sociology at Bedford College—The Academic Registrar, University of London, S.W.7 (April 1). A William Prescott professor of the care of animals in the University of Liverpool—The Registrar (April 23).

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. 346.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Laws of Shell-Growth in English Native Oysters (*Ostrea edulis*)

ON investigating recently an economic problem on growth in the native oyster, *Ostrea edulis*, close relations were found between volume and weight of the entire animal, and both mean diameter and mean axis of the shell (mean axis being the mean of the described[1] dimensions of length, breadth—or height zoologically, and width—or thickness). As oysters are measured in wooden tubs (4 'wash' = one 'tub') on the oyster-beds and mean diameter is the simplest criterion of size, volume and mean diameter are the most interesting relations economically. Volumes and mean diameters for Essex native oysters from Roach River are given in Fig. 1, R^1, and show a close approximation to the relation $y = 0{\cdot}0404\ x^{3{\cdot}531}$ where y is volume in c.c. and x = mean diameter in cm. The plottings are of samples of 10–40 oysters estimated at 2, 2 or 3, 3, 4, 4 or 5, and 5 years of age, with additional samples of small oysters, for which I am greatly indebted to Mr. Austin Gardner and M. Rigoine de Fougerolles. Samples of tiny oysters grown in 1934 in the sea were obtained living on a limed tile from France and are plotted, since English spat attached to shell are difficult to detach whole, and any difference between English and French spat is estimated to be non-significant on the scale shown.

It is clear that a definite law of growth exists irrespective of rate and notwithstanding the range of individual variation which will be discussed later. It can be shown that, for any given increment in average mean diameter, the average increase in volume is successively approximately 11·56 times, 4·19, 2·76, 2·20, 1·90, 1·72, 1·60, 1·52, 1·45, 1·40 and so on: thus from ½ in. to 1 in. the increase in volume is 11·56 times or 1,056 per cent; from 1 in. to 1½ in. 4·19 times or 319 per cent; from 1½ in. to 2 in. 2·76 times or 176 per cent; 2 in. to 2½ in. 2·20 times or 120 per cent; 2½ in. to 3 in. 1·90 times or 90 per cent. Similarly, the increase in mean diameter from 1 cm. to 2 cm. is 11·56 times and from 2 cm. to 3 cm. 4·19 times and so on; and from 0·5 cm. to 1 cm. 11·56 times and from 1·0 cm. to 1·5 cm. 4·18 times and so on.

It is known that the rate of growth of the shell varies locally with habitat and from season to season[2] with environmental conditions, and that therefore there is no special size for a given age. Nevertheless, age can be estimated empirically from local knowledge to within one year in a fair proportion of shells. The estimations plotted in Fig. 1, R^1, are subject to these limitations; for example, groups 2–3 and 4–5 were put in intermediate classes; most of the shells showed uniformly good growth.

Experiments in the sea on the growth of Essex native oysters in the first and second year have been made over a long period[2], and one sample has been reared into the fourth year. This sample was taken out of the sea in the summer of 1927 when the fourth year's growth had begun: two of the largest of these are plotted in Fig. 1 (WM^1). A few oysters reared

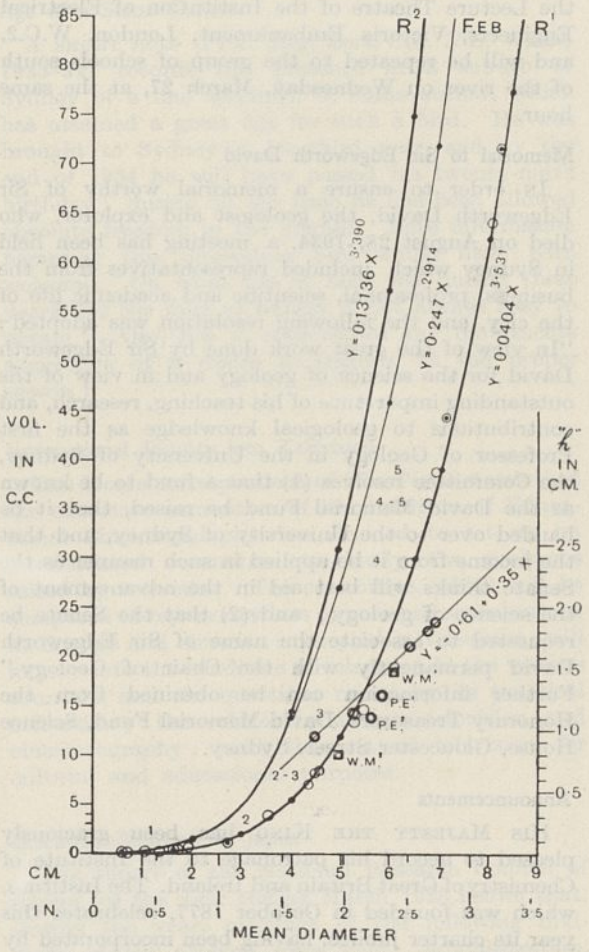

FIG. 1. Laws of shell-growth in some habitat races of *O. edulis*.

R^1: relation between volume of the entire living animal and mean diameter of the shell in Roach River, Essex natives. October 1934.

R^2: relation between volume and mean axis in the same material as used for R^1. October 1934.

F.E.B.: approximate relation between volume of the entire living animal and mean axis of the shell (with mean diameter reduced by the amount of new shell shoot). Fal Estuary; East Bank, November 1934.

Samples are shown by open circles of different kinds; individuals by circles with large central dots, and calculated points by dots; the numerals 1, 2, etc., give the estimated age in summers of adjacent samples. *W.M.*, *P.E.*, experimental samples from West Mersea, and Port Erin ponds.

Slopes and constants of the log-graphs are close approximations and are modifiable for immaturity.

in the Port Erin tanks[3] and examined in the third summer of growth (1934) during the growth period are also plotted in Fig. 1 (*P.E.*[1]). In these two cases new thin shell shoots have rapidly increased the mean

diameter without an immediate commensurate increase in volume[4]. The samples and experiments illustrate the wide range of variation in annual rate of growth, and indicate that well thought out and long standing experiments in the sea are needed in different localities to obtain satisfactory data correlated with the environmental conditions. It is hoped to begin such experiments in the near future.

The relation of mean axis lies somewhat closer than mean diameter to volume and offers a better criterion of comparison between different stocks of oysters. The difference between certain types of Essex natives and Fal Estuary bank oysters already noticed[4] is given definite expression in the deduced graphs (see Fig. 1, R^2 and *F.E.B.*) for the relation of volume to mean axis, details of which will be published later.

The resemblance of the shape of *O. edulis* to a segment of a sphere is real, since the 'heights' (h) of segments of spheres having the same volume and mean diameter as the major oyster samples noted above give the straight line graph in Fig. 1, within experimental error, when plotted against mean diameter. (Prof. L. Rosenhead kindly gave me a formula for finding unknown heights from given diameter and volume.) The fundamental shape of this oyster is therefore a function of that of a segment of a sphere; for a definite relation also exists between segment heights and observed oyster widths, as will be shown when the subject can be treated more fully at a later date.

J. H. ORTON.

University, Liverpool.
Dec. 20.

[1] Orton, J. H., Report on a Survey of the Fal Estuary Oyster Beds, p. 12, Falmouth, 1925.
[2] *ibid.*, Fig. 9, p. 22 and p. 23.
[3] Orton, J. H., Parke, M.W. and Smith, W.C., NATURE, 131, 26; 1933.
[4] Orton, J. H., *J. Mar. Biol. Assoc.*, 15, 367 and 418; 1928.

Detection of Nuclear Disintegration in a Photographic Emulsion

IT has been shown recently by Chadwick and Goldhaber[1], and by Fermi and his collaborators[2], that some light nuclei, particularly lithium and boron, are disintegrated by slow neutrons. In the case of boron, the mass-energy relations seemed best satisfied by assuming a disintegration into three particles[1]. The simplest reaction, namely:

$$B^{10} + n^1 \rightarrow Li^7 + He^4 \quad . \quad . \quad . \quad . \quad . \quad (1)^2$$

should, according to the accepted masses of the particles, release some two million e. volts more energy than is observed. Unless the existence of new isotopes, He^5 or Li^8, of improbably low masses, be assumed, no other disintegration into two particles would fit the mass-energy relations.

To decide the type of reaction directly we have made use of the following method. A photographic plate was soaked in a solution of borax and then dried, thus introducing boron into the gelatine. The plate was then exposed for 15 hours to a radon-beryllium neutron source of strength 80 millicuries, enclosed in a thick lead cylinder to reduce the effect of the gamma-rays. Both source and plate were surrounded by paraffin.

One of us (H. J. T.) has worked for some time on the detection of fast particles by the tracks produced in photographic emulsions. By the courtesy of the research staff of Messrs. Ilford, Ltd., new types of plate have been prepared specially suitable for this work, and we have used these special plates in the present experiments.

The plate impregnated with borax shows, under a high magnification, numerous short straight tracks, of which the equivalent length in air is $1{\cdot}1 \pm 0{\cdot}1$ cm. There are some 50,000 such tracks per sq. cm. of the plate. A photomicrograph of one of the tracks is reproduced (Fig. 1. $\times 1250$). Control experiments with untreated plates show that the tracks cannot reasonably be ascribed to any other cause than the disintegration of boron by slow neutrons.

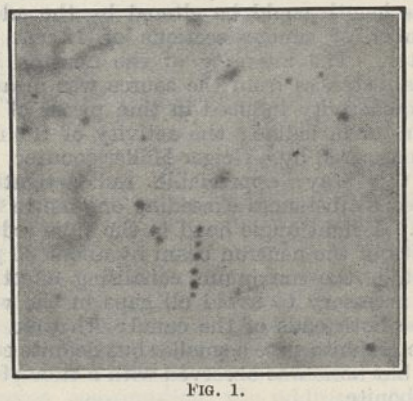

FIG. 1.

Tracks of this kind cannot be due to a three-particle disintegration, and we must therefore conclude that the disintegration takes place according to reaction (1), which requires that the mass of the B^{10} atom should be $10{\cdot}011 \pm 0{\cdot}001$, the other masses being known to within fairly narrow limits.

Note added in proof: In a similar way, by using a salt of lithium, we have obtained tracks which correspond to the reaction

$$Li^6 + {}_0n^1 \rightarrow He^4 + H^3. \quad . \quad . \quad . \quad . \quad . \quad (2)^1$$

The length of these tracks represents the sum of the ranges of the two resultant particles, and is found to be $6{\cdot}9 \pm 0{\cdot}2$ cm. air.

H. J. TAYLOR.
M. GOLDHABER.

Cavendish Laboratory,
Cambridge. Feb. 11.

[1] NATURE, 135, 65, Jan. 12, 1935.
[2] Amaldi, D'Agostino, Fermi, Pontecarvo, Rasetti and Segrè *Ricerca Scientifica*, VI, vol. 1, No. 2, Jan. 31, 1935.

Directed Diffusion or Canalisation of Slow Neutrons

IT has been shown by Fermi and his collaborators[1] that the efficiency of radioactivation of certain elements by neutron bombardment is greatly increased by surrounding them with water, paraffin or similar hydrogen-containing substances. This effect is attributed to multiple collisions between neutrons and protons, similar to those due to the thermal agitation of gas molecules, producing reduction in speed of the neutrons, which facilitates capture by other nuclei.

It was pointed out to us by Dr. Leo Szilard, who was then working in this laboratory, that this retardation by diffusion should afford a possible method of controlling the direction of propagation of slow neutrons. The mean free path of slow neutrons between successive collisions with protons is considerably less than their range in air. Consequently,

it was anticipated that a stream of slow neutrons would diffuse more readily along an air column contained in a tube having walls composed of a substance of high hydrogen content, than through the walls themselves.

