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The Future of British Agriculture

AT a time like the present, when radical changes are taking place or being contemplated in our national economy, when countries like Great Britain, Holland and Denmark are abandoning the policy of Free Trade and venturing on the thorny paths of Protection and national self-sufficiency, efforts to discern the future acquire an interest and importance that far outweigh the vaticinations of those who don the prophet's mantle in more settled and humdrum times. History, we know, is replete with the misjudgments and miscalculations of statesmen and politicians who, besides having to deal with the incalculable in human nature, have also been handicapped by lack of scientific training and outlook; and the question is now frequently asked whether men trained in the methods and content of science could not do better? So far, they have seldom been called upon to act, or even to advise, in the affairs of State; and it is not certain that, had they been asked, they would have been more successful than their contemporary statesmen, trained in the law, the humanities or in business. Are the views of scientifically trained men on political, economic, social, religious and philosophical questions more far-sighted, more reasoned and less biased by traditional beliefs and emotional prejudices than those of others?

We believe that a general vote on this question would result in a decided 'No': and the main reasons for the answer would be that the scientific mind, like the artistic, generally runs in grooves, and the methods that are applied so fruitfully in the positive sciences are either not applied, or if used are misapplied, in those spheres which to a large and regrettable extent are still dominated by instinct and desire rather than by reason and the public good. Although the doctrine that mental ability acquired in one sphere is not transferable to another unless the subject matter is correlated, seems to apply here, a case can be made out that scientific habits of mind, such as initial doubt, careful testing of fundamental assumptions and evaluation of evidence, do come within the category of transferable qualities. If this is so, it affords an additional reason why those engaged in scientific pursuits should seek to pull their weight in the social boat by using their talents in trying to solve some of the pressing social and economic questions that now await solution.

Prediction, based upon generalised knowledge of natural facts, is one of the major, and perhaps the most useful of the functions of science: we know how well it succeeds in the strictly mathematical sciences and in certain applied sciences like astronomy and engineering, but in agriculture, which is a congeries of applied sciences still largely dominated by tradition and empiricism, prediction is far more difficult; there are so many variables; the weather and the human factor between them upset many a calculation. Some measure of sympathy must therefore be extended to Sir John Russell, who, in his recent discourse at the Royal Institution on the future of British agriculture, set himself a very difficult task. Many eminent persons, he remarked, had lost their well-earned reputations by dabbling in the future, but in these critical times, one had to take risks; and the safer method was to base one's predictions on present trends and movements.

Among the unchanging elements in our agricultural economy, Sir John Russell mentioned the present regional distribution of crops, which is determined largely by climate and soil; it is,

however, an interesting fact that all our crops, excepting sugar-beet, hops and lucerne, are grown in every county, and it seems to us quite possible that efficiency in production and distribution might be increased by introducing some measure of rationalisation. According to free-trade principles, each country should grow what it is best fitted to grow, and exchange its excess for foreign products which it wants. Might not the same principle be applied to regions within a country? And is it not time to contemplate the subdivision of the country into regions that would take the place of the counties, many of which are very small and some minute, and in this way save expenditure on administration? We may yet live to see established a modern form of the old Anglo-Saxon heptarchy.

The sturdy, independent and strongly individualistic character of the English farmer will, Sir John suggested, remain as a bulwark against collectivist tendencies in the population, and that is to the good, because State supervision failed during the late War: it failed in France in the Revolution, and it is proving a failure in Russia now. Further, the English countryman's attachment to animals (however fond he may be of killing them!) will ensure that the production of animals and milk will continue to form the major part of his occupation; he is also likely to retain his love of craftsmanship and his dislike of mass production methods. Thanks to the development of agricultural education, there is arising a generation of farmers who are keener, more alert and more anxious to make the best of their farms than were their predecessors.

Implied in Sir John Russell's prognostications is the improbability of any really fundamental changes taking place in our political and economic structure. Our present individual farming, he holds, will persist, and continue to be of the small capitalist type that now occupies about one half of our farm-holdings with an area varying from 100 to 300 acres. There is, however, a prominent school of agricultural thought, of which Mr. C. S. Orwin, of the University of Oxford, is an able exponent, which believes that nationalisation of the land will follow as a direct consequence of our present parlous agricultural conditions. The old partnership relations of landlord and tenant have disappeared; the landlord has lost most of his capital and can no longer undertake the duties which that partnership imposed upon him. The land is crying out for fresh capital—for drainage, water supplies, farm equipment and housing—and if the changes which this school sees coming are brought about, namely, an increase in family-farms on one hand, and in large-scale, mechanised and specialised farms on the other, the call for new capital will be greater than ever. As an economic necessity, the State must take over the land, provide the necessary capital, but not necessarily control the farming practice.

It is not always realised that the vast majority of the world's farming is done by the peasant class—small men with little or no capital, whose standard of living is low compared with that of industrial workers, who are gluttons for work, and to whom agriculture is a mode of life rather than a money-making occupation. Although this type of farming cannot as a rule compare in economy and efficiency with the large-scale mechanised type, nevertheless it is encouraged by practically all Governments, because it represents an element of stability in the State: family-farmers are self-supporting in times of depression and they constitute a reserve of man-power in time of war. Even highly industrialised nations like Great Britain have been constrained to encourage this type, though not always with success. In this connexion, Sir John Russell points out that the main difficulties are concerned with marketing and leadership, and he does not believe that we should succeed in establishing co-operative colonies of smallholders on the highly successful lines of Denmark; he envisages rather a type of land settlement, self-contained and self-supporting, in which living, not selling, is the leitmotiv, each unit producing what it can and bartering its excess for commodities it does not produce. Some experiments of this kind are being made in England; they have been successful in French Canada, in other parts of the British Empire, and in the United States, but in nearly every case the settlers have been drawn together and united by a spiritual bond, such as the Church.

The factory type of farming, which is based on mechanisation of agricultural operations and specialisation in the growing of only one or two crops, is obviously the more economical in man and horse labour, but is not of such general application. Sir John Russell stated that the ordinary system of English farming requires 25–30 permanent employees per square mile, whereas on a highly mechanised farm in Saskatchewan one man per square mile suffices. The case for the development of factory farms and of

small holdings has been ably expounded by Mr. C. S. Orwin in his book on "The Future of Farming" (Oxford University Press, 1930), but his conclusions appear to be in direct opposition to Sir John Russell's prediction that the medium-sized farm owned by the small capitalist will continue to prevail in Great Britain.

If it cannot be admitted that British agriculture has grown and developed continuously from very early times, progress was catalysed by the coming of the industrial era and the fear of starvation during the Napoleonic wars. The growing of turnips, clover and rotation grasses, which did not become general until more than a hundred years after the idea had been introduced from Flanders; the improvements in livestock due to Bakewell, the brothers Colling, Thomas Bates and others; and later the use of artificial fertilisers and the breeding of new varieties and strains of economic plants, have all contributed their quotas to the great increases in production that were rendered necessary by tremendous growth in population. As in industry, the problem of production seems very largely to have been solved; the most urgent problems now are those of distribution and quality of product.

In Great Britain, however, the problem of increased production is still with us, for owing to our greatly reduced income from the export of goods and services and investments overseas, not to mention possible international complications, expert opinion is now generally agreed that we must grow more food at home. Sir John Russell agrees that our present output of 36–40 per cent of the nation's food supply is too low, and he asks for an impartial inquiry to be conducted by technical and business experts, and representatives of the Ministry of Agriculture, the Foreign, Colonial and Dominions Offices, who would advise where the line should be drawn. A question embodying this timely suggestion was asked in the House of Commons on July 15, when the Minister of Agriculture replied that it was not acceptable, but the Government was fully alive to the question of domestic production of food in relation both to the interests of agriculture and to the general economy of the country. It would appear that the Prime Minister and the Cabinet are not enamoured of deliberate long-term planning; their agricultural quiver seems to be fully charged with the intricate and delicate problems associated with the working of the various marketing boards, which were launched with the entirely praiseworthy object of securing an economic return to the producer. In Sir John Russell's view, the ordered development of British agriculture involves deciding how much should be produced at home; and he favours the contract system, with obligations on both sides, including the social obligation of paying a living wage to the workers. That system works well for milk, sugar-beet and bacon, but it is not applicable to produce like beef, mutton, potatoes, eggs, which are handled by a multitude of small distributors. The problem of distribution, it is generally conceded, is of outstanding importance, and no Government that does not tackle it resolutely and impartially is worthy of our support.

The history of British agriculture shows that although men of enlightenment have seldom been lacking, progress has usually been extremely slow, owing to the crusted conservatism of the farming population. In the last hundred years, science has done wonders in giving the farmer the means to increase production, but although he has used them to some extent, the potentialities, especially of fertilisers and of scientific breeding, still remain very great. In the past, the greatest spur to progress has always been economic necessity, and as this is now again in the ascendant, it seems probable that, at any rate in the near future, changes in our economic system generally are likely to play a greater part than the application of new scientific discoveries. When we reflect that about one quarter of our population is living to-day on or under the border-line of poverty, that the average income of 75 per cent of our insured workers is £3 a week or less, and that about 70 per cent of those who died in 1933–34 left no more than £100, or less, we cannot be surprised at the economic unrest that obtains in so many quarters. Until some solution or amelioration of the problem of the existence of poverty amidst plenty is forthcoming, substantial national progress seems out of the question.

The Chancellor of the Exchequer may derive satisfaction from the statement that "we" have recovered 80 per cent of our prosperity, and that "we meet in an atmosphere of such happiness and contentment as has not been seen since the War" (as he told the bankers in a recent post-prandial speech), but such assertions do not help the cause of social peace and development; rather do they, by substituting illusion and self-satisfaction for ascertainable fact and self-suppression, reflect an attitude of mind which is the negation of the realistic spirit of all true science.

The Oldest European Civilisation

The Palace of Minos:
a Comparative Account of the Successive Stages of the Early Cretan Civilization as illustrated by the Discoveries of Knossos. By Sir Arthur Evans. Vol. 4, Part 1: Emergence of Outer Western Enceinte, with New Illustrations, Artistic and Religious, of the Middle Minoan Phase; Chryselephantine 'Lady of Sports', 'Snake Room' and Full Story of the Cult; Late Minoan Ceramic Evolution and 'Palace Style'. Pp. xxxv+378+14 plates. Vol. 4, Part 2: 'Camp-Stool' Fresco—Long-robed Priests and Beneficent Genii; Chryselephantine Boy-God and Ritual Hair-Offering; Intaglio Types, M.M.III–L.M.II; Late Hoards of Sealings; Deposits of Inscribed Tablets and the Palace Stores; Linear Script B and its Mainland Extension; Closing Palatial Phase—'Room of Throne' and Final Catastrophe; with Epilogue on the Discovery of 'Ring of Minos' and 'Temple Tomb'. Pp. xvi+379–1018+22 plates. (London: Macmillan and Co., Ltd., 1935.) 2 parts, £9 9*s*. 0*d*. net.

THE fourth volume, in two parts, of "The Palace of Minos" completes what is the most remarkable account of an archæological site ever published, and it appears just forty years after Sir Arthur Evans began his first exploration at Knossos. The whole work, to use the author's own words, "has some title to be regarded as an Encyclopaedia of Minoan cultural features, of its Art, and of its Religion". These two parts run to 1,069 pages, with 966 figures in the text and 36 plates, and from this comprehensive material a reviewer can only select for comment some of the more remarkable matters here brought to light as illustrative of Minoan religion, art and civilisation.

We begin with the most recent additions to our knowledge of Minoan religion. In a private house adjoining the palace, there was found stored in a large jar a collection of objects belonging to a domestic snake cult. These articles included 'snake-tubes', large cylindrical vessels up which the snakes could climb to drink from little cups attached to the sides of the tubes, and a tripod 'snake table', the upper surface of which is divided into four separate compartments and has in the centre a base for a bowl to contain food for four snakes. Sir Arthur cites numerous parallels from other ages and regions of similar cults of domestic snakes (p. 138 ff.). The ring-snake, *Tropidonotus natrix*, still common on the site of Knossos, is apparently the species which was the special object of Minoan veneration and affection. Besides this, another snake is thought to have had influence of a different kind, its skin supplying a pattern, the 'wave and dot' motive, which is common in Minoan art. This is the cat-snake, *Tarbophis vivax*, which has markings rather like those of the adder. The author traces the spread of this pattern west to Etruria, where the snake was likewise an object of veneration and fear (p. 178 ff.). Like much else in Greek religion, the snake cults associated with Athena, Asklepios, dead heroes and ancestors had their Minoan precursors.

The custom familiar from classical Greece of the ceremonial cutting off of childhood's locks at puberty is another religious usage that is shown to have had a Minoan origin (p. 475 ff.). The exquisite ivory figurine of a boy, now illustrated for the first time, has his hair shorn off over the whole crown and is thought to have worn a skull-cap of thin gold upon his pate. This has led Sir Arthur to revise his view about some plaited locks carved in steatite found in a domestic sanctuary, and he now regards them as simply votive, comparing them with a Thessalian monument representing locks of votive hair.

In the sphere of art, this volume presents us with accounts and illustrations of some of the most admirable works of the Minoans. The ivory figure of the tonsured boy, already mentioned, is one of these; and it is interesting to be able to compare him with the other ivory 'boy-god', discussed by the author in a former volume, but here illustrated anew (p. 468 ff.). Both these little statuettes, typically Minoan as they are, surprise and delight by their astonishing realism. It is because the Minoan had little of the liking for such metrical formalism as appealed to the early Greek artist that these Cretan works of art often seem more akin to the fourth century B.C. than to the age of archaic art. What is perhaps the finest Cretan masterpiece yet discovered—finer even than the famous Boston ivory goddess—appears on the frontispiece of the first of these two volumes. It is the gold and ivory figure of a girl dressed for the Minoan bull-ring. It is now in the Toronto Museum. Sir Arthur Evans calls her "our Lady of Sports", regarding her as the Minoan goddess herself in the dress of one of her protégés, the taureadors of those days. Another work of a very high order is a gold pendant in the form of two bees or hornets symmetrically grouped with a ball and a granulated disc between

them (p. 75). This ornament, dating back to about the twenty-third century B.C., is one of the finest extant examples of the goldsmith's art. For the rest, many charming art miniatures are illustrated among the engraved stones, rings and sealings which are fully discussed in these volumes.

It is, however, the evidence for the high degree of Minoan civilisation that always fills the present generation with admiration and wonder. Earlier volumes have familiarised us with the efficiency of Knossian sanitation, and here we have something more about the well-designed drain-pipes and the carefully made refuse-pits for dumping rubbish. We glean in passing that Minoans may have held cattle-shows, that they were meticulous in their business methods, that the palace magazines could store as much as 16,800 gallons of oil. They used camp-stools, their women were lavish in the employment of 'make-up', and as early as the fifteenth century before our era they were wearing gloves. Towards the end of the volume, there is a full account of Minoan script, for which the Oxford University Press has now a fount. Numerals can be read, the gist of some of the writings can be grasped; but until a bilingual text turns up we cannot read the language that Minos spoke.

How did this great civilisation come to an end? It has usually been held that a piratical raid, perhaps of 'Achæans' from the Greek mainland, destroyed the Cretan palaces with fire and sword. Sir Arthur Evans puts forward the suggestion that an earthquake, more serious than many that had occurred before on this shock-ridden site, shattered the palace, which was partly gutted, and that the Minoan dynasty removed the seat of Government to some healthier spot. There was, at any rate, a persistent tradition in classical times that Minos met his end in Sicily (p. 959 ff.).

The oldest civilisation in Europe is set before us in a strangely vivid fashion by the author's discoveries. This work is literally 'epoch-making', because Sir Arthur has supplied the epochs for European prehistory; but he has done more, because he has made the Minoan Cretans live for us. He has pictured a race bound to sacerdotalism and haunted by the supernatural, a people whose art like their culture was sometimes superficial. Yet they prepared the way for the civilisation of the Greeks and consequently for our own. We can look back and say that poetry, history, philosophy and science might not have arisen in the world but for those early and successful attempts of the Minoans to build an ordered and civilised society. C. T. S.

Vibration in Engineering

(1) Practical Solution of Torsional Vibration Problems:
with Examples from Marine, Electrical and Automobile Engineering Practice. By W. Ker Wilson. Pp. xviii+438. (London: Chapman and Hall, Ltd., 1935.) 25*s*. net.

(2) Torsional Vibration:
Elementary Theory and Design Calculations. By W. A. Tuplin. Pp. xviii+320. (London: Chapman and Hall, Ltd., 1934.) 21*s*. net.

(3) The Theory of Vibrations for Engineers:
an Intermediate Course. By E. B. Cole. Pp. x+263. (London: Crosby Lockwood and Son, Ltd., 1935.) 15*s*. net.

THE theory of vibrations has in recent years become of dominating importance in engineering. It is well known, for example, that vibrations in heavy machinery may be of a destructive nature, causing failures in the machines themselves and having damaging effects upon surrounding structures. The growing importance of the subject is leading to a considerable output of research but, although a number of books have been published in other countries, especially Germany, there has been until now no reasonably complete exposition in English of the more recent work on the torsional vibrations of shafts.