We have verified Dr. Szilard's prediction in the following manner. Neutron sources consisting either of about 100 millicuries of radon with beryllium, or of 150 milligrams of radium in tubes surrounded by beryllium, were embedded in paraffin blocks 10 cm. in diameter and 10 cm. high, and placed inside a large cavity in the base of a hollow cylinder of paraffin wax. The walls of the cylinder were 7–10 cm. thick, and its length could be altered by the addition of a number of similar sections of 12 cm. internal diameter. The intensity of the neutron beam at various distances from the source was measured by the radioactivity induced in thin pieces of silver or rhodium or in iodine; the activity of the detectors being measured by a Geiger-Müller counter.

In this way, appreciable radioactivation was obtained at distances exceeding one metre from the source. A right angle bend in the tube reduced the intensity of the neutron beam by about 30 per cent. To obtain the maximum canalising effect, it was found necessary to avoid all gaps in the walls and to close both ends of the canal with wax. A tube of pure graphite gave a smaller but definite canalising effect, but none was observed with a tube of adulterated ebonite.

Fuller details of these experiments will appear in a forthcoming issue of the *British Journal of Radiology*, and other observations will be published independently by Dr. Szilard.

F. L. HOPWOOD.
T. A. CHALMERS.
St. Bartholomew's Hospital Medical College,
London. Feb. 19.

[1] *La Ricerca Scientifica*, V, **2**, 7–8; 1934. V, **2**, 380; 1934. VI, **1**, 2; 1935.

The Absolute Field Constant in the New Field Theory

IN the modification of Maxwell's theory proposed by one of us[1], the notion of an 'absolute field', called b, played an essential part. In the electrostatic case, the universal constant b is simply the upper limit of the field strength, whilst in the general case of an arbitrary field, b sets a limit to the possible values of $\sqrt{(\vec{E}^2-\vec{H}^2)}$, when $\vec{E}$ and $\vec{H}$ are calculated in that Lorentz frame in which the Poynting vector vanishes in the given world-point. (In the exceptional case when there is no such Lorentz frame, that is, if $\vec{E}$ is perpendicular to $\vec{H}$ and $\vec{E}^2 = \vec{H}^2$, there is no limit.) Born and Infeld[2] have calculated b from the experimental values of the charge e and mass m of the electron by equating to mc^2 the total energy of that centrally symmetrical electrostatic solution which has the total charge e. By this procedure b works out to be $9{\cdot}18 \times 10^{15}$ E.S.U.

We now believe that this determination may be wrong, notably too high, because the spin had been neglected. Since the solution for the spinning electron cannot yet be calculated, we must content ourselves with giving a rough estimate. Let μ be the magnetic moment of the spin and r' the *new* radius of the electron (to be calculated here) and let us try tentatively to account for the observed mass m by the energy of the spin only (neglecting the electrostatic energy). The following statement will then be correct as to order of magnitude:

$$\frac{1}{2}\frac{\mu^2}{r'^3} = mc^2.$$

We can assume that μ is Bohr's magneton:

$$\mu = \frac{eh}{4\pi mc^2} = \frac{e}{2}\cdot\frac{e^2}{mc^2}\cdot\frac{hc}{2\pi e^2} = \frac{er_0}{2\alpha},$$

where

$$\alpha = \frac{hc}{2\pi e^2} = \frac{1}{137{\cdot}2},$$

the fine-structure constant, and $r_0 = e^2/mc^2$, the quantity usually called the radius of the electron; it is connected with the electronic radius r_{el} of the new field theory by the equation

$$r_{el} = 1{\cdot}236r_0.$$

From our first equation we find now:

$$r' = \frac{r_0}{2\alpha^{2/3}} = \frac{r_{el}}{2{\cdot}472 \times \alpha^{2/3}} = \frac{1}{11}r_{el}.$$

Since r' is considerably larger than r_{el}, the electrostatic energy in the new model will be a small fraction of mc^2, and we are justified in neglecting it for our rough estimate.

Again, the field 'in the interior' of the magneton may safely be equated to the absolute field b, which fact, as to the order of magnitude, will be expressed by

$$b = \frac{\mu}{r'^3} = \frac{2mc^2}{\mu} = 4\alpha\cdot\frac{e}{r_0}\cdot\frac{mc^2}{e^2} = 4\alpha\cdot\frac{e}{r_0^2}.$$

This is to be compared with the value, say b_{el}, formerly calculated from the electrostatic energy:

$$b_{el} = \frac{e}{r_{el}^2} = \frac{e}{(1{\cdot}236r_0)^2}.$$

We have

$$b = 4(1{\cdot}236)^2\cdot\alpha\cdot b_{el} = \frac{b_{el}}{22{\cdot}5}.$$

If the estimates are not too rough, the new point of view increases the radius of the electron by a factor of about 10, and decreases the limiting field to about the twentieth part.

MAX BORN.
Cambridge.
ERWIN SCHRÖDINGER.
Oxford. Jan. 28.

[1] M. Born, NATURE, **132**, 282; 1933.
[2] M. Born and L. Infeld, *Proc. Roy. Soc.*, A, **144**, 426; 1934.

The Hypothesis of Continental Drift

THE late Dr. A. Wegener claimed the advantage for his hypothesis of 'continental drift' that it could be tested by making repeated astronomical observations of the positions of land stations; for drifts at the rates of only a few feet a year would suffice to carry the land masses far within the span of geological time. Few geologists would in respect to this problem deny the applicability of the dictum that 'the present is the key to the past'; the question is whether precision determinations of 'position' will give measurable results within a reasonable time.

In 1932 Herr Hans Jelstrup determined the

longitude of Sabine I., East Greenland, and comparing his value with that of Börgen and Copeland's (1870) he finds a westerly drift of 615 metres. Owing to uncertainties inherent in the methods used in 1870, this figure is unreliable, but Herr Jelstrup concludes that at least 250 metres of the apparent drift is a real one, and he expresses the hope that it will be possible to repeat his observations in, say, 1942 to establish the fact of drift beyond all possible doubt[1].

Herr Jelstrup's results would seem to warrant the initiation of an investigation of the matter as a world problem by fixing now the positions of a network of stations, so that by future observations the reality of 'continental drift' may be settled one way or the other in the lifetimes of at least the younger of us. The stations must be chosen with due regard to geological situation. To examine 'continental drift' we shall want them on the great 'shields'—especially on extensive 'crystalline massifs', the so-called 'stable blocks'. That large horizontal displacements have taken place in the 'mobile belts' of the crust is known and it would be valuable to have stations on such belts which show activity at the present day, for example, the East-Indian island arcs, so that the movements of the 'stable blocks' may be related to the crumplings of the 'mobile belts'. Such results cannot fail to throw light on the mechanism of mountain building, and there is good reason to believe that it will now be possible to raise the study of crustal movements to a science by obtaining quantitative data.

The time has come for some international body to take up the matter (1) to inquire what stations, such as the great observatories, have been determined with sufficient accuracy to be of use, (2) to consider what further stations shall be established, and (3) to organise periodic redeterminations every five or ten years in the future.

L. HAWKES.

Bedford College,
Regent's Park, N.W.1.
Feb. 1.

[1] *Naturen.*, No. 10, p. 300; 1934.

Action of Thyroid Extract on the Respiration of Tissues of Invertebrates

THE respiration of fresh tissues (whole and macerated), and of dried and powdered tissues of various invertebrates with and without the addition of thyroid extract, was measured in the Barcroft-Warburg apparatus (in Ringer solution, sea-water, normal saline or water, according to the tissue).

It was found that in the case of eggs of insects—mono-voltinic *Bombyx mori* during æstivation and incubation (1st and 3rd stages of egg development)—thyroid extract caused an increase of oxygen consumption up to 23 per cent; on hibernating eggs the effect of thyroid extract was even more marked, and oxygen consumption was increased up to 3,700 per cent. The experiments were carried out at temperatures of 17°–37° C. With whole and various portions of the silk-glands of *Bombyx mori*, oxygen consumption was increased up to 15 per cent.

Echinoderma. An increase up to 300 per cent was noted with unfertilised eggs and with ovaries of *Spherocinus granularis*.

Crustacea. With fertilised eggs in all stages of development of *Carcinus mœnas*, *Eupagurus prideauxii*, *Portunus corrugatus* and *Portunus holstatus* an increase up to 300 per cent was noted.

Mollusca. With fertilised eggs of *Aplysia limacina*, an increase up to 220 per cent was noted.

Tunicata. With the ovary of *Ciona intestinalis* an increase of oxygen consumption up to 360 per cent was noted.

In every case the action of the thyroid extract was identical on the uninjured and freshly macerated tissues.

The action of the thyroid extract was even more marked on suspensions of tissues which had been dried and powdered, for example, increase of oxygen consumption was noted up to:

5,000	per	cent	with	powdered	eggs of *Bombyx mori*;
3,000	,,	,,	,,	,,	silk-glands of *Bombyx mori*;
9,300	,,	,,	,,	,,	ovary of Echinoderma;
4,000	,,	,,	,,	,,	eggs of Crustacea;
2,700	,,	,,	,,	,,	eggs of Mollusca;
30,000	,,	,,	,,	,,	ovary of Tunicata.

The influence of thyroid extract on oxygen consumption is almost instantaneous and lasts up to 20 minutes. In the case of suspensions of powdered tissues which have been standing for months (eggs and silk-glands of *Bombyx mori*) and show almost zero oxygen consumption, the addition of thyroid extract causes an almost immediate restoration of oxygen consumption.

Solutions of potassium cyanide did not diminish the action of thyroid extract on suspensions of dried and powdered eggs of *Bombyx mori*; the cyanide alone, in the absence of thyroid extract, was found to increase the oxygen consumption of this suspension.

All the experiments are made with the thyroid extract 'Elyteran' (Bayer). Synthetic thyroxin was found to have no effect at all on oxygen consumption. Full details will be published elsewhere.

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and
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Anæsthesia Produced Electrically

IN his letter entitled "Testing for Unconsciousness after an Electric Shock", in NATURE of January 19, Capt. C. W. Hume expresses the opinion that the electric stunning of animals is based on dogmatic assertions. He need not fear that research in this matter will not be welcomed by all concerned, or that any inquiry, based on actual investigation, will be stifled. It is, however, only a matter of time before such research confirms the opinions expressed by eminent physiologists in favour of electric anæsthesia for animals.

The points raised by Capt. Hume do not help to clarify matters; in fact, argument from such premises is liable to confuse the issue. They may be commented on as follows:

(1) The subject referred to is a human being. Animals are very much more susceptible to electric shock than humans as shown by the extraordinary cases of animal electrocution on record. There is no evidence of the existence of a 'nightmare state' in the case of animals.

(2) The interrupted D.C. used by Regensburger and Hertz is weak compared with the sinusoidal A.C. used in electric stunning if maximum values be considered. A 10 per cent interrupted D.C. giving a meter reading of 31 milliamp. is really a current of 310 milliamp. 0·5 amp. R.M.S. A.C. represents a maximum current of 710 milliamp. It is beyond doubt that the stunning effect depends on the strength of the current and not the length of time for which it is applied. The A.C. is therefore twice as effective as the intermittent D.C. used by Regensburger and four times that used by Hertz.

(3) The current strength applied in electric stunning is considerably above that required to produce immobility during application only. It has been noted that, with animals, a low current just sufficient to paralyse produces rigidity. A higher current invariably produces relaxation, and it is only when this state is reached that pain-unconsciousness is assured.

(4) and (5) It must be definitely stated that experiments on human beings do not prove anything with regard to the effect of electric current on animals such as sheep and pigs, and cannot logically be cited in this connexion. Further, the fact that Hertz's experiments were carried out on incurable invalids means that the results are not necessarily valid for healthy subjects. In my experience, the animals that are difficult to stun electrically are those that are unhealthy. In particular, a pig which would not stun properly was found to be tuberculous.

(6) The 'nightmare state', whether it be produced or not in animals as in human beings, implies insensibility to pain. In electrical accidents, severe burning has been felt only as a 'stinging sensation'.

(7) If muscular contraction persists in an animal for more than a second, either the current is too low, the electrodes improperly applied or the animal unhealthy. In actual practice, almost all animals under proper conditions of electric stunning relax instantly and remain relaxed until normal post mortem reflex action commences.