(1 and 2) Mr. Ker Wilson and Mr. Tuplin have each devoted a complete book to this important division of the subject of vibrations, and have discussed the applications of the theory to the design of multi-cylinder engines. Mr. Wilson, in a book of more than 400 pages, has been able to give a very thorough account, with numerous practical examples, many drawn from marine engine design. He also devotes a great deal of space to the theory and design of damping devices and to instruments for the measurement of vibration amplitudes. His work should prove of great service to many practising engineers.

Mr. Tuplin's treatise includes very full details of practical methods as well as much general theory. His book is shorter than Mr. Wilson's but, in the space at his disposal, he has included a surprisingly large amount of

material without giving any impression of crowding or undue abbreviation. Except that he does not discuss measuring devices, he deals with nearly all the subject matter of the larger book and he includes a number of fully worked practical examples. Many of his methods differ from Mr. Wilson's, and the two books should be regarded as mutually complementary rather than as alternatives.

(3) Mr. Cole's book is of a different nature, being an introductory textbook on the general theory of those parts of the subject of vibrations that are important to engineers. The theories of free vibrations, with and without damping, and of forced vibrations are first dealt with. Engine vibrations, the elimination of vibration, the transverse vibrations of beams, and the whirling of shafts are then briefly discussed. The exposition is throughout very clear and is helped by a large number of excellent figures. Examples for practice are added at the ends of the principal sections, the answers being given. All engineering students with any mathematical ability would profit by using this book as a supplement to the chapters on vibrations in their textbooks of strength of materials and theory of machines, and many mature engineers might find it of value as an introduction to more specialised treatises and original papers.

The Reptiles of China

The Reptiles of China:
Turtles, Crocodilians, Snakes, Lizards. By Clifford H. Pope. (Central Asiatic Expeditions: Natural History of Central Asia, Vol. 10.) Pp. lii+604 +27 plates. (New York: American Museum of Natural History and G. P. Putnam's Sons; London: G. P. Putnam's Sons, 1935.) 10 dollars.

MR. POPE'S "Reptiles of China" is the outcome of some fourteen years of continuous study. Four of these were spent in the field collecting and observing, the remainder in a more detailed study of his material in New York, and a comparison of it with the collections already existing in the other great museums of the world. No complete survey of this large area has been attempted before, and herpetologists will be grateful to Mr. Pope for having collected, examined and arranged the mass of material and literature relating to the subject which is now available.

The area dealt with is China south of a line connecting the northern extremity of the Gulf of Liaotung with the northernmost point of Kansu Province. This, although the author does not say so, is, roughly speaking, China south of the Great Wall, together with the eastern part of Tibet; the Island of Hainan is included but not Formosa. The bulk of the volume, pp. 19–453, is given up to the account of the Chelonians (22 species), the Crocodilians (1 species) and Snakes (130 species and subspecies); while the Lizards (65 species, pp. 457–487) are condensed into an annotated check list, with keys for their identification.

The descriptions, although short, are generally sufficient for their purpose. For the first time in any large textbook, we have details of the sexual variation in snakes and of their penial characters. That the latter have considerable specific value cannot now be doubted, although their full taxonomic importance can only be assessed when we have a wider knowledge of them. Habits also, in so far as they are known, are fully recorded. The field-naturalist will welcome these, but to the museum worker they have also a value, although at present he is inclined to ignore them. The mental 'make-up' of reptiles, as shown by their mode of life, has scarcely yet been studied, but it is evident that certain habits are confined to certain groups and, in their way, are as distinctive of the group as morphological characters. When they can be properly interpreted and correlated, they will have a significance which the taxonomist cannot afford to ignore.

On the other hand, the descriptions as regards external morphological characters, particularly those relating to the generic diagnoses, appear sometimes too brief. This is a pity, for a work of this magnitude, although intended primarily as a means of identifying the species, would have been so much more valuable had it included also that general anatomy which forms the basis of our classification and upon which the identifications depend. Without a knowledge of the generic characters also, it will be difficult sometimes to place a species new to science, or one new to the country and not mentioned in the work.

The volume is well illustrated; most of the text figures are new. There is a map, and a list of localities where collections have been made; these are all properly fixed as regards their geographical positions, a very necessary procedure for a region that is so little known. The bibliography includes all the available literature up to 1934. Mr. Pope has spared no pains to make his work as complete as possible; he is to be heartily congratulated on the result. M. A. S.

A Manual of the Principles of Meteorology

By R. Mountford Deeley. Pp. xi+285+4 plates. (London: Charles Griffin and Co., Ltd., 1935.) 15*s*. net.

THIS is not a manual so much as a criticism of the present science of meteorology. The author points out that the distribution of temperature in the lowest six miles or so of the atmosphere—the troposphere—does not fit the pressure distribution, the lowest pressures occurring in high latitudes where the air is coldest. Differences of pressure on the earth's surface must therefore be caused by differences of temperature at high levels in the stratosphere, which is relatively warm in high latitudes and over barometric depressions, and relatively cold in low latitudes and over anticyclones. His thesis is that this high-level heating is caused by corpuscular radiation from the sun; the main stream of corpuscles is directed by the earth's magnetism into two sub-polar rings which therefore form belts of low pressure, while local barometric depressions originate from stray streams of corpuscles.

The main support for this theory is found in a series of diagrams comparing the mean daily pressures and ranges of pressure over the North Atlantic with daily sunspot numbers, which show some general resemblances (and also many discrepancies), but the author also considers that variations of corpuscular radiation explain the great climatic changes of geological time.

The style is discursive and often obscure, while there are many small errors and some serious omissions. For example, there is only the barest reference to the Bjerknes theory of cyclones and no mention at all of the 'polar front' or of Simpson's well-known theory of the part played by variations of solar radiation in climatic changes. The get-up is good on the whole, but the isothermal maps are poor.

Leçons de zoologie: Annélides

Par Prof. M. Prenant. (Actualités scientifiques et industrielles, 196.) Pp. 95. (Paris: Hermann et Cie, 1935.) 16 francs.

THE author has selected his material judiciously so as to give the reader an account of the principal structural and biological features of annelids. Brief descriptions of *Polygordius* and of its trochosphere larva, of *Nereis* as a type of the Polychæta, and of the principal variations in parapodia and in a few other structural features precede the classification and the two pages devoted to the ecology of marine worms. A more summary consideration follows of the Oligochæta, Hirudinea, Myzostomida and Echiurida, the last giving the opportunity for observations on the determination of sex in *Bonellia*. The comparative account of the excretory organs and the chapters on regeneration and asexual reproduction, often with accompanying changes of form, for example, in *Heteronereis*, are of particular interest. The figure of a trochosphere of *Echiurus* showing a segmented mesoderm is incorrectly attributed to Baltzer, who stated that the mesoderm is unsegmented.

Problèmes actuels de l'astrophysique

Par Prof. L. Houllevigue. Pp. xii+268. (Paris: Armand Colin, 1935.) 14 francs.

IN this volume Prof. Houllevigue gives an interesting and chatty account of many of the points at which the astronomer of to-day is touching upon the palpably unknown. It is interesting to see not only the selection of problems made by the author but also the way in which these problems are envisaged by a Frenchman. To take one example of his special point of view, the chief emphasis in his account of recent and coming advances in telescopes is placed upon the Ritchey-Chrétien researches, whereas most people would deal with the 200-inch telescope now being constructed for California. Among the twenty-five subjects chosen, we may mention the Cepheids, the corona, solar radiation, Saturn's rings, celestial 'wanderers', the evolution and expansion of the universe, novæ, interstellar gas, in order to show the range covered by the book.

The treatment is simple and popular, astronomers of many countries are fairly represented in the appropriate sections and the book will be read with very considerable interest, even where the reader does not agree with the author's point of view.

Worlds in the Making

By R. Barnard Way. Pp. 136. (London: The Chatterbox Co., Ltd., 1934.) 3*s*. 6*d*. net.

THE evolution of planets from primordial matter through nebulæ, galaxies and stars is here described in simple language, accompanied by a general description of the universe as it is at present and of the various objects composing it, from electrons to spiral nebulæ. The development of our own earth up to its present physical state and into a possible future one is given in detail, forming the main theme of the second half of the book, which is well illustrated with numerous drawings and diagrams made by the author. Although obviously intended for young people, the presentation of the subject is not too childish to appeal to older readers who require a brief elementary survey of the origin of worlds in general and of our own in particular.

Intermediate Physics

By Dr. C. J. Smith. Second edition. Pp. xii+900. (London: Edward Arnold and Co., 1935.) 16*s*. net.

THE call for a second edition shows that Dr. Smith's book is well appreciated, and it is clear that a great amount of work has been done in its preparation. Amongst the additions and improvements may be noted the theory of dimensions in Part I, a remodelling of a great deal of Part II, an increase in the matter dealing with interference in Part III, a short section on supersonics in Part IV, and an entire rearrangement of Part V. Candidates in university scholarship examinations should now find all the material for answering the papers in physics, and the harder matter is carefully distinguished from that dealing with fundamentals, which latter is adequate for the needs of the intermediate or pass candidate, to whom the book can be highly recommended.

Phosphate in the Western Basin of the North Atlantic*

By H. R. Seiwell, Woods Hole Oceanographic Institution

SINCE various investigators have illustrated the dependence of marine plant growth on certain inorganic substances in the sea[1], a knowledge of the variation and mechanism of the phosphate distribution is significant in questions of marine fertility. Dissolved phosphate investigations have taken a place along with studies of other fundamental properties of sea-water, and lately these results are also being used as identifying properties for the purpose of tracing the origin and courses of water masses in the sea.

Phosphate observations considered here were obtained during the *Atlantis* cruises of 1931 to 1933 in the western basin of the North Atlantic[2]. The investigation of dissolved phosphate in this region is similar to that made in the South Atlantic within recent years by the *Discovery*[3] and the *Meteor*[4]; and in the northern North Atlantic by the *Meteor*[5].

In general, within the area of investigation, vertical distribution of phosphate in the upper part of the water column parallels temperature (and density) distribution; the homogeneous water overlying the principal thermocline being almost exhausted of phosphate. Principal differences in vertical distribution of phosphate are indicated by variation in thickness of the phosphate-poor surface layer, and the variation of depth and value of the maximum phosphate concentration. The maximum horizontal variation of phosphate occurs at mid-depths.

It is convenient to classify the vertical distribution of phosphate phosphorus into three types characterising different parts of the western North Atlantic basin.

1. Convergence type: characterises the region influenced by the principal American coastwise convergence[6] (extending from Florida to Nova Scotia). The phosphate-poor surface layer (0–5 mgm. P per m.^{3}) is not more than 100 metres thick; below this, phosphate increases to a maximum value of about 30 or more mgm. of P per cubic metre at depths of 300–500 metres and then decreases slightly in still deeper water; at 2,000 metres, phosphate content is usually just less than 30 mgm. P per cubic metre.

2. Central Atlantic type: characterises the northern half of the area, east of the American coastwise convergences. The phosphate-poor surface layer (0–5 mgm. P per m.^{3}) overlies the principal thermocline and is generally 300–400 metres thick; below this, phosphate content increases to a maximum value of about 30 (or more) mgm. P per cubic metre at depths of 800–1,000 metres, and then decreases slightly in still deeper water.

3. Tropical Atlantic type: characterises the southern part of the area; the phosphate-poor surface layer (0–5 mgm. P per m.^{3}) is about 100 metres, or less, in thickness, below which phosphate rapidly increases to a well-developed maximum value of 50–60 mgm. per cubic metre at intermediate depths of 600–800 metres, and then decreases in still deeper water; at 2,000 metres, phosphate content is generally in the vicinity of 30 mgm. P per cubic metre.

The vertical distribution of phosphate (Fig. 1) shows that the water column becomes progressively richer in its most stable part (the thermocline), so that considerable resistance is offered to enrichment of the surface layers of the open ocean by the usual agencies which bring about vertical circulation (winter chilling, wind stirring, etc.). It is this condition which has led us hitherto to assume that well-developed discontinuity layers, such as occur in the tropical Atlantic, effectively shut off a supply of phosphate from the rich midstrata to the illuminated surface layers[7].

The phenomenon of turbulence which accompanies all movements of sea water may be a significant factor in transporting phosphate, and other dissolved nutrient substances, from the rich midstrata, up into the illuminated surface layers of the open ocean. Turbulence results from impulses given to the water mass; in the case of a horizontal current, there is an accompanying vertical displacement of water particles which brings about an exchange of properties between different strata. The magnitude of turbulence, or eddy motion, in the sea is expressed by the coefficient of eddy conductivity (having the dimensions of grams per centimetre per second) which appears to lie usually between 1 and 20 C.G.S. units[8].

To make use of the concept of turbulence for the purpose of calculating the amount of phosphate transported vertically from the depth of its maximum concentration up into the illuminated layer of the sea, the phosphate gradient and the average eddy coefficient characterising that part of the

* Contribution No. 77 from the Woods Hole Oceanographic Institution.

water column involved in the transport must be known. The magnitude of the transfer of phosphate by eddy conductivity may be calculated by the following equation :

$$N = \frac{A}{\rho}\frac{dP}{dz},$$

where N represents phosphate (grams) transported per second through a square centimetre of area ; A, the coefficient of eddy conductivity (C.G.S. units) ; ρ, the density of the water ; and dP/dz the average vertical variation of phosphate (grams per cubic centimetre per centimetre). The phosphate gradient can be measured with a fair degree of accuracy, but the average eddy coefficient must be approximated at the present time. The method and arguments used to determine the order of magnitude of eddy conductivity in the western North Atlantic have been previously discussed by me[2], and here it will suffice to state that in that part of the water column involved in the upward transport of phosphate (between depth of phosphate maxima and homogeneous layer) the average eddy coefficient was calculated to range from about 30 C.G.S. units, north of lat. 30° N., to 10 C.G.S. units or less, south of lat. 15° N.

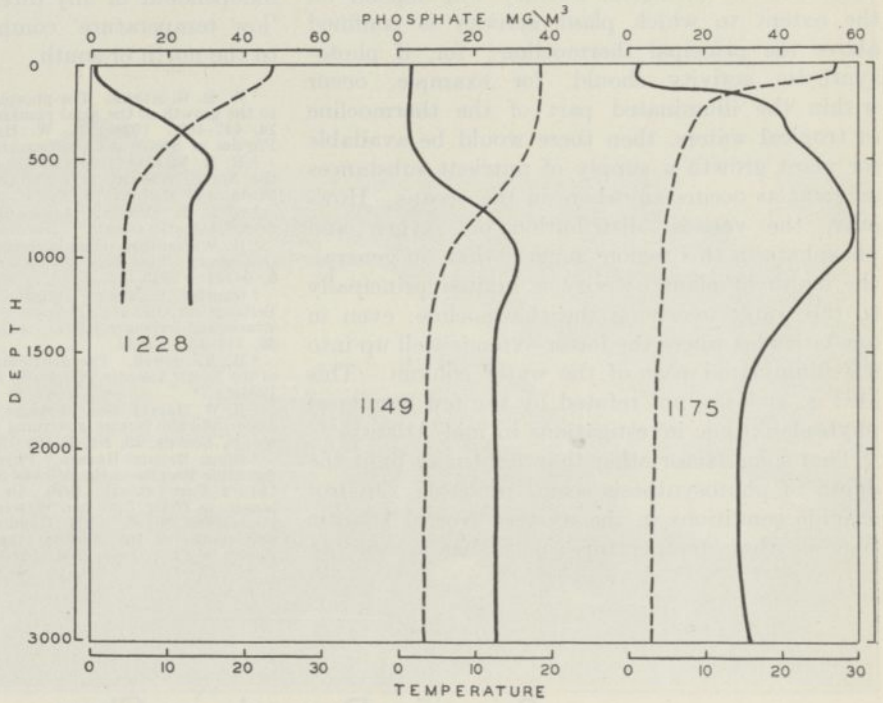

FIG. 1. Vertical distribution of phosphate (mgm. P per m.[3]) and temperature at *Atlantis* stations 1228 (35° 57′ N., 73° 05′ W.), 1149 (32° 59′ N., 60° 16′ W.) and 1175 (6° 50′ N., 40° 25′ W.) ; February–April 1932.

The amount of phosphate transported annually from the phosphate-rich midstrata to the homogeneous water overlying the thermocline, as calculated, ranged from $3{\cdot}0 \times 10^{-4}$ gm. P per square centimetre of horizontal area in the extreme south to more than 6×10^{-4} gm. in the north central part of the area. Thus, in the southern half of the area the higher midstrata concentrations of phosphate (with correspondingly greater variations with depth, Fig. 1) are offset in their influence on the eddy transport of phosphate by decreased turbulence.