F. DE LA C. CHARD.

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Moulting and Replacement of Feathers

MY attention has been directed to a letter in NATURE of January 26 from Miss Anne Hosker. In this letter, Miss Hosker states that I am wrong as regards the statement made in my paper[1], namely, that "As compared with other bird-groups the condition (of moulting in the penguin), as far as I am aware, is absolutely unique".

In the specimen on which the statement was founded (which can still be seen in the British Museum, Natural History), almost fully grown new feathers can be exposed, on dissection, occupying the highly specialised feather follicles embedded in the subcutaneous tissue (cf. loc. cit. text-figures 6 and 7). They can be cut out of these follicles, dried and demonstrated to be nearly as large as the old feathers about to be shed, and of course more perfect; while, as I stated, the tip of the new feather, if still in continuity with the old, is thrust through the lower umbilicus and pushes the old feather before it, so that the latter may be as much as nearly a quarter of an inch distant from the outer surface of the skin. In other words, the new feather is already fully formed and ready to come through before the old feather is shed.

If this can be proved not to be a unique phenomenon in the avian world, I think most ornithologists will be greatly surprised; but after reading Miss Hosker's letter I would beg leave to make the suggestion that perhaps she and I have been writing about two different things. Miss Hosker seems to have been dealing with the well-known mode of development of the series of prepennal and pennal feathers as they first emerge from the chick. On the other hand, I was dealing in my paper with the wonderful adaptation to be observed in the penguin when moulting, an adaptation the object of which is obviously to lose as little time as possible, since until the penguin has completed its moult it cannot enter the water and so has to starve.

PERCY R. LOWE.

45 Cadogan Place,
S.W.1.

[1] *Proc. Zool. Soc.*, p. 499; 1933.

Molecular Spectrum of Cadmium Vapour

PROF. ROBERTSON'S observation[1] of a maximum at 2212 A. in the spectrum of an arc between cadmium electrodes which is much more intense than the cadmium band at 2125 is very interesting. This observation is surprising in view of the fact that no maximum at 2212 was observed by Cram[2] in fluorescence or Tesla discharge, while the 2125 band was easily observed both in fluorescence and discharge. The condensed copper spark giving more intensity near 2212 than 2125 when used as source for fluorescence excited 2125 with no emission maximum at 2212. These two bands have nearly the same intensity in absorption. The failure of an emission maximum at 2212 to appear along with the 2125 band of cadmium in fluorescence and discharge in pure cadmium vapour shows that the 2212 maximum is likely to be due to an impurity. The opportunity for observing spectra due to impurities (such as CdO, CdH, etc.) is always much greater in the arc in air than in a quartz tube containing only pure cadmium.

The earlier reproductions of the spectra of electrodeless discharges through cadmium vapour given by Robertson show a maximum at 2212 at low pressure but no 2212 maximum at high pressure. This favours the view that the 2212 maximum comes from an impurity the relative importance of which in the vapour is less at high cadmium pressures. Cram failed to observe an emission maximum at 2212 in cadmium vapour at any pressure.

If we consider the corresponding bands of zinc and mercury, the following similarities are observable. Let *B* represent the bands Zn 2060, Cd 2212, Hg 1808 and *C* the bands Zn 2000, Cd 2125, Hg 1692. In absorption, the intensity of *B* is greater than or equal to that of *C*. In emission from a Tesla discharge through the vapour at pressures of 10–40 mm., *C* is much more intense than *B*. In most cases *B* was not observed at all. In contrast, Robertson observed in the cadmium arc spectrum an emission maximum corresponding to *B* much more intense than *C*. This would indicate either that conditions in the cadmium arc were especially favourable to emission of *B* or that the 2212 emission maximum was due to an impurity.

Since learning of Robertson's results, we have photographed the spectra of arcs with electrodes of

carbon, and zinc or cadmium, with the carbon positive. The spectra are shown in Fig. 1. The cadmium arc shows the emission maximum at 2212 but the zinc arc does not show a corresponding maximum at 2060. This failure of 2060 is probably not due to insufficient vapour pressure of zinc in the arc since the reversals of the zinc and cadmium resonance lines are approximately equal in width, and the intensity of *B* and *C* relative to the resonance

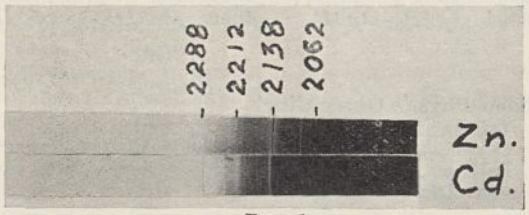

FIG. 1.

lines in absorption is about the same for zinc and cadmium. This observation shows that conditions in the arc are not favourable for emission of band *B* of zinc although they still may be for *B* of cadmium. This, however, again indicates that the source of the emission maximum at 2212 in the cadmium arc is an impurity.

J. G. WINANS.
S. W. CRAM.
University of Wisconsin.
Dec. 22, 1934.

[1] J. K. Robertson, *Phil. Mag.*, 14, 795; 1932. See also NATURE, **135**, 308, Feb. 23, 1935.
[2] S. W. Cram, *Phys. Rev.*, 46, 205; 1934.

Deamination in Virus-infected Plants

BONCQUET[1] noticed increased production of ammonia in curly top of beets and in tobacco mosaic and traced it to the presence of denitrifying organisms occurring in association with the diseased plants. Jodidi and co-workers observed similar increase in spinach blight[2], spinach mosaic[3] and cabbage mosaic[4] and attributed it to denitrification since there was diminution in total nitrogen. The latter authors indicated the possible formation of hydroxy acids, but did not study the related acid metabolism.

In the course of an inquiry on the mechanism of increased formation of ammonia in spiked sandal, I noted distinct increase in hydroxy acids, especially malic, in the earlier stages. In the more advanced condition, succinic acid was found to be present in the diseased tissues while it was entirely absent from the healthy ones. These observations having suggested the presence of an active deaminase in infected plants, a series of quantitative studies were carried out, adopting the method of Kisch[5].

The following were some of the results obtained:

Deaminase activity of healthy and spiked sandal.

Time in hours	Ammonia (in c.c. *N*/50) produced by 1 gm. of leaf powder		Carbon dioxide (in c.c. *N*/50) produced by 1 gm. of leaf powder	
	Healthy	Spiked	Healthy	Spiked
1	0·2	0·8	0·8	1·4
4	0·5	2·7	2·1	4·7
8	0·8	5·8	3·4	9·6
14	1·2	9·2	5·1	16·8

It is clear from the above that the increased production of ammonia is due to greater oxidative deamination in the diseased tissues. Further work on these and other aspects is in progress and will be published shortly in the *Journal of the Indian Institute of Science*.

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Department of Biochemistry,
Indian Institute of Science,
Bangalore.
Dec. 22, 1934.

[1] *J. Amer. Chem. Soc.*, **38**, 2572; 1916.
[2] *J. Agric. Res.*, **15**, 385; 1918.
[3] *J. Amer. Chem. Soc.*, **42**, 1061; 1920.
[4] *ibid.*, **42**, 1883; 1920.
[5] *Fermentforschung*, **13**, 433; 1932.

Interconvertibility of Glucose and Fructose in Plant Tissue

IN a recent paper from this laboratory[1] it was shown that sucrose is formed both from glucose and from fructose when starch-depleted leaves of red clover or wheat plants are placed in 10 per cent solutions of these hexose sugars in the dark. This result was explained by assuming that glucose and fructose are transformed into each other in plant tissue.

Continued research has now confirmed the above assumption. The experiments were made with several plant species, both grasses and legumes. The plants were first kept in the dark for forty-eight hours to deprive them of starch, whereupon they were placed in 10 per cent sugar solutions so that the ends of the stems were immersed while the leaves did not come into direct contact with the liquid. After a further twenty-four hours in the dark the leaves were cut off from the stems and dried and analysed separately. The drying was carried out *in vacuo* at 100°.

The results show that glucose and fructose are indeed easily converted into each other in plant tissue. The transformation takes place already in the stems, which is also the seat of sucrose synthesis. These reactions are not affected by an addition of 10 per cent toluene to the sugar solutions, and are only slightly retarded by a 0·05 molar potassium cyanide solution. There was evidence that in leaves part of the glucose disappears, possibly as a result of respiration. Under the conditions of the experiment, the synthesis of starch was very slight or nil. The stalks of horse-beans were found to contain much more invertase than the leaves.

The following experiment with horse-beans will illustrate the quantitative proportions in question. 20 plants were used for each determination. All values are computed on a 'residual-dry weight' basis.

	Dry matter Per cent	Total soluble sugars	Glucose	Fructose	Sucrose	Insoluble sugars
N leaves	9·05	7·35	0·7	4·35	0	4·3
N stems	6·0	7·1	0·7	4·6	0	10·25
D leaves	7·75	3·9	0	2·9	0	5·6
D stems	5·55	1·9	0	1·9	0	10·85
G leaves	11·65	17·3	6·2	3·6	5·1	7·0
G stems	8·0	26·25	12·2	7·55	5·15	11·2
F leaves	13·3	17·2	2·95	7·05	6·5	5·3
F stems	8·1	29·15	8·7	14·8	7·25	10·6

(*N* = normal plants, *D* = plants kept in the dark for forty-eight hours, *G* = plants kept in 10 per cent glucose solution for a further twenty-four hours, and *F* = plants kept in 10 per cent fructose solution for twenty-four hours).

M. NURMIA (NORDLUND).
Laboratory of the Foundation for
Chemical Research,
Helsingfors, Finland.
Jan. 4.

[1] Virtanen, A. I., and Nordlund, M., *Biochem. J.*, **28**, 1729; 1934.

Spectrum of Nova Herculis, 1934

In many respects the most recent nova is following the usual course in its spectral changes. The present spectrum is a medley of bright bands and of absorption lines: the bright hydrogen bands are accompanied by a number of absorption components on the side of shorter wave-length, while corresponding to each component and with the same Doppler displacement are a number of absorption lines due to atoms of Fe^+, Ti^+, Cr^+, Ca^+, etc.

The chief feature of interest in the spectrum now is the emergence of several bright forbidden lines of O I, first weakly visible in the spectrum of December 27, 1934. They are increasing in brightness and now stand out from the rest of the spectrum, conspicuous both by their strength and by the absence of accompanying absorptions. They are the exact analogues in the spectrum of O I of three well-known lines in the spectra of nebulæ and novæ, which are forbidden lines of O III. The first of the three lines of O I has been identified with the principal auroral line. The other two lines of O I have been observed in nebulæ also[1] but have not previously been found in novæ. The two sets of lines are:

O I		O III	
5577	$^2p\ ^1D_2 - {}^2p\ ^1S_0$	4363	$s^2p^2\ ^1D_2 - s^2p^2\ ^1S_0$
6300	$^2p\ ^3P_2 - {}^2p\ ^1D_2$	5007	$s^2p^2\ ^3P_2 - s^2p^2\ ^1D_2$
6364	$^2p\ ^3P_2 - {}^2p\ ^1D_2$	4959	$s^2p^2\ ^3P_1 - s^2p^2\ ^1D_2$

A. Beer.
F. J. M. Stratton.

Solar Physics Observatory,
Cambridge University.
Feb. 21.

[1] Bowen, *Astrophys. J.*, **81**, 12; 1935.

Points from Foregoing Letters

A definite relation is found by Prof. J. H. Orton between the mean diameter, or the mean axis, of the English native oyster and the volume of the entire animal; this relation is similar to that between the diameter, or thickness, and volume of a segment of a sphere. Prof. Orton supplies graphs showing these relations in oysters from several localities. He indicates upon the graphs the age of the oysters, known in a few cases from tank experiments and estimated empirically in the remaining instances from local knowledge. Prof. Orton believes that the probable increase of the stock on an oyster-bed in a given time could be predicted, given sufficient observations.