After phosphate has been transported into the water overlying the principal thermocline, it is available for phytoplanktonic consumption either by direct utilisation (if the thermocline is sufficiently close to the surface) or by stirring of the relatively homogeneous layer by winds, waves, etc. If this transported phosphate enriches the water over the thermocline uniformly, the increased concentration per unit volume may be calculated by dividing the amount of phosphate transported per unit area[8] by the thickness of the homogeneous layer.

According to our calculations, the annual phosphate enrichment of the homogeneous water, per cubic metre, decreases in a south–north direction from more than 60 mgm. P in the south to less than 20 mgm. in the north central part of the area. Hence, in the south a unit volume of homogeneous water receives about four times as much phosphate by eddy transfer as it does in the north, whereas in the south the total supply, per unit of surface area, to the water over the thermocline is only about one half as much as in the north. The discrepancy results from the lesser thickness of the water layer overlying the thermocline in the tropics ; and the contrast indicates that, within the area, regional variations of chemical fertility cannot be estimated on the basis of unit volume measurements alone. Indeed, this analysis also suggests that, when comparing the fertility of other regions, a consideration only of the concentrations of nutrient substances per unit volume of water may lead to erroneous interpretation of conditions, particularly if the regions differ

in vertical distribution of their physical and chemical qualities.

On the basis of our recent results, it is tentatively concluded that, throughout the entire basin of the western North Atlantic, regardless of existing vertical density gradients, there is a significant eddy transfer of phosphate from the rich mid-strata to the impoverished surface layers. This, in general, is opposed to previous ideas that, in the open ocean, well-developed discontinuity layers restrict vertical transfers of dissolved nutrient substances from the rich underlying midstrata.

It is apparent that, in the open ocean, the consequence of the eddy transfer of nutrient substances to biological fertility will depend on the extent to which plant activity is confined above the principal thermocline; for, if photosynthetic activity should, for example, occur within the illuminated part of the thermocline of tropical waters, then there would be available for plant growth a supply of nutrient substances as great as occurs anywhere in the oceans. However, the vertical distribution of oxygen and phosphate in this region[2] suggest that, in general, the depth of plant activity is limited principally to the water overlying the thermocline, even in low latitudes where the latter extends well up into the illuminated part of the water column. This idea is, at least, not refuted by the few results of phytoplanktonic investigations in mid Atlantic.

That some factor other than light may limit the depth of photosynthesis seems probable; hydrographic conditions in the western North Atlantic suggest that temperature may bar access to tropical latitudes for plant species adjusted to low temperatures, and thus restrict phytoplankton to the warmer water over the thermocline. In mid latitudes the great thickness of the overlying warm water (Fig. 1) would, for lack of light, prevent a continuous phytoplanktonic distribution between surface strata in high latitudes and subsurface illuminated strata of similar temperature in the tropics. Phytoplanktonic communities in the tropics would thus tend to be limited to 'high temperature' species; and the lower and cooler parts of the photic layer would be left barren of plants unless some development of 'low temperature' organisms had taken place there independent of any direct connexion with similar 'low temperature' communities in high latitudes to the north or south.

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Scientific Research in China

The Academia Sinica

By V. K. Ting, Secretary-General, Academia Sinica, Nanking, China

'ACADEMIA SINICA' is the official designation for the Central Research Organisation established by the National Government in Nanking in 1928. According to its charter, it is the highest institution for scientific research in China. In the mind of its founders it is to be a sort of Academy of Sciences, Department of Scientific and Industrial Research, and Kaiser-Wilhelm-Gesellschaft combined. Unlike all the other institutions, it is independent of political control, for it does not come under any Ministry or Board, but is directly responsible to the National Government, which means the President of the Republic. It also functions as the highest national organisation for conferring honours upon individuals and institutions both at home and abroad that have distinguished themselves in science. For the purpose of directing and co-ordinating scientific activities in China, there is a council consisting of thirty members, selected from among the scientific workers of the country, and a certain number of ex-officio members who have also the right to elect candidates for the presidency of the Academia Sinica.

So far, however, its work as a group of closely connected and co-ordinated institutes for the purpose of carrying out original research has been more important than its other functions. As it

is constituted at present, it controls ten research institutes, including physics, chemistry, engineering, astronomy, meteorology, zoology and botany, psychology, geology, history and philology (including anthropology and archæology), and the social sciences. Thus the scope of research is extremely wide; for, on one hand, it includes such routine service as meteorology; on the other, it embraces the social sciences as well as history and philology, which are usually considered to belong to the 'humanities'. The following brief account will give some idea of the work being done in these institutions.

Observatory Hill because an observatory was built there in the year 1341, and continued to exist down to the beginning of the seventeenth century. The present Institute possesses up-to-date equipment, and maintains in addition a seismological station. It has a radio-transmitting station of its own, and broadcasts its forecasts daily. It keeps in close touch with the provincial meteorological stations all over China, and maintains several branch stations of its own, including one at Kokonor and another at Lhasa. For the purpose of upper air investigation, weekly flights are made by arrangement with the Bureau of Aviation.

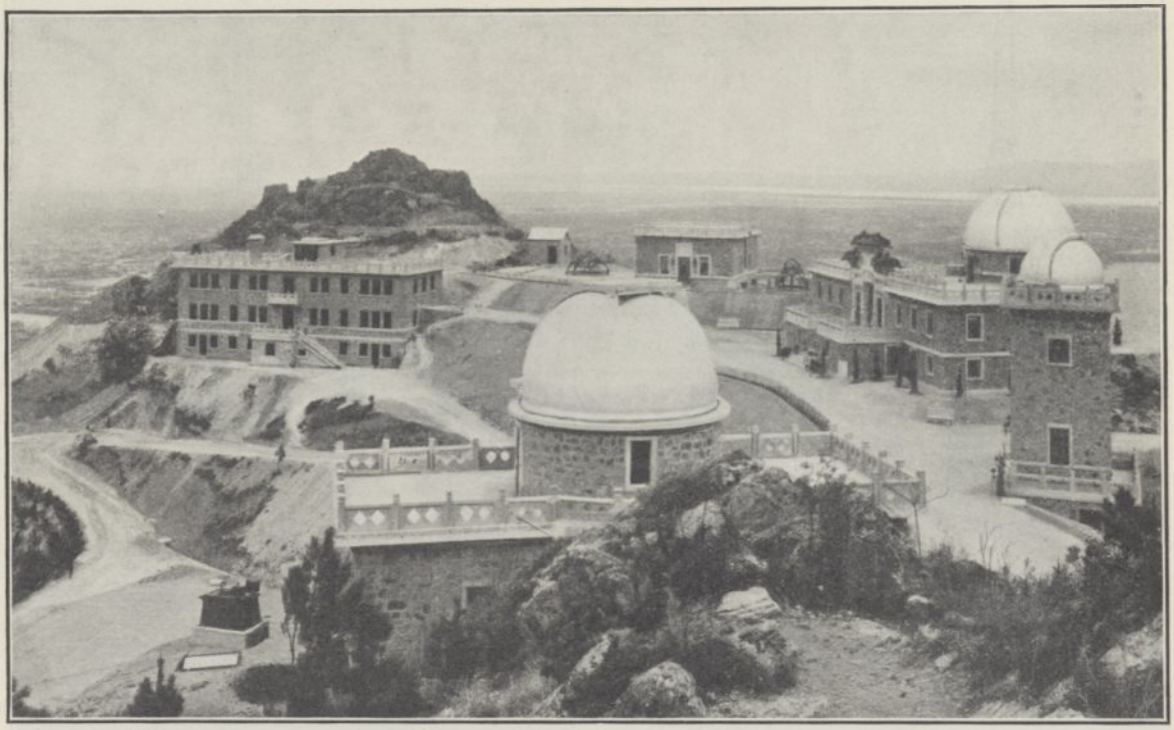

FIG. 1. Astronomical observatory of the Academia Sinica, on the Purple Mountain, near Nanking.

The Institutes of Astronomy and Meteorology are both located in Nanking. The former is built on one of the peaks of the Purple Mountain, 900 ft. above the plain just outside the east gate of Nanking (Fig. 1). It is one of the best equipped observatories in the Far East, having at its disposal one 600 mm. reflector, one 135 mm. meridian circle and one 200 mm. equatorial refractor with a 150 mm. astro-camera. In addition to compiling the almanac, supplying time service and determining geographical co-ordinates, the Institute of Astronomy carries out regular photometric and spectrophotometric studies of the sun, the planets and stars, makes observations of the variable stars, and studies solar activity with a Hale spectrohelioscope. The Institute of Meteorology is situated on another hill in the city. It is called

Three more institutes are located in Nanking: namely, those of geology, zoology and botany, and history and philology. The Institute of Geology has four sections: namely, stratigraphy and palæontology, petrology and mineralogy, economic and dynamic geology, and geophysics. Thus in scope it does not differ much from the National Geological Survey of China, which is an older institution under the Ministry of Industry, but more attention is paid to the theoretical side of geology. In co-operation with the National Geological Survey, it has also done considerable mapping, especially in the Yangtze Valley. Its publications, although less voluminous than those of the National Survey, have also gained international recognition. Its director, Dr. J. S. Lee, at the invitation of the Universities' China

Committee in London, has recently lectured on the geology of China before the Geological Society of London and in various universities of Great Britain.