Photographic plates impregnated with borax register the action of neutrons (from a radon-beryllium source) upon the boron atoms in the borax. Messrs. H. J. Taylor and M. Goldhaber have found some 50,000 microscopic tracks produced per square centimetre, and from the length of these tracks they confirm the previous deduction that boron atoms are transmuted to lithium plus helium. Similar experiments show that lithium acted upon by neutrons gives helium plus hydrogen atoms of mass 3. These nuclear reactions release several million volts of energy.

Neutrons, the most efficient agents in atomic transmutations, can be directed or canalised along tubes having walls made of a substance of high hydrogen content. This prediction by Dr. Szilard has been confirmed by Prof. F. L. Hopwood and Mr. T. A. Chalmers, who used hollow cylinders of paraffin wax. A graphite tube also gave a small canalisation effect, but none was observed with impure ebonite.

If the spin of the electrons be taken into consideration, the value of the 'absolute field constant' calculated by Born and Infeld ($9{\cdot}18 \times 10^{15}$ E.S.U.) is considerably diminished. Drs. Max Born and E. Schrödinger estimate roughly that its value is decreased about twenty-fold, while the radius of the electron is increased ten-fold.

From a comparison of determinations of longitude in 1870 and 1932, Sabine I., East Greenland, seems to have drifted westwards several hundred metres. Dr. L. Hawkes advocates the establishment, in specially selected parts of the world, of stations specially fitted to determine by astronomical observations the occurrence of lateral drift. He points out that the results would throw light on the mechanism of mountain building; it should also prove or disprove Wegener's theory, which assumes that the continents are the broken pieces of a sheet of lighter and more acid rock 'floating' upon a denser and more basic rock, and that they are still moving laterally.

A large increase in respiration by organs of various invertebrate animals, under the action of thyroid extract, is reported by Dr. Rivka Ashbel. Comparative figures are given for the eggs of silkworms, crabs and molluscs, and the ovary of the sea-urchins and sea-squirts.

In Nature of February 23, Prof. Robertson supported his earlier observations that cadmium vapour emits ultra-violet light of wave-lengths 2212 A. by pointing out that the cadmium arc emits such light, and that the zinc arc emits the corresponding light of wave-lengths 2060 A. Prof. J. G. Winans and Mr. S. W. Cram now write that the zinc arc shows no corresponding *maximum* at 2060 A., and maintain that the 2212 band observed by Robertson is probably due to an impurity such as cadmium oxide or hydride.

Mr. A. V. V. Iyengar has observed in 'spiked' sandal an increase not only in ammonia but also in hydroxy-acids (malic and succinic). He suggests that these are formed by an active deaminase (an enzyme capable of replacing the $-NH_2$ group of amino-acids by the $-OH$ group of water, leading to the formation of hydroxy-acids and ammonia). The same deaminase may be responsible for the increased production of ammonia in tobacco mosaic, spinach blight and mosaic, etc.

It has been found that ordinary cane-sugar (sucrose) is formed by starch-free plant leaves from either glucose or fructose alone, although its molecule is made up of both these simpler sugars. M. Nurmia now reports further experiments showing that plant tissues have the property of changing glucose into fructose.

Research Items

Early Man in China. Further researches and discoveries at Choukoutien, the site of discovery of Peking man, are described in three recent communications to the Geological Society of China. Messrs. Ralph W. Chaney and Lyman H. Daugherty deal with the occurrence of *Cercis* in association with the remains of *Sinanthropus* (Bull. 12, No. 3). Fragments of charred wood pointing to the use of fire by Peking man have been identified as a new species of *Cercis*, a member of the family of Leguminosæ. In honour of the late Davidson Black it is named specifically *Blackii*; but it is sufficiently akin to *C. chinensis*, common in Chili Province, to suggest the probability that the climate in Peking man's day was much as it is now. P. Teilhard de Chardin and Dr. W. C. Pei report on discoveries in 1933–34 at Choukoutien (Bull. 13, No. 3) which, while not altering previous conclusions, add distinctness to precedent views on the stratigraphy and physiography of late Cenozoic times in north China. It is now apparent that the Lower Pleistocene, unknown for so long, is one of the most important Cenozoic formations in north China. New localities in the form of pockets have been opened up which make it possible to distinguish five, or even six, stages, instead of the three sedimentary units and the single fossiliferous horizon (*Sinanthropus* beds) previously differentiated. A preliminary report on the late palæolithic cave is presented by Dr. W. C. Pei (Bull. 13, No. 4) in which the archæological and palæontological finds are described. Five cultural layers were found. Three human skulls and a large series of other human bones were discovered and among the artefacts 28 perforated teeth (canines) of fox or badger, which by their juxtaposition suggest the use of teeth as a necklace. As possibly younger than the remains of southern Ordos and older than Hailar, a tentative dating as equivalent to Magdalenian man in Europe is suggested.

Beehive Graves in the Sudan and Sinai. Mr. G. W. Murray describes and figures in *Man* of February six beehive tombs, closely resembling the *nawamis* of Sinai or the *rijjum* of Arabia, which he discovered in 1926 in the neighbourhood of the fishing village of Halaib on the Red Sea coast. Superstructures had been erected over the original interment by corbelling until a beehive of three metres internal diameter at base and 1·7 m. high had been formed with an aperture in the roof large enough to admit the passage of a man. Outside this a dry stone tumulus six metres in diameter had been piled up rather untidily. The Sinai *nawamis* differ from the Halaib graves by having a neatly built retaining wall around them. Two graves were examined and in each at about 20 cm. depth very much decomposed bones covered with stones were discovered. The only objects found with them were two copper rings. They appeared to be pre-Islamic, but of no very great antiquity. They recall the more elaborate graves described by Schweinfurth from Gebel Maman. Sinaitic *nawamis* excavated by Curelly were found to contain shell ornaments and flint arrow-heads belonging to a primitive race, but not necessarily very early in date. Corbelling in mud brick occurs at a very early date in Egyptian tombs. Dr. Reisner, in a private letter which is quoted, refers to Second Dynasty examples and says that he now assigns the use of rude brick corbelling to the last king of Dynasty I. Therefore the practice of corbelling seems to have originated in mud-brick in the Nile Valley about the time of the First Dynasty, to have been copied in rubble masonry by the inhabitants of the desert, and to have spread north-eastward into Sinai and Northern Arabia and south-eastward into the Sudan and Eritræa, where it is not yet quite extinguished by the Moslem type of burial.

Influence of Light upon Goatsucker's Song. Gilbert White shared the general impression that the song of the goatsucker begins "exactly at the close of day", but S. E. Ashmore's observations in Surrey and Glamorgan carried on during three summers, show that there is a considerable amount of variation (*British Birds*, February, p. 259, 1935). In the course of the day, there are generally two spells of song, one commencing after sunset, the other before sunrise. The former began 18–101 minutes after sunset, the latter between 123 minutes and 27 minutes before sunrise; but the average times respectively are about 35 minutes and 50 minutes. It would seem that light intensity is one factor in determining the song, for the presence of bright moonlight delayed the commencement of the evening song, though it is not so easy to understand why it should have hastened the commencement of the morning song to the extent of more than half an hour before sunrise. Another problem lies in the seasonal variation of the periods, which are longer in mid-July than in June or August, although light conditions are not then at their highest. The author hazards the suggestion that there may be a "connexion with the hour at which are found flying the moths and other creatures which form the bird's food".

Deep-Sea Fishes and a New Trawl. Mr. Eide Parr ("Report on Experimental Use of a Triangular Trawl for Bathypelagic Collecting with an Account of the Fishes obtained and a Revision of the Family Cetomimidae". *Bull. Bingham Oceanographic Coll.*, 4, 1934. Contribution No. 35, Woods Hole Oceanographic Institution) describes a trawl which was successfully used during the first Caribbean cruise of the *Atlantis* sponsored jointly by the Woods Hole Oceanographic Institution and Yale University. The large triangular trawl, 50 ft. long each side of the opening and with three otter boards, was provided by the Bingham Oceanographic Foundation of Yale University. Although difficulties in equipment and arrangements were great, one haul was extremely successful, showing that with certain alterations, easily made on land, this trawl should be a valuable addition in deep-sea collecting to supplement the results obtained by the smaller nets. Many large fish are caught, but not so many small specimens, owing to the coarser mesh. The one successful haul yielded a total of 47 species of fish and 491 individuals, 373 of which belonged to the genus *Cyclothone*. The author, having examined a large number of samples from the east central Atlantic, concludes that there are only three species of this genus in the area studied—*C. braueri*, *C. pallida* and *C. microdon*. Several new species are described and a new sub-family and genus. Among the new species is a male *Borophryne*, agreeing in all essentials with *B. apogon* of Regan and Trewavas,

but differing in the number of rostral spines and in other minor points. As the author states, "it is thus for the first time possible to introduce a new Ceratoid species referred to its proper genus on the basis of a still unattached male only".

Silicoflagellates and Tintinnids of the Great Barrier Reef. Dr. S. M. Marshall (Great Barrier Reef Expedition 1928–29. Scientific Reports. British Museum (Natural History). 4, No. 15; 1934) shows that silicoflagellates are rare in the material available since their small size enables them to pass through the meshes of the finest net. By centrifuging the water samples it is found that they were present in small numbers, but show no seasonal variation. The Tintinnoinea were captured in the tow-nettings taken with the international fine silk net described by Russell and Colman (2, No. 2; 1931). They fall into two groups, those adapted to neritic conditions, and those of oceanic habitat which are restricted to water of relatively high salinity. Neritic species are common throughout the year, but especially in March. Oceanic species are rarer and occur mainly in August and September from the weekly stations when the salinity inside the barrier was more than 35 per cent. Fifty-six species are recorded, twenty-two being cosmopolitan and known from the Atlantic, Pacific and Indian Oceans, sometimes from temperate and even arctic regions. Nine species are restricted to warm seas. Results from stations on or near the outer reefs suggest that there is a rich tintinnid fauna in the ocean waters outside, of which only some species can live permanently within the barrier. Three species are new to science. Several forms hitherto only known from the eastern tropical Pacific are now recorded from the western Pacific also.

Vegetative Propagation at Edinburgh. For a long time horticulturists have regarded the Edinburgh Botanic Gardens as the place to which to turn for advice and help in matters of plant propagation. This has been largely due to the general willingness of the staff to help, but also to the great interest of the late L. B. Stewart in the problem of vegetative propagation. Dr. R. J. D. Graham, who was closely associated with his work, has now stated briefly some of the main conclusions reached by Stewart during his long struggle with the practical problems associated with vegetative propagation (*Trans. Proc. Bot. Soc. Edin.*, 31, Part 3; 1934). One difficulty is to know when to make the cuttings. A general guide is to take the cutting when the season's growth is completed, when reserve foods for next season's growth are being accumulated and when at the same time vigorous cells capable of wound protection are still present. Stewart had cuttings taken of many plants every month, and from these data a list is now published by Dr. R. J. D. Graham showing in what months successful (more than ninety per cent) propagation was obtained.

Potato Diseases in Great Britain. The Ministry of Agriculture and Fisheries has recently issued a new portfolio of "Leaflets on Diseases of Potatoes" as No. 3 of its series of collected leaflets (London: H.M. Stationery Office, pp. 45, 1*s.* 6*d.* 1934). This loose-leaflet volume replaces No. 3 of the older sectional volumes, "Cultivation and Diseases of Potatoes". Three leaflets on potato-growing and the selection of seed tubers are omitted, as the subject-matter is to be expanded into a new bulletin. Six of the original leaflets have recently been revised, and issued as advisory leaflets, in which form they are included in the new portfolio. They deal with common scab, the Colorado beetle, powdery scab, black-leg, mosaic and virus diseases, and dry rot. Advisory leaflet No. 71, on the Colorado beetle, is enriched with a new coloured plate, while there are more half-tone illustrations than formerly. A seventeen-page insert has been printed specially for the new collection, and briefly describes nine miscellaneous diseases, namely, skin spot, spraing, black scurf and stem canker, violet root-rot, white root-rot, pink rot, watery wound rot, *Verticillium* wilt, and silver scurf. Potato blight, wart, *Sclerotinia* rot and leaf-roll diseases, are adequately described by the inclusion of four older leaflets.

Distribution of Earthquakes. A new map by Capt. N. H. Heck of the distribution of earthquakes throughout the world is published in the *Geographical Review* of January 1935. It is based mainly on the location of epicentres instrumentally determined during the period 1899–1933. To these have been added epicentres of major earthquakes of historical record especially in China, Syria and the Lesser Antilles. The map shows clearly two great belts of activity. Of these, the more striking is the Mediterranean-Pacific belt, which appears to girdle the earth via the Mediterranean, southern Asia, the north Pacific and West Indies, with main branches southward via the Malay Archipelago and New Guinea to New Zealand and from the West Indies into South America. The second belt is that of the mid-Atlantic, and this is entirely oceanic and is marked by few major shocks, but of course there is less scope in this belt for instrumental records. It is noticeable that practically all the great ocean deeps are within the belts and all the largest rifts on the land surface are within the great belt or its branches. There would appear to be no belt crossing the Pacific Ocean, the branch to Easter Island being linked to South America. In the South Atlantic, a detached area around the South Sandwich group may prove to be an extension of the mid-Atlantic belt.

Overhead Irrigation. Investigations into the methods and value of overhead or spray irrigation in Australia have been made at the Commonwealth Research Station at Griffith, New South Wales, and some conclusions are published in Pamphlet No. 50 of the Council for Scientific and Industrial Research, Melbourne ("The Design of Overhead Irrigation Systems", E. S. West and A. Howard). The system depends on the distribution of water under pressure from orifices in lateral pipes branching from the mains. These laterals are 1-in. pipes placed on the ground. They can easily be moved from place to place or rotated to ensure complete irrigation. The advantages of the system compared with surface methods are the greater control over the quantity and distribution of the water, the absence of water-logging which may occur near irrigation trenches, the lack of need of ditches and levees with a consequent saving of ground and the added possibility of irrigating at will an area not previously prepared, and lastly a great saving in labour. There are, however, some disadvantages in the system, including the initial cost, depreciation of plant and the cost of pumping the water. The authors believe that the spray system is cheaper and more advantageous than surface irrigation on undulating land with light soils, and that the converse is true on heavy flat land.

Flow of Colloidal Systems. Dr. A. S. C. Lawrence (*Proc. Roy. Soc.*, A, Jan. 1) has examined the flow of colloidal liquids, which do not in general behave as simple viscous liquids. The flow was investigated by suddenly changing the flow through a glass tube from colourless solution to solution containing a dye, and photographing the advancing boundary of colour. This boundary is parabolic for ordinary viscous liquids. The colloidal systems fall into two classes: in one the resistance is small at the wall of the tube, rises rapidly to a maximum and falls off again to the centre of the tube; in the other, the 'gelating' class, the resistance to flow increases as the axis of the tube is approached. Some of the colloidal solutions show very marked elastic properties. The anomalous flow is interpreted as due to the mutual interference of large, non-isodimensional (that is, elongated) micelles.

Absolute Measurement of X-Rays with a Geiger Counter. G. L. Locher and D. P. Le Galley (*Phys. Rev.*, Dec. 15, 1934) have applied the Geiger-Müller counting tube to the absolute measurement of X-ray intensities. A narrow beam of X-rays is passed through a counter in such a way that only electrons liberated in the gas of the counter are counted. Using krypton at 6·3 cm. pressure and zirconium fluorescent *K*-radiation, the absorption of the rays in the gas column is known to be 3·75 per cent, and since the number of electrons corresponding to this absorption is counted, the number of quanta in the beam may be deduced. The scattering of the beam may be neglected compared with the fluorescent absorption. The beam calibrated in this way was used to obtain the sensitiveness of Eastman X-ray film. The minimum visible blackening was obtained with $7{\cdot}2 \times 10^5$ quanta per sq. cm. A curve connecting the blackening of the film with the incident quanta is published.

Action of Alternating Magnetic Fields upon Ferromagnetic Particles. About twelve years ago, W. M. Mordey described experiments on the action of single and multi-phase alternating magnetic fields on ferromagnetic particles (see *Proc. Phys. Soc.*, **40**, 338; 1928). The phenomena observed suggested that under certain conditions there was a repulsion of the particles from strong to weak field regions. Thus when the particles were strewn on a surface above a series of vertical magnets excited alternately by two-phase current, they moved in the direction opposite to that of the movement of the successive alternate north and south poles to which the arrangement corresponds. No satisfactory interpretation of the phenomena was given. Further experiments have been made by H. Stafford Hatfield (*Proc. Phys. Soc.*, **46**, 604; 1934), using particles of iron, steel, magnetite and pyrrhotite. No anomalous repulsive action was observed when the particles were attached by adhesive to one arm of a torsion balance, or when the particles were allowed to fall freely through the fields. The essential factors involved may be appreciated by considering the effect on a magnetised particle resting on a surface due to a moving vertical magnet, or series of magnets, below the surface. Owing to friction, the horizontal force on either pole of the particle will be effective only when that pole is raised from the surface; that is, after the upward vertical force has passed a definite value. The particle as a whole will, therefore, move oppositely to the magnets below, each pole of the particle stepping out alternately. It is clear that remanent magnetism is necessary for these effects to occur, and that their magnitude will depend on the shape and mass of the particles as well as on their magnetic characteristics. The behaviour of particles under more complex conditions can readily be given on the above basis.

Constitution of Xylan. Previous work on the structure of the polysaccharide xylan revealed that the substance was composed of chains of xylopyranose units linked through the 1–4 positions of the pentose molecule. The glycosidic linkages were known to be β in type, and in many ways xylan presented close structural analogies with cellulose. More recent investigations by W. N. Haworth, E. L. Hirst and E. Oliver (*J. Chem. Soc.*, 1917; 1934) show that xylan prepared from esparto celluloses of different origin is possibly more closely related to the plant gums than to normal cellulose. It contains, in addition to the xylopyranose residues, a fixed and constant proportion of combined *l*-arabinose in the furanose form. This *l*-arabofuranose unit is retained during methylation and the methylated xylan gives on hydrolysis 90 per cent of 2 : 3-dimethyl xylose and about 6 per cent of 2 : 3 : 5-trimethyl *l*-arabofuranose. The last product shows that the arabinose residue must be present in the furanose condition in xylan and that it forms a terminal group attached to a chain of consecutive xylopyranose residues—the first occasion on which the natural occurrence of arabofuranose has been observed. Xylan is non-reducing, and previous experiments by Schmidt in favour of a terminal carboxyl group could not be confirmed. Trimethyl xylose has not been detected in the cleavage products of methylated xylan, and it seems evident that the trimethyl arabofuranose takes the place of this as a terminal group in what is otherwise a series of xylopyranose units. Alternative structures which are possible in the present stage of the investigation are considered.

The Spectroscopic Binary ζ Aurigae. Work performed at Cambridge at the recent eclipse of the variable ζ Aurigae is described in the November *Monthly Notices R.A.S.* This spectroscopic binary is also an eclipsing variable and consists of a *K* type supergiant and a *B* star, and has an especial interest since it is the first accurately to give the dimensions and mass of a red supergiant from observations alone. The Cambridge observations consisted of an accurate measurement of the magnitude difference between the normal and eclipsed system, made by Dr. W. M. Smart with a photo-electric photometer. The difference was found to be 2·281 m., with the very small probable error of 0·004 m. At the same time, spectroscopic observations were made at the Solar Physics Observatory. These are described by Dr. A. Beer. A remarkable feature is the appearance of the Ca+ lines in absorption in the violet spectrum of the *B* star when this star emerges from the eclipse. Naturally, these lines are absent from the normal *B* spectrum, which is readily distinguished from the *K* spectrum in the violet by its greater intensity. The appearance of the Ca+ lines is due to the passage of the light from the *B* star through an extensive Ca+ chromosphere or envelope carried by the red star. As the *B* star moves clear of the eclipsed position, these Ca+ lines decrease in intensity. The distance between the two stars is about 10^{10} km., and their diameters 335 and 2½ times that of the sun, for the red supergiant and *B* star respectively.

Twenty-second Session of the Indian Science Congress

THE twenty-second session of the Indian Science Congress was held at Calcutta on January 2–8. The session was memorable for the foundation of the National Institute of Sciences of India, which it is intended shall perform for India some of those functions which the Royal Society discharges with regard to science in the United Kingdom. The foundation of this Institute forms a land-mark in the organisation of scientific research in India. The inauguration ceremony of the National Institute was performed on January 7 by His Excellency Sir John Anderson, Governor of Bengal, when Dr. L. L. Fermor, president, delivered his presidential address.

His Excellency Lord Willingdon, Viceroy and Governor-General of India, opened the session on January 2. In his speech, Lord Willingdon referred with satisfaction to his being the first Viceroy to be present at its meetings, and mentioned briefly the importance of the contribution to Indian science being made by Government through scientific services and scientific departments, and through the agency of bodies like the Imperial Council of Agricultural Research and the Indian Research Fund Association. After mentioning the munificent endowments for scientific research created by men like the late Sir Jamshetji Tata, the late Sir Tarak Nath Palit and the late Sir Rash Bihari Ghosh, he mentioned specially the growing contact between scientific research and the practical demands and requirements of industry, of which the assistance given by the Burma Oil Company to the foundation of the College of Engineering at Rangoon, and the recent donation of Messrs. Steel Brothers for research in oil technology at Lahore, are examples. In concluding, he referred to the necessity for scientific workers to organise themselves so as to ensure the maximum of achievement that is possible with the resources available.

In his presidential address, Dr. J. H. Hutton referred briefly to the work of the Academy Committee appointed at the Bombay session and recommended the scheme for the foundation of a National Institution of Sciences of India for adoption by the Congress. He then referred to the vast field available in India for the organised efforts of science, and cited rural economy, food reform and town planning as matters in which science may and should be utilised and directed for the benefit of the community. Speaking of the vast field India offers to anthropologists, containing as it were a veritable museum of living physical types, of social organisations, cultures and religious beliefs, he pointed out that the question of race in India requires very careful and detailed examination by trained anthropologists. He directed attention to the numerous sites of archæological interest awaiting excavation and to the great need for systematic linguistic research in southern India. The necessity of studying the symbolism of dreams, folk-lore proper and religious beliefs and practices was emphasised and an appeal was made to concentrate more on the organised collection of facts than on their interpretation.

In his presidential address to the Section of Agriculture, Dr. F. J. F. Shaw laid stress on the necessity and importance of systematic breeding work for resistance to disease. In this connexion he mentioned the production at Pusa of new types of Rahar (pigeon pea—*Cajanus indicus*) resistant to the wilt disease caused by *Fusarium*. He also mentioned that a comprehensive scheme for breeding rust-resisting types of wheat has recently been undertaken by the Imperial Agricultural Department, from which it is hoped fruitful results will be obtained. After referring to breeding work done on linseed, potato and sugar-cane in India, he pointed to the necessity of a cytological study of these crops. He hoped for co-operation in this sphere from the universities of India.

At a joint meeting of the Sections of Agriculture, Mathematics and Physics, Chemistry, Botany, Geology and Zoology, it was decided to start an Indian Society of Soil Science.

The presidential address by Prof. N. R. Sen to the Section of Mathematics and Physics was a general review of the development of theoretical physics from the early stage of classical mechanics to the present state of quantum mechanics, laying special stress on the difficulties of the existing theory. The viewpoints of the two rival schools of thought, namely, of a continuous field theory being able to describe correctly the entire scheme of Nature, or of discontinuous quantum processes ultimately finding a solution to the problem of matter and radiation, were analysed and discussed.