The Institute of Zoology and Botany was originally the Metropolitan Museum of Natural History, which devoted itself exclusively to faunal and floral studies, especially of south and south-west China. With the organisation of a comprehensive National Museum under the joint auspices of the Academia Sinica and the Ministry of Education in 1934, it has been reorganised into the present Institute in order to avoid unnecessary duplication. At present the Institute concentrates its efforts on marine biology, especially fisheries, economic entomology and plant pathology.

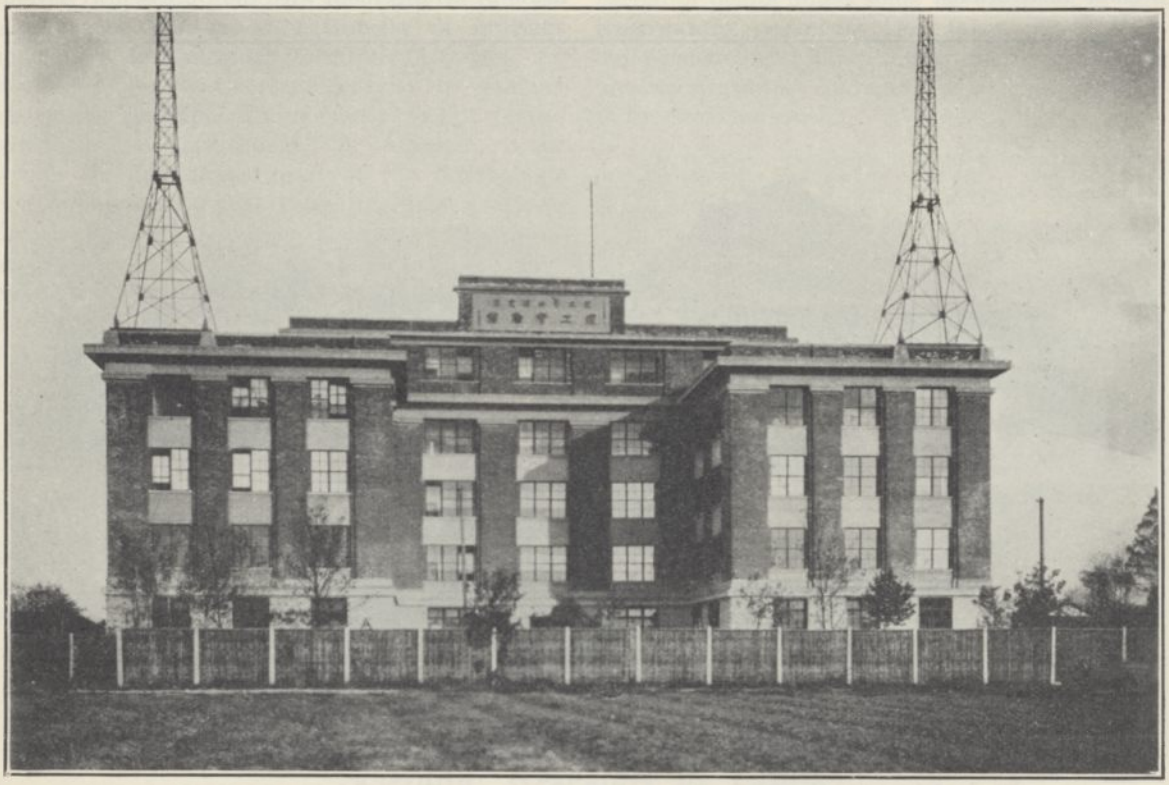

FIG. 2. Laboratory for Physical Sciences and Technology, Shanghai, housing the Institutes of Physics, Chemistry and Engineering of the Academia Sinica.

Of all the institutes, that of history and philology is the best known outside China because of the important discoveries at Anyang in north Honan province, made by the Section of Archæology. For the first time, ancient Chinese history is being checked by carefully planned and executed excavations. The site was the capital of the Shang Dynasty (1500–1200 B.C.), and had been known since 1899, when bones inscribed with archaic characters were first brought to the antiquarian market. Since 1928, excavation work has been going on without interruption. An enormous number of inscribed bones and shells, bronze, pottery, stone implements and stone carvings belonging to different cultural periods have been uncovered, and buried palaces and mausoleums have been carefully unearthed and mapped. Some of the treasures are to be shown at the coming Exhibition of Chinese Art in London. International recognition came in the form of the award of the *prix de Stanilas Julien* by the French Academy. No less important although less spectacular are the works of the historical and the linguistic sections, both of which have issued a number of publications.

The Institute of Social Sciences was also founded in Nanking. It had four sections: those of law, economics, sociology and ethnology, the last of which has been the most productive. A number of monographic studies have been made on the primitive tribes in north-east and south-west China. In 1934 it was amalgamated with the Institute of Social Survey of the China Foundation for the Advancement of Education and Culture, and its head-quarters moved to Peiping. Thus reorganised, the new Institute devotes itself entirely to economic studies, and the old section of ethnology has been changed into that of anthropology and put under the Institute of History and Philology.

The Institutes of Psychology, Physics, Chemistry

and Engineering are located in Shanghai. That of psychology is the smallest, and at present its work is largely confined to neural physiology and anatomy. It is being moved to Nanking. The three other institutes are, however, in their permanent quarters, which form a two-story building with a total floor space of 75,000 sq. ft. built in 1933 at the cost of £50,000 (Fig. 2). Both physics and chemistry possess excellently equipped laboratories. In addition to pure research, efforts are being made to study local problems. Thus, in chemistry, work has been done on Chinese drugs, paper and glass-making, metallurgy of certain rarer minerals; in physics on wireless, X-rays and geophysical surveying; and in engineering on ferrous metallurgy and ceramics, the aim being the better utilisation of China's resources in industrialisation. Both the Engineering and the Physical Institutes maintain standards testing laboratories; the latter fulfils partly the function of a bureau of standards.

The Academia Sinica as a whole receives from the National Treasury a grant of £100,000. Together with the income from its reserve fund and other grants, its budget during the last few years has averaged about £150,000.

Obituary

Prof. Edwin B. Frost

EDWIN BRANT FROST, who died on May 14, was born on July 18, 1866, at Brattlebro, Vermont. His father, Carlton Pennington Frost, was the seventh in descent from ancestors who had left Ipswich, Suffolk, in 1634 in order "to avoid the more savage oppression of England". They were shipwrecked off Yarmouth, but the family started again in 1635, and after a voyage of fifty-three days they reached Boston, and settled in New Hampshire, Vermont and Maine. Edwin Brant Frost derived his second name from the wife of his paternal grandfather Benjamin, who had married Mary Catherine Brant. His early home was in the green hills of the valley of the Connecticut River. His father was surgeon-major for some months in the Civil War and for three years after it, and in 1871 he was called to a professorial chair in medicine at Dartmouth College, Hanover, New Hampshire. Thus it came about that his two sons spent their learning years at Dartmouth College.

Edwin B. Frost, the younger son, graduated as A.B. in 1886, in physics. In the following year he accepted an invitation from Prof. C. A. Young to go to Princeton. Young was then engaged in writing his textbook on general astronomy, and Frost gave help in reading the proofs—an admirable way of taking a course in astronomy. He became A.M. in 1889, and then came to Europe to continue graduate studies, first at Strassburg under Kohlrausch, and later at the Astrophysical Observatory, Potsdam, under Prof. H. C. Vogel.

At Vogel's suggestion, Frost made observations with a thermopile to study the distribution of radiation over the sun's disc for comparison with Vogel's earlier study of ultra-violet radiation. Nova Aurigæ was discovered by Anderson in February 1892, and during Dr. Scheiner's temporary illness Frost photographed the spectrum of the nova with a small improvised spectrograph attached to the Repsold astrographic refractor. He also took a share with Scheiner in the measurement and reductions of the photographs of the cluster in Hercules, taken with the same refractor.