Among the papers read at the meetings the following may be mentioned: (1) atomic arrangements in anthraquinone crystals, by Dr. K. Banerjee, (2) aerial waves produced by meteorites, by Dr. S. K. Banerjee, (3) meteorological papers on nocturnal cooling of the atmosphere by radiation, by Dr. K. R. Ramanathan and Mr. Ramdas, (4) Heilbronn's class-number, by S. Chowla, (5) some boundary problems in non-linear parabolic equations, by R. Siddiqi, and (6) two hydrodynamical papers, by N. Bose and S. Sen Gupta.

In his address to the Chemistry Section, Dr. A. C. Sarkar gave a review of recent work on high coal-tar hydrocarbons, especially acenaphthene, fluorene and phenanthrene. Symposia were held on chemical aspects of light absorption and cellulose chemistry.

The presidential address of Diwan Anand Kumar to the Zoology Section dealt with the spicules and classification of Tetraxonida, an order of non-calcareous sponges. Apart from the papers read, the Section discussed at its meetings the question of "Standardisation of the Courses in Zoology for the University Examinations" and at a joint meeting of the Botany and Zoology Sections the "Teaching of Elementary Biology in Secondary Schools in India". The Section adopted a resolution stressing the need for the establishment of a station for marine and estuarine biology in Bengal. A committee was also appointed to organise a Zoological Society for India.

Prof. J. H. Mitter, in his presidential address to the Botany Section, dealt exhaustively with mycological and plant pathological research in India. He laid stress on the need of co-operation between universities and the plant pathologist, who has not always much time at his disposal to carry out the purely scientific work on the life-history of the pathogen. He further pointed out the desirability of establishing a bureau of stock cultures of fungi and the publication of an up-to-date textbook on mycology for India.

The problem of cereal rusts in India was discussed at a joint meeting of the Botany and Agriculture

Sections. Dr. K. C. Mehta, Dr. U. N. Pal, Dr. F. J. F. Shaw, Mr. P. K. De and Dr. B. B. Mundkur took part in the discussion.

The presidential address to the Geology Section by Dr. M. S. Krishnan dealt with the classification of the Dharwar system of Pre-Cambrian rocks. A three-fold division was suggested in which the lowest consists of a metamorphosed complex, while the middle division is characterised by manganese ores (gondite type) and marbles, and the upper one by banded ironstones. The origin of some of the types of sediments in this system was discussed in the latter part of the address.

In addition to the papers which were contributed to this Section, there was a symposium on the Bihar earthquake of 1934, jointly with the Physics Section, in which Drs. A. C. Banerji, S. K. Banerjee, C. W. B. Normand and S. C. Roy and Messrs. D. N. Waida and W. D. West took part. S. K. Banerjee touched upon some general facts and exhibited a model of a seismograph of his own design suited for recording severe shocks near the focal region; A. C. Banerji discussed the inter-relationship of the cooling of the crust and the distribution of radioactive material in the earth, and also the influence of the tidal attraction of the sun and the moon in precipitating an earthquake in an unstable crust. Roy illustrated his remarks with actual seismograms and the various phases found therein. According to him the focal depth of this earthquake was about 13·5 km., and the speed of one phase coincided with that in dunite. Normand emphasised the necessity for more seismographs and especially damped instruments in the Indo-Gangetic valley adjoining the Himalayan seismic belt. Wadia dealt with the geological aspects and on the possibility of the existence of fractures parallel to the 'Main Boundary Fault' underneath the Ganges valley in Bihar, while West from geodetic considerations thought that the earthquake might have been produced by the conversion of the rocks of the eclogite and dunite shell into those of less density.

Major K. R. K. Iyengar devoted his presidential address to the Section of Medical and Veterinary Research to the consideration of the problem of rabies in India. He pointed out that all attempts to cultivate artificially the organism causing it having failed, it is not possible to improve upon the somewhat crude methods employed at present to prepare the serum and to devise more efficacious means of prophylactic treatment. Certain improvements in the technique of preparing serum adopted during the previous year at Coonoor were described. It was further pointed out that although a number of institutes for anti-rabies treatment have been established in India, no preventive measures are being taken to deal with the disease at its source. Referring to the example of Germany, Australia and the British Isles where rabies has been eradicated by strictly controlling dogs and their movements, Major Iyengar pressed for co-operative efforts for the destruction of stray ownerless dogs, and for the compulsory registration and licensing of dogs in all municipalities and district boards. He advocated destruction of jackals as well in rural areas. Quarantine methods against imported dogs, in his opinion, would not be effective unless the local dog population is properly controlled. He recommended that anti-rabies treatment should be decentralised to the utmost extent possible, so that persons bitten by dogs could have treatment near their homes.

A symposium on vitamins was held at a joint meeting of the Sections of Chemistry and Medical and Veterinary Research.

Dr. G. S. Ghurye took "Anthropology and our Educational System" as the theme of his address to the Anthropology Section. If anthropology is to serve as a guide to better social conditions, a study of the social and cultural history of the various races of mankind, primitive as well as advanced, is very necessary. Such a study would help in suggesting solutions to many pressing social problems. It was therefore suggested that anthropology should be included as a subject in all courses of study prescribed for students wishing to take up public life in one form or other as their career.

The Section adopted a resolution to start an Anthropological Society for India, if possible by enlarging the scope of the Bombay Anthropological Society.

In his address to the Psychology Section, Dr. S. C. Mitra dealt with the relation of psychology to problems of life. After pointing out the various ways in which a knowledge of psychology can be utilised to solve social problems, he pressed for the establishment of an Institute of Applied Psychology.

S. P. AGHARKAR.

Underground Water Supplies

ALTHOUGH the title of his paper, read before the Royal Society of Arts on February 20, was "Water Supplies from Underground Sources", Lieut.-Col. J. D. Restler gave it a rather wider scope by including some preliminary notice of water supplies in general. He pointed out that the problem of water supply is very different from that of the supply of gas and electricity, because gas and electricity can be manufactured for all practical purposes at any point where it is desired to do so, and electricity can be transmitted in bulk over long distances with comparative ease and relatively high efficiency, whereas in the case of water, serious engineering difficulties arise if large quantities are to be delivered over long distances. The capital cost becomes very heavy and the efficiency, due to pipe friction and other causes, is exceedingly low.

Dealing more particularly with the subject of subterranean supplies, Col. Restler described the conditions under which they have to be obtained. In sinking a well, or boring, in many localities, it is quite usual to pass through a large number of strata yielding water of an entirely different character, separated in some cases by comparatively few feet. The classes of water met with vary to such an extent that some may be so soft as to attack lead pipes, and others so hard as to be entirely unsuitable for steam raising or domestic purposes. Others again, right in the centre of England, may be quite salt. As a general principle, if underground water of suitable quality can be found in sufficient quantity at a convenient depth and within a reasonable distance of the locality where it is required, such a source, from a water undertaking point of view, has great advantages over a surface or river source. Underground sources of supply are less liable to

contamination, assuming that there is a sufficient covering of impervious strata and that the outcrop lies in an area where only pure rain water is collected.

The engineering works required for obtaining water from water-bearing strata may be divided into three sections, the first being small borings, such as those required for the supply of small quantities to country houses, medium size factories, etc.; the second section would comprise large borings, such as those required for public water supply undertakings or large manufacturing works; and the third section would consist of large wells, with headings or galleries, such as those required for the supply of large towns and cities. Borings under the first category would be capable of delivering water at the rate of about 100,000 gallons in twenty-four hours, those in the second category at the rate of about two million gallons in twenty-four hours, and those in the third category at a rate exceeding five million gallons in twenty-four hours. The first and second classes have many points in common, the principal difference being that the plants and apparatus required in the second case are considerably larger and heavier. The paper then went on to describe the procedure of making the borings and sinking the lining tubes.

In the course of his paper, Col. Restler mentioned that water derived from an underground source is, in very cold weather, many degrees higher in temperature than water derived from a river source, and that it is quite noticeable that the former does not freeze in mains or service pipes so soon as river water. This is a point of practical importance, because when very cold water is being transmitted through mains, it frequently produces a local contraction in the metal and causes cast iron pipes to fracture.

Post-Glacial Research in Ireland

IT has been evident for many years that a large number of the special problems of plant and animal distribution in Ireland could only be solved if it were possible to obtain trustworthy evidence as to the major post-glacial changes in the Irish fauna and flora. Accordingly a committee was formed in 1933, with the object of promoting detailed investigations of representative glacial and post-glacial deposits and, particularly, of enlisting the method of pollen analysis in the detailed study of the problem. The work and aims of the committee up to the end of 1934 are summarised by various authors in the November number of the *Irish Naturalist* (5, 125; 1934). Active field work was commenced in 1934, so that full details of the results are not yet available. The particular feature of the work was, however, that the sites examined were chosen because they included definite and representative archæological horizons in various parts of the country.

An outline of the broad results of the pollen analyses of peats is given by Prof. Knud Jessen, and this indicates the main features of the work attempted. From results on the deeper bogs examined, the tentative suggestion is made that there was an increase in moisture in the later part of the Bronze Age, which occasioned wide-spread replacement of forest by peat bog. If, as is possible, this change corresponds in time with the sub-boreal to sub-Atlantic climatic change so well known on the Continent, the late Bronze Age in Ireland should synchronise with the beginning of the Iron Age (Halstatt period) in Europe. Before this transition, Ireland was forest clad to the western coasts and high up the mountains. Since then, forests have disappeared from western Ireland.

Investigations carried out in Northern Ireland were devised to secure, if possible, chronological comparisons between the raised beaches and the development of inland bogs containing Stone Age culture layers. The results will be awaited with interest, as will those from the Lough Neagh area, where the discovery of fossil *Naias flexilis* fruits may throw light on the origin of the American element in the Irish flora. The late glacial deposits of the Ballybetagh bogs, the classical site for remains of the Irish 'elk', yielded a collection of northern or highland types of plants apparently of a date prior to the post-glacial birch epoch.

University and Educational Intelligence

CAMBRIDGE.—Mr. K. W. M. Pickthorn, fellow and tutor of Corpus Christi College, has been returned unopposed as National Conservative member of Parliament for the University. His was the only nomination for the seat vacant by the resignation of Mr. G. H. A. Wilson (Conservative), Master of Clare College, who is to be the next vice-chancellor of the University.

LONDON.—The Senate, at its meeting on February 21, approved a proposal to hold external examinations of the University in New York. This proposal, which is an entirely new departure in the history of the University, was submitted by His Excellency the American Ambassador and the British Foreign Office to the State Department in New York, which has given its formal sanction. These examinations are to be available for both British subjects and students of other nationalities.

The Court has accepted the offer by the Radcliffe Trustees of the Radcliffe 24-in. refracting telescope, which was the main instrument of the Radcliffe Observatory in Oxford and has now been rendered available by the removal of this Observatory to South Africa. It is hoped, so soon as funds can be obtained by the University for this purpose, to re-erect the Radcliffe telescope on the site of the present University of London Observatory in Mill Hill Park, where the Wilson 24-in. reflector and the Fry 8-in. refractor, as well as other instruments, are already housed.

APPLICATIONS are invited for Lady Tata Memorial Research Scholarships in medicine, of £400 a year each, for research work in diseases of the blood with special reference to the leukæmias. These scholarships are renewable annually up to a normal maximum of three years, and there are likely to be at least two vacancies for new candidates ready to begin work in October 1935. The scholarships are open to suitably qualified men or women of any nationality, and are ordinarily awarded on a whole-time basis. Applications must be made by April 15. Further particulars and forms of application may be obtained from the Secretary, Scientific Advisory Committee, 138 Bedford Court Mansions, London, W.C.1.

AMERICAN university statistics are exhibited and interpreted in an article by Dr. Walters, president of the University of Cincinnati, in *School and Society* of December 15. The outstanding feature of the returns is the reversal of the tide of enrolment, which has been ebbing since 1930. This recovery, which is much greater in institutions under public control than in

others, and is most pronounced in the mountain and south central States and least in New England and middle Atlantic States, is attributed to the following influences: financial aid for students from the Federal Emergency Relief Administration, the difficulty of finding employment for young people leaving school, improved economic conditions in some parts of the country and the persistent faith of parents in the value of higher education. 'Liberal arts' continues to be the most popular choice of entering students, although its percentage (72) of the total entries was slightly lower in 1934 than in the preceding year. Some striking increases in the entries into the various professional schools were: 48 per cent in agriculture, 27·5 per cent in commerce and business administration and 20·5 per cent in engineering. Another statistical article in the same issue directs attention to the fact that one tenth of the expenditure of Yale University last year was on assistance to students in need of financial aid.