On his return from Europe in the autumn of 1892, Frost took up work as instructor in physics at Dartmouth College, Hanover, and devoted spare time to the translation of Scheiner's textbook "Die Spectralanalyse der Gestirne" (1890). This translation with extensions was published with Messrs. Ginn and Co., in 1894, under the title "Astronomical Spectroscopy".

His participation in the research activities at Potsdam, however, had made Frost aware of possibilities remote from pedagogy. He became professor at Dartmouth College in 1896, and two years later he was appointed to the chair of astrophysics in the University of Chicago. In 1898 he joined the staff of the Yerkes Observatory at Williams Bay under the directorship of Dr. G. E. Hale, and he had among his fellow workers Barnard and Burnham and Dr. W. S. Adams. When Dr. Hale was searching (1903–4) for a site for solar observations for the Carnegie Institution, Frost was called on to undertake the duties of deputy director. In 1904 Dr. Hale resigned the directorship of the Yerkes Observatory, and Frost succeeded him as director in 1905.

Hale had designed and constructed the Rumford spectroheliograph, which was mounted on the Yerkes telescope. To Frost had been assigned in particular the duty of designing and using the Bruce spectrograph (1902), to replace the earlier spectrograph used by Hale and Ellerman, on the 40-inch refractor in their study of the spectra of stars of the Fourth Type. The general design of the instrument was prepared by Frost and Dr. Hale, and it was carried out under the superintendence of Mr. Ritchey in the workshops of the observatory. With this instrument, Frost and Dr. Adams secured their observations of the radial velocities of twenty stars of the Orion type (helium stars). Thus whilst Dr. Campbell at the Lick Observatory was attacking with splendid success the task of measuring the radial velocities of stars with well-defined lines in their spectra, Frost devoted his attention to stars of class *A* with less-defined lines,

and showed that such stars could be dealt with successfully. Hence it came about that velocity determinations have been accumulated for more than 500 stars, by the joint work of thirty-five observers, including Frost, Mr. Barrett, Mr. O. J. Lee and Dr. Otto Struve, who had joined the staff in 1922. Out of more than 4,000 photographs, Frost had taken about 9 per cent, Mr. Barrett about 37 per cent, Mr. Lee about 11 per cent, Dr. Struve nearly 23 per cent. Out of the 500 stars observed, 187 or 37 per cent were believed to be spectroscopic binary stars by reason of their observed variable velocities.

Besides editing in 1907 the solar observations of Dr. C. H. F. Peters made at Hamilton College, Clinton, N.Y. in 1860–70—a task involving labour out of all proportion, it must be confessed, to the scientific value or availability of the results—Frost published more than a hundred papers, mainly in the *Astrophysical Journal*, of which he was then active managing editor for twenty-seven years. Seven volumes of *Publications of the Yerkes Observatory* have appeared recording the work of many workers in diverse lines of astronomical activity. No wonder that with so much editorial work in the daytime, his eyesight suffered when he imposed on it also the strain of observational work at night. It was on December 15, 1915, that detachment of the retina declared itself, and with cheerful belittlement of his affliction, he used to estimate the gradual diminution of the percentage of normal vision left to him as years went by. He resigned the directorship of the Yerkes Observatory in July 1932.

Frost will be remembered with respect and affection by his many students and colleagues as a man of peculiarly genial nature in human relations, of very varied interests—natural history, botany, music, literature—and for his amazing courage and cheerfulness in carrying on his life's work in spite of the affliction of increasingly defective eyesight. A large circle of friends will join in deep sympathy with Mrs. Frost and her family, and in good wishes for the success of Dr. O. Struve in carrying on the directorship of the Yerkes Observatory.

News and Views

Past and Future of Chemical Industry

In his medallist's address to the Society of Chemical Industry at Glasgow on July 3, Dr. E. F. Armstrong briefly reviewed developments in chemical industry in the last twenty-five years, with particular reference to his own experiences with Crosfield's and Gossage's. Noting the unpreparedness of chemical industry for the Great War, although chemists and chemical industry came well out of that searching ordeal, he urged the importance of maintaining in peace time in active being those industries which in war will furnish the plants, the materials and the chemists necessary for war production. Another war might make even greater demands on our chemical resources, and modern mass-production plants cannot be improvised. Apart from the ability of the industry to expand rapidly to supply war needs, the availability of the technical personnel capable of handling intricate manufacturing processes as well as emergency problems is even more important. Dr. Armstrong directed attention to the tendency towards continuous processes, automatically controlled, and viewed with anxiety the future position of important products still made in Great Britain by batch processes. He referred to the systematic work required to secure the best results when a particular aggregation of plant has to be adapted to making several substances in turn, as in the colour industry, and briefly discussed the rationalisation of chemical industry as well as the formation and work of the Association of British Chemical Manufacturers and the effect of tariff changes on chemical industry.

Looking to the future, Dr. Armstrong advocated changes in the management of the Society of Chemical Industry, including a recognition of the ephemeral character of most of the meetings, papers and discussions, and a much stronger participation in public affairs by the chemist. The training of the chemist in industry is not finally complete without some study of management, and it is essential for the chemist to realise that management can be scientific, and although nothing can substitute personality a thorough knowledge of a subject is equivalent to power. Labour questions offer an important field for experiment in which chemical industry has already pointed the way, and a reduction in working hours, a later entry into industrial life as well as an earlier departure are all matters obviously desirable from technical as well as social and economic points of view. Dr. Armstrong made a powerful plea for more attention to the problems of the smaller firms, which could frequently be solved by closer co-operation particularly in development. It is probable that, in the future, allied industries will tend to become more and more chemical manufacturers, and the importance of the chemist thus to increase. Technical men must prepare themselves to meet the situation; there is a suspicion that the individual chemist has not progressed individually with his industry. It is essential to attract the best type of young men and to see to it that they are encouraged and adequately rewarded from the start.

Ecological Expeditions in East and West Africa

The Department of Botany at the British Museum (Natural History) has received 838 plants collected on the Cambridge Botanical Expedition to Nigeria by Messrs. P. W. Richards and R. Ross. The main object of the expedition was to make an ecological

survey of a limited area of West African rain-forest comparable with those previously made by Mr. Richards in Guiana and Sarawak. This meant a study of the floristic composition and structure of various types of primary forest on one hand, and a study of soil and micro-climatic conditions on the other. In addition, Mr. W. J. Fletcher Cambell made a general soil survey. Mr. Ross studied the succession of secondary forest on old farms and Mr. G. C. Evans worked on the growth, transpiration and assimilation of two species of undergrowth shrubs. The base camp was about five miles from Akilla in the Shasha Forest Reserve, Ijebu Province, and the area worked was mostly within a radius of five miles from the camp. Four months were spent here, and a visit, via the creeks, was made for a fortnight to Nikrowa in the Okomu Forest Reserve, Benin Province, where the rain-forest is said to be the finest in Nigeria. Collecting was mainly incidental to ecological work. The specimens are particularly rich in forest trees, and special attention was paid to Bryophytes. It was possible to fix a hygro-thermograph in a tree top eighty feet from the ground in primary forest and to take daily readings over a period of several weeks. A mud and bamboo laboratory was built with a dark room quite efficient for working with panchromatic plates.

THE collection of plants made by Mr. P. M. Synge on the British Museum Expedition to Uganda and Kenya has been received ; it contains 1,231 numbers. Mr. Synge's main object was the study of vegetational zones in the higher parts of the East African mountains and the environmental factors influencing them. Particular attention was paid to the arborescent Senecios, and a long series was collected. Some observations were made on humidity and temperature in the higher zones, but a complete record could not be obtained. Dr. Taylor made the main collections on the joint visits to the Aberdare Mts. and Birunga Mts. Three visits were made to Mt. Elgon and one to Mt. Kenya, while the Nyamgasani valley on the south side of Ruwenzori was ascended and collections made up to the limit of vegetation. Some water plants and algæ were collected from the Nyamgasani lakes : a little collecting was also done in the papyrus swamp around Lake Kioga.

Archæological Exploration in Africa

PROF. LEO FROBENIUS, president of the Frankfurt Research Institute for Cultural Morphology, who has recently returned from his twelfth expedition to Africa, claims, it is said, that the results of his explorations in the Libyan Desert and the Sudan have now established the validity of his theories of the origin and direction of diffusion of the periods, or phases, which he distinguishes in the history of civilisation. It will be remembered that Prof. Frobenius, working on the material which he has been engaged in collecting in Africa for nearly thirty years, has not only produced an elaborate classification and scheme of distribution of the main forms of culture in that continent, but has also put forward certain views as to their historical development and affiliations. In an interview with the correspondent of *The Times*, which appears in the issue of July 31, Prof. Frobenius is reported as saying that he has now discovered in the Neolithic of the Sudan, the period in which agriculture and the domestication of animals first appear, the missing, but essential, link in the chain of evidence joining prehistoric to historic cultures. It is further reported that, since October last, a staff of twenty research workers attached to the Institute and distributed from Scandinavia to Southern Rhodesia, including France, Spain, Italy, North Africa, Abyssinia and Arabia, has been engaged in filling in gaps in the evidence and adding details to the chart of cultural distributions, which is now approaching completion.