Science News a Century Ago

Resumption of Work on the Thames Tunnel

The construction of Brunel's tunnel beneath the Thames from Rotherhithe to Wapping began in 1825, had been brought to a premature close in 1828, and for nearly seven years work was at a standstill. In 1834, however, a "Tunnel Club" was formed, principally by fellows of the Royal Society, and successful efforts were made to secure assistance from the Government for the completion of the tunnel. At a meeting of the shareholders held on March 3, 1835, in the City of London Tavern, the chairman announced that £247,000 in exchequer bills was to be advanced on the security of the property. He said that "the Company were much indebted to the late Government, as well indeed as to the present, for this aid. Great credit was due to all those who had advocated the grant of money, and among those who had formed the deputation to the Government were men of all parties. It had indeed, been the wish of all persons, at home and abroad, that this splendid work should be completed, and foreigners considered it a national disgrace that it should have been allowed to remain seven years without an attempt being made to complete it. The time, however, was not far distant when it was confidently believed this magnificent work would be completed." At the same meeting, Brunel made a report in which he said that on February 4 "the water-ways, which had been closed for several years were reopened, as a preparatory step for entering the shield. It was quite satisfactory to find that the infiltrations are very inconsiderable, and are just the same as they were before". The tunnel was opened to the public on March 25, 1843.

Bessel's New Method of Lunar Distances

An advertisement in *The Times* of March 8, 1835, announced: "This day is published, 8vo., 5s., BESSEL'S NEW METHOD OF LUNAR DISTANCES—Distances of the Sun and the four planets Venus, Mars, Jupiter and Saturn, from the Moon, calculated according to Mr. Bessel's method, together with their places for every day in the year 1835; to which is added, an Ephemeris of the Moon calculated for every third hour of mean Greenwich time upon M. Damoiseau's Tables; the culmination of the Moon for every day in 1835 for the Altona meridian, with the auxiliary quantities to reduce it to other meridians; and Tables for finding the Latitude by the Pole Star for 1835, calculated under the direction of H. C. Schumacher. John Murray, Albemarle St."

Sir Robert Peel and Mrs. Somerville

After offering a Civil List Pension to Airy, Sir Robert Peel wrote in March 1835 to Mrs. Somerville, saying, "In advising the Crown in respect of civil pensions, I have acted equally with a sense of public duty and on the impulse of my own private feelings in recognising among the first claims on the Royal favour those which are deserved from eminence in science and literature. . . . In reviewing such claims, it is impossible that I can overlook those which you have established by the successful prosecution of studies of the highest order, both from the importance of the objects to which they relate, and from the faculties and acquirements which they demand. . . . I am enabled to advise His Majesty to grant to you a pension on the civil list of two hundred pounds per annum; and if that provision will enable you to pursue your labours with less of anxiety, either as to the present or the future, I shall only be fulfilling a public duty, and not imposing upon you the slightest obligation, by availing myself of your permission to submit such a recommendation to the King". The pension was conferred on Mrs. Somerville and later, when Lord John Russell was Prime Minister, it was increased to £300 a year.

Death of Thomas Drummond

Early in March 1835, Thomas Drummond, the botanical collector, died at Havana, after spending ten years collecting in North America. The younger brother of James Drummond (1784 ?–1863) who investigated the botany of Western Australia, Thomas Drummond began life as a nurseryman in Forfar, but became known to botanists by distributing sets of mosses. In 1825 he was selected as assistant naturalist to Dr. (afterwards Sir John) Richardson in Sir John Franklin's second land expedition in connexion with the discovery of a North-West Passage. He accompanied the expedition westward by the Hudson and Lakes Ontario and Winnipeg to the Mackenzie River, but quitted the main party at the Rocky Mountains. His subsequent botanical expeditions took him on foot across the Allegheny Mountains to St. Louis, to New Orleans and to Texas. At Velasco he was attacked by cholera but was afterwards able to continue his excursions. He finally embarked for Havana on February 9, 1835. The plants he sent home were described by Sir William Hooker in his "Flora Boreali Americana", his "Journal of Botany" and in the "Companion to the Botanical Magazine".

Objects for the Microscope

In the *Records of General Science* of March 1835 under the heading "Scientific Intelligence", it is stated that "Mr. Andrew Pritchard, Pickett Street, Strand, has just published a useful little work for such persons as take an interest in examining the beauties of the minute works of nature. It consists of a list of 2000 microscopic objects, and is intended to serve as a guide for selecting and labelling subjects of natural history, botany and mineralogy. Some good observations are prefixed in reference to mounting microscopical subjects, with remarks on the circulation of animals and plants."

Societies and Academies

LONDON

Royal Society, February 21. F. W. ASTON: The isotopic constitution and atomic weights of hafnium, thorium, rhodium, titanium, zirconium, calcium, gallium, silver, carbon, nickel, cadmium, iron and indium. Mass-spectrograph analyses both by anode rays and the ordinary discharge have been made of thirteen elements. Rays from some twenty new isotopes were discovered in all. The atomic weights estimated by the photometrical measurements of abundance are generally in good accord with the accepted ones. In the case of cadmium, success was attained in an unexpected manner and interesting observations were made on the behaviour of metallic methyls in the discharge. Work on the isotopic constitution of elements is now fairly complete. All but four, palladium, iridium, platinum and gold, have given positive results of some sort. Some 247 stable isotopes are known and one of the most astonishing facts revealed is the occurrence of a stable elementary atom for practically every natural number up to 210. J. M. STAGG: The diurnal variation of magnetic disturbances in high latitudes. For some years it has been known that irregular, short-period perturbations ('disturbances') in the earth's magnetic field at a few isolated localities have a daily variation in their time of incidence, but it was not known whether the variation is governed by local or universal time or how it is affected by magnetic latitude. Using the records from ten magnetic observatories in both hemispheres, it has been established that short-period irregular disturbance is controlled by local time up to the magnetic axis pole. Below magnetic latitude 70°, the variation in disturbance has a dominant single maximum in the late evening throughout the year; above 80° its phase is reversed and the transition from summer to winter conditions involves radical change both of type and scale. In the intermediate zone the incidence of disturbance varies also with season and with the state of general disturbance, both forenoon and evening maxima being conspicuous.

PARIS

Academy of Sciences, January 14 (*C.R.*, 200, 77–268). JULIEN COSTANTIN: The practical consequences of the germination of potato seeds in the mountains. The art of raising potatoes from seed requires a special technique which is not generally known. This is of importance in connexion with the production of strains of potatoes capable of resisting disease, and details are given. HENRI VALLÉE was elected *Correspondant* for the Section of Rural Economy. I. VINOGRADOV: A new variant of the demonstration of Waring's theorem. TIBÈRE POPOVICIU: Remarks on the algebraic equations the derived equations of which have all their roots real. PAUL DUBREIL: An ideal attached to a skew algebraical curve defined by its monoidal representation. SIMON STOÏLOW: The topological characterisation of Riemann surfaces. GEORGES TZITZÉICA: Certain networks. JEAN LOUIS DESTOUCHES: A new conception of physical space. B. GAMBIER: Quadrics with one parameter touching their envelope along two conics. ST. GOLAB: The measurement of areas in Finsler spaces. FLORIN VASILESCO: The method of *balayage* of Poincaré extended by M. de La Vallée Poussin, and its relations with the generalised problem of Dirichlet. ROBERT MEYNIEUX: The continuous functions of a real variable which possess a theorem of algebraic addition. G. DEDEBANT, PH. WEHRLÉ and PH. SCHERESCHEWSKY: The maximum of probability in permanent movements. Application to turbulence. ALBERT TOUSSAINT: Contribution to the study of infinite multiplanes in a plane current. JULIEN KRAVTCHENKO: Theorems of validity in problems of wakes. MME. MARIE LOUISE DUBREIL-JACOTIN: The theorems of existence relating to permanent periodic waves in two dimensions in heterogeneous liquids. PIERRE CHEVENARD: A micromachine with photographic registration for the mechanical testing of metals. This machine utilises test-pieces of 1–1·5 mm. diameter only, an advantage when dealing with costly alloys. An outline of the possible applications of the machine is given. GEORGES MANEFF: The effects of the theory of relativity. JEAN DUFAY and MLLE. M. BLOCH: Rapid changes in the spectrum of Nova Herculis. Absorption bands attributed to cyanogen. Discussion of observations made at the Lyons Observatory. The rapid changes noted about December 25 and 27 appear to be due to a large cyanogen absorption band, the head of which is at 4216 A. This appears to be the first time cyanogen bands have appeared in a Nova. BERNARD LYOT: The spectrum of the solar corona in 1934. Eleven diagrams are given showing the intensities of the green line observed in 1934. PAUL BERNARD: The absence of hysteresis in piezo-electric phenomena. An experimental study of the effect of the rate of increasing or decreasing the pressure on the quartz on the quantities of electricity set free. No such effect could be measured and hence there is no hysteresis. L. G. STOKVIS: The geometric loci of the neutral point of a triphase system. PIERRE JACQUET: The adsorption of certain colloids by metallic surfaces and its influence on the structure of electrolytic deposits. ANDRÉ ARON: The magnetic properties of thin sheets of nickel. Study of semi-transparent nickel films deposited in hydrogen or in nitrogen, with special reference to the effect of temperature on the Curie points. ADOLFO WILLIAMS: The persistence of intercombination lines [of the spectrum]. PAUL MONDAIN-MONVAL and ROGER WELLARD: The influence of temperature on the explosion of mixtures of air and hydrocarbons. Experiments bearing on the causes of knocking in internal combustion motors: the results support the peroxide theory. PIERRE MONTAGNE: The calculation and graphical representation of the elementary displacements in reactions of homogeneous chemical equilibria. Variations of temperature and pressure. JEAN PERREU: The calorimetry of saline solutions: system sodium sulphate, magnesium sulphate, water. LOUIS DOMANGE: The action of steam on copper fluoride. ALEXIS TCHITCHIBABINE and MICHAEL BESTOUGEFF: The action of ethylene oxide on hydrogen sulphide. The primary reaction product is thioethylene glycol, $HO.CH_2.CH_2.SH$, but if the temperature is allowed to rise, further condensation takes place, one of the products being a strong base, triethylolsulphinium hydroxide. JEAN TABUTEAU: The oxidation of carvomenthene by selenious anhydride. The synthesis of carvotanacetol. EDMOND SAURIN: Some deposits of tectites of southern Indo-China. NORBERT CASTERET: The deepest known penetrable hydrogeological opening, the Martel abyss (Ariège). EMMANUEL DE MARTONNE: Areism and the movements of the soil in the Argentine plains. MARCEL MASCRÉ and MLLE. ALICE ROLLEN: The influence

of tensio-negativity on the structure of the plant cell. ALBERT MAIGE: The variations of plastidal imbibition during chloroplastogenesis, amylogenesis and amylolysis. J. MAGROU: The immunity reactions of plants towards *Bacterium tumefaciens*. MLLE. JEANNE LEVY, MLLE. DENYSE KOHLER and L. JUSTIN-BESANÇON: The relations between the constitution of some aminoether oxides and their pharmacodynamical actions. MLLE. MARIE LOUISE VERRIER: The comparative morphology of the visual cells and the theory of duality of vision. ALBERT VANDEL: The crossing of geographical races of *Trichoniscus* (*Spiloniscus*) *provisorius* giving an exclusively male descent. W. KOPACZEWSKI: The jellying of human serum by acids.

LENINGRAD

Academy of Sciences (*C.R.*, 4, No. 5–6). I. VINOGRADOV: A new evaluation of $G(n)$ in Waring's problem. A. GORGIDZE: A method of successive approximations as applied to a problem of the theory of elasticity. A. POPOV: Some applications of the simplest discontinuous functions. I. ASTAPOVITCH: New determination of the mean heliocentric velocity of meteors by means of the diurnal variation method. J. SEKEZH-ZENKOVITCH: The problem of a discontinuous movement of a liquid around a circle. B. GALERKIN: Contribution to the theory of an elastic cylindrical shell. E. GAPON and D. IWANENKO: Alpha-particles in light nuclei. N. NYBERG: The possibility of approximate spectrophotometry without obtaining a spectrum. N. ORLOV: A new synthesis of the hydrocarbons of the C_nH_{2n+2} series. The proposed synthesis of saturated aliphatic hydrocarbons differs from all those previously described by the complete hydrogenation of the furane derivatives. I. NAZAROV: The action of metallic sodium on fatty ketones (3). The reaction between metallic sodium and isobutyrone. A. PETROV and L. ANCUS: Low temperature hydrogenation and polymerisation of acetylene in the presence of nickel catalysts. Liquid products of hydrogenation and polymerisation of acetylene were obtained both at atmospheric pressure and temperature of 180°–200° C., and at increased pressure (up to 25 atmospheres) and temperatures not above 40° C. V. TCHELINTSEFF: Acid oxygenetic organic compounds. L. NIKITIN: On some acoustic electrochemical phenomena. V. KARASIK and M. LIKHATCHEV: The relation between the chemical nature and biological activity of dihydroxide of methyldiphenylarsine and its derivatives. V. SOLOVJEV: Hydromodulus of the spring wheat, *T. durum*, in the Transvolga hills. A. POTAPOV: Tyrosinase of tea leaves, and its probable rôle in tea manufacture. G. MOLOTKOVKIJ: Determination of the coefficient of ventilation in leaves. The coefficient of ventilation is the volume of air, in cubic millimetres, passing through one stoma in a second. A method for its determination is described. I. KOLOMIEC: Scheduling the dates of watering and drought in accordance with the stages of plant growth as a means of controlling the yield. A. VACENKO: Inheritance of glume pubescence and of the black colour of the ear in *T. durum*. A. SVETOVIDOV: Geographical variability of *Coregonus lavaretus pidschian*. V. ARGAMAKOVA: Some Ophiuræ from the east coast of Sakhalin. *Ophiocten miocaenicum*, another *Ophiocten* species and *Amphiophiura aenigma* are described from Miocene deposits of the Island of Sakhalin.

SYDNEY

Royal Society of New South Wales, November 7. J. C. EARL and H. M. PARKIN: The fastness of certain aminoazo dyes to washing. Aminoazobenzene and its *N*-methyl, *NN*-dimethyl, *N*-benzyl and *NN*-methyl benzyl derivatives were studied comparatively as regards the fastness to washing of dyeings on wool made with them under exactly similar conditions. The *p*-sulphonic acids of the last four of the above compounds were also compared. In both series the *NN*-methyl benzyl derivatives were very much faster to washing than the other dyes. F. P. DWYER and D. P. MELLOR: Compounds of palladium with benzildioxime. An investigation of the compounds of palladium with the isomeric forms of benzildioxime has shown that palladium is strictly analogous to nickel, in that one molecule of the metal is co-ordinated with two molecules of α (anti)-benzildioxime and with one molecule of γ (amphi)-benzildioxime. However, unlike all the common metals and the other metals of the platinum group, palladium gives an insoluble compound Pd $(C_{14}H_{10}N_2O_2)$ with β (syn)-benzildioxime. J. G. CHURCHWARD: Note on the occurrence in New South Wales of black chaff of wheat caused by *Bacterium translucens*, var. *undulosum*, S.J. and R. Infected stems, leaves, chaff and grain of commercial and other varieties were found in several wheat-growing districts in New South Wales. Work at the University of Sydney would suggest that the disease is widespread and has been present in New South Wales, unrecognised, for a number of years. The extent of the losses caused by it are not yet known. A number of the most popular varieties of wheat in New South Wales are susceptible. C. C. TOWLE: An inquiry concerning a certain conventionalised type found along the coast of New South Wales. Of the flaked stone implements found, the conventionalised types are essentially asymmetrical in form, and various interpretations have been given concerning the uses to which they were put by the aborigines. Systematic inquiry shows that the most probable reason for the asymmetrical form of the implements was the highly refractory nature of the material available for flaking. For several reasons, the flakes of this form produced the most satisfactory implements. The conventionalised implements dealt with in the paper have been classified as scrapers, and they have been correlated with some of the conventionalised scrapers from the far western areas of New South Wales. The implements from those parts where a tractable material was available are more symmetrical in form. M. B. WELCH: The moisture equilibrium of timber in different parts of New South Wales. (2) Murwillumbah. During the period October 1930–October 1932, a moisture equilibrium investigation was conducted at Murwillumbah, New South Wales. It has been found that in general the atmospheric humidity conditions are higher than at Sydney, and the mean moisture content of ten different timbers kept indoors over the period was 13·2 per cent, whereas similar timber under the same conditions at Sydney showed a mean of 12·0 per cent. Periods of very high humidity were found to occur during which the mean monthly moisture content for timbers such as tallowwood and blackbutt was in the vicinity of 16 per cent and Queensland maple exceeded 17 per cent. During such periods, satisfactory air seasoning of timber for the Sydney market does not appear to be practicable.

Forthcoming Events

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

Monday, March 4

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Dr. Susan Finnegan: "Arachnids Injurious to Man".*

UNIVERSITY OF CAMBRIDGE, at 5.—Sir Daniel Hall: "The Pace of Progress" (Rede Lecture).*

UNIVERSITY OF LEEDS, at 5.15.—Prof. F. A. E. Crew: "Biology and Human Affairs".*

KING'S COLLEGE, LONDON, at 5.30.—Prof. J. S. Lee: "The Geology of China considered in Relation to Secular Movements" (succeeding lecture on March 11).*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Prof. E. P. Stebbing: "The Encroaching Sahara".

Wednesday, March 6

ROYAL SOCIETY OF ARTS.—Sir Henry Richards: "The Problem of Noise".

SOCIETY OF PUBLIC ANALYSTS, at 8.—(at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1).—Annual General Meeting.

Dr. Bernard Dyer: An Address giving Reminiscences of the Society and some of its Prominent Members.

BRITISH SCIENCE GUILD AND ROYAL INSTITUTION, at 9.—(at the Royal Institution).—Sir Frederick Keeble: "The Fertility of the Earth". (Research and Development Lecture.)

Thursday, March 7

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Sir Arthur Eddington: "Time and Entropy".*

Friday, March 8

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. A. Michels: "Some Results of High Pressure Measurements in Gaseous and Liquid Systems" (succeeding lecture on March 15).*

ROYAL INSTITUTION, at 9.—Sir John Russell: "The Future of British Agriculture".

SOCIETY OF CHEMICAL INDUSTRY, March 8.—Conference on Meat to be held at the University of Liverpool.
3–5. "The Chemistry of Meat".
6–7.30. "Meat Storage".

INSTITUTE OF METALS, March 6–7. Annual General Meeting to be held at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

Official Publications Received

GREAT BRITAIN AND IRELAND

University of London Institute of Education. Studies and Reports, No. 4: The Yao Tribe, their Culture and Education, by Benno Heckel; Arts and Crafts in the Training of Bemba Youth, by Griffith Quick. Being Reports presented to the Department of Colonial Education in the Institute. Pp. 53. (London: Oxford University Press.) 2*s.* net.

University of Leeds. Thirtieth Report, 1933–34. Pp. 162. Publications and Abstracts of Theses by Members of the University during Sessions 1933–34. Pp. 34. (Leeds.)

Empire Cotton Growing Corporation. A Review of the Work of the Experiment Stations, Season 1933–34. By Dr. J. C. Willis. Pp. 38. (London: Empire Cotton Growing Corporation.) 1*s.* 6*d.*

The British Electrical and Allied Industries Research Association (Incorporated). Fourteenth Annual Report, October 1, 1933, to September 30, 1934. Pp. 131. (London.)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 2, No. 12: The Genus *Pityx*, Witham, emend. By Prof. W. T. Gordon. Pp. 279–311+8 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 7*s.*

The National Institute of Agricultural Botany. Fifteenth Report and Accounts, 1933–34. Pp. 23. (Cambridge.)

Quinine Manufacture in India. By George Elliott Shaw. (Seventeenth Streatfeild Memorial Lecture, 1934.) Pp. 16. (London: Institute of Chemistry.)

OTHER COUNTRIES

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. No. 59: Contribution à l'étude de *Pinakodendron Ohmanni* Weiss. Par Dr. A. Rousseau. Pp. 32+4 plates. No. 60: Beitrag zur Kenntnis der Rhizopoden, morphologische und systematische Untersuchungen und ein Klassifikationsversuch. Von Dr. Henri De Saedeleer. Pp. 112+8 plates. No. 61: Les Brachiopodes du Dinantien de la Belgique. Par F. Demanet. Pp. 116+10 plates. No. 62: Recherches sur les parasites des mollusques terrestres de Belgique—Trématodes larvaires. Par W. Adam et E. Leloup. Pp. 40. Memoires, Hors série. Résultats scientifiques du Voyage aux Indes orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Publiés par V. Van Straelen. Vol. 2, Fasc. 14: Opisthobranches et Silicodermés (Oncidiades), par A. Labbé; Prosobranches parasites, par W. Adam. Pp. 115+1 plate. Vol. 2, Fasc. 15: Sponges. By H. V. Bröndsted. Pp. 27. Vol. 2, Fasc. 16: Cephalopoda. By W. Adam. Pp. 28. Vol. 4, Fasc. 10: Diptera II: i. Cyclorrhapha: Muscidæ, Calliphoridæ and Tachinidæ, by J. R. Malloch; ii. Syrphidæ, par A. von Stackelberg; Hymenoptera II; i. Chrysididæ, di F. Invrea. Pp. 34. (Bruxelles.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 35, Part 4: Proposition of T.N.N. Equations in the Kinetics of Enzymes. By Kenzo Nakajima and Torahachi Kamada. Pp. 151–291. Vol. 37, Part 2: Studies on the Dwarf Disease of Rice Plant. By Teikichi Fukushi. Pp. 41–164+6 plates. (Tokyo: Maruzen Co., Ltd.)

Kungl. Svenska Vetenskapsakademiens Handlingar. Serie 3, Band 13, No. 7: Some Statistical Investigations of Eclipsing Binaries. By Erik Holmberg. Pp. 25. Serie 3, Band 14, No. 1: Das Wachstum der Körperlänge des Menschen. Von Gaston Backman. Pp. 145. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.)

Meddelanden från Statens Skogsförsöksanstalt, Häfte 28, Nr. 1: Redogörelse för Barkborrekampanjen efter Stormhärjningarna 1931–1932: Bericht über die Bekämpfungsaktion gegen Borkenkäfer nach den Sturmverheerungen 1931–1932. Av Ivar Trägårdh och Viktor Butovitsch. Pp. 258. (Stockholm.)

Indian Lac Research Institute. Annual Report for the Year 1st April 1933 to 31st March 1934. Pp. 35+4 plates. (Nankum.)

Smithsonian Miscellaneous Collections. Vol. 92, No. 9: The Skeletal Musculature of the Blue Crab, *Callinectes sapidus* Rathbun. By Doris M. Cochran. (Publication 3282.) Pp. 76. Vol. 93, No. 4: Pioneer Wind Tunnels. By N. H. Randers-Pehrson. (Publication 3294.) Pp. 20+4 plates. (Washington, D.C.: Smithsonian Institution.

The Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1933, together with the Twenty-seventh Annual Report of the Central Committee of the Association for the Year ending 31st March 1934. Pp. 78. (Coonoor.)

Borough of Durban: Durban Museum and Art Gallery. Annual Report for the Year ended 31st July 1934. Pp. 12+4 plates. (Durban.)

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