FURTHER particulars are now to hand of an archæological discovery in Tanganyika reported early in July. According to a dispatch from Nairobi in *The Times* of August 1, Commander Nino del Grande, leader of an expedition collecting snake poison for the preparation of a snake-bite serum, camped for five days on the site of the ancient city discovered near Nguruka. He reports that the city is four and a half miles long by one and a half miles broad and is constructed terrace-wise on the wall of the Great Rift escarpment. Remains of houses, estimated to number four thousand, were found. Each had three or four rooms and stone walls four feet in thickness. Large stone tombs, one containing a skeleton, were found in the valley below. It is given as the opinion of Commander del Grande that no very high antiquity is to be assigned to these remains. It is thought that they may be about five hundred years old and the work of an advanced tribe, possibly the ancestors of the Wambulu now living some fifty miles away. The site is being examined by Dr. L. S. B. Leakey, whose verdict on the relation of these remains to other vestiges of stone structures found in various parts of East Africa should be of signal importance for the cultural history of the southern half of the continent.

Excavations in the Fens

THE importance of intensive exploration of the Fens, which led to the formation of the Fenland Research Committee at Cambridge, under the presidency of Prof. A. C. Seward, has already been referred to in these columns. Some of the results already obtained are now on exhibition at the British Museum, Bloomsbury, at the head of the main staircase. The sites selected are mostly between March and Mildenhall, and more or less connected with the Ouse, Cam and Bedford Rivers, where the post-glacial period is represented by peat, clay and silt, in which a sequence of human occupations can be traced, while light is further thrown on land movement and forest development. Waterways and promising sites have been traced by surveying on the ground and from the air, and an interesting feature is the occupation in Roman times of what used to be river banks but are now parallel mounds flanking slight depressions, in which shrunken rivers originally flowed. The contraction of the peat

has left these banks in relief, and the amount of this wastage is indicated by the Holme post, which proves that Whittlesea Mere is about 11 ft. lower than in 1848. The co-operation of workers in many fields has been secured, and much attention given to the botany, geology and zoology of the region, which is linked to North Germany and Scandinavia by its foraminifera and tree-pollen, to say nothing of changes in relation to sea-level. The work supervised by Dr. Grahame Clark in association with Mr. C. W. Phillips and Major Fowler has been rendered more difficult by the presence of water in the deeper cuttings; but funds have been provided, mainly by the Percy Sladen Memorial Fund, and the present exhibition, which will be open at least two months, will reveal to a larger public the potentialities of the Fens as a field of research in various branches of science.

Iron Age Site on the Sussex Weald

A FURTHER addition to the sites of industrial activity in Sussex in later prehistoric and Roman times, for which archæologists are indebted to the activity in investigation of Mr. S. E. Winbolt, is made by the discovery of an Early Iron Age camp on the Weald in Piper's Copse, one and a quarter miles east of North Chapel, West Sussex. The situation is remote and the discovery was due to the fact that a fox had dug its earth in a dry place where a small iron smelting hearth had been constructed in the inner slope of a bank. This was found on investigation to be the north-west end of an enclosure formed by a bold bank and deepish ditch, in good condition, except on the south-east, where an attempt had been made at levelling. The dimensions of the camp, Mr. Winbolt states in a communication to *The Times* of August 5, are a little more than 300 ft. by 270 ft. outside measurement, the inner area comprising about 1¼ acres. The height of the rampart, where best preserved, is 14 ft. from the bottom of the ditch. Two points of special interest arise in connexion with this discovery. The camp lies on the Wealden level (*c.* 120 ft.) and although Early Iron Age camps are known on heights fringing the Weald, such as at Holmbury and Hascomb, Saxonbury and Dry Hill, this is the first to be recorded at the Wealden level. The second point of interest is its date and purpose. These are fixed by red burnt material, charcoal, nodules of local iron ore and five fragments of La Tène iii pottery, as well as by many big lumps of iron ore lying near by. The site lies about two miles from the eastern slope of Blackdown near a stream flowing into the Arun and is in the middle of a country rich in iron ore of a moderate quality, where iron furnaces and forges of late medieval date abound, as, for example, at Mitchell Park, Shillinglee, Ebernoe and Roundwyck. Mr. Winbolt points to this as a further instance of the previous existence of Iron Age and Roman iron workings where medieval and Tudor workers are found.

Science and Culture: A new Indian Monthly

IT was anticipated by the founders of the Indian Science Congress that the Congress would stimulate in India an interest in science and in scientific research. At the time of its formation, the reforms in Indian university education resulting from the recommendations of the Curzon Commission were becoming effective and the universities were beginning to be centres of research. The spirit of scientific inquiry grew during the War period, and if the formation of scientific societies and the issue of scientific journals are to be regarded as criteria of increased interest in science, the hopes of the founders of the Congress have been fulfilled. There are in existence a number of specialist societies, the most recent addition being a Physical Society, and we referred recently (**135**, 410, 441; March 16, 1935) to the foundation of the National Institute of Sciences of India with its affiliated academies, the Asiatic Society of Bengal, the U.P. Academy of Sciences (Allahabad), and the Indian Academy of Science (Bangalore). In so large a country as India it is natural that there should be more than one academy, but the choice of names for these bodies is not happy and is likely to cause confusion in references to their publications.

THE more general aspects of science have in the past been dealt with by the weekly periodical *Current Science*, and we have now received the first issue of a monthly journal, *Science and Culture*, published by a non-profit corporation in Calcutta. The object of this periodical "is the dissemination of scientific knowledge amongst the public and advocacy of its application to all walks of life as far as practicable". The first issue contains a number of valuable articles the majority of which deal with topics of local interest, but the lecture by Prof. M. N. Saha "Ultimate Constituents of Matter" will attract a wider public. There are, in addition, reviews of books and a correspondence column. The latter, containing preliminary accounts of scientific investigations, seems scarcely in keeping with the other contents. These 'letters to the editor' would have appeared more suitably in *Current Science*. We welcome this new periodical, and if the high standard of the first number be maintained its success is assured.

British Empire Naturalists' Association in Jersey

IN the official report of the summer meeting of the British Empire Naturalists' Association in Jersey, Mr. Leslie Beckett, honorary organising secretary of the Association, states that many rare plants and birds were observed. Particularly was the island fruitful in flora, and of the more interesting examples noted, mention is made of many plants rare or unknown in England but quite well established and safe in Jersey; for Jersey is the northern limit of many Continental and North African plants. The English or five-spotted catchfly (*Silene gallica*) was found in profusion nearly everywhere, and near Crabbe, the party found the rare variety, *quinquevulnera*, which few of the botanists present had seen before. One party found a big patch of the Jersey bugloss (*Echium plantagineum*) between St. Brelades and Corbière. On the sand-dunes near Le Pont was found the rare yellow broomrape (*Orobanche ritro*) which is not found elsewhere between this

locality and Spain. On the last afternoon of the fortnight, *Convoluta Roscoffensis* was noted, an extraordinary example of symbiosis between a worm and an alga. Of bird-life, Mr. Le Maître led a party to the cliffs at Crabbe, to photograph the herring-gullery there, and the Rev. Pere Burdos led a party to the Pinnacle, a rock 200 ft. above sea-level near Plemont, where the peregrine falcon, raven, puffin and nesting guillemots, razorbills and oyster-catchers were seen. The granites in which Jersey is so rich interested the geologists, and while studying a quarry near Gorey Castle the rare hyssop-leaved loosestrife plant was noted. The first meeting of the London branch of the B.E.N.A. will be held at the Furnival Hall, Furnival Street, on October 16, when Mr. J. Ramsbottom will lecture on "Moulds and Mushrooms".

Technical College Buildings

IT is little less than astonishing that a country like Great Britain, which has been the pioneer in scientific work and retained so high a standard of scientific achievement, should have such a paucity of literature dealing with material needs in the matter of buildings and equipment necessary for its field of activity. Books dealing with laboratories can be counted on the fingers, while for any wide general account of technical institutions dealing with the application of science to the trades, it is necessary to go back nearly half a century. The report, published at the expense of the Carnegie United Kingdom Trust, by a Joint Committee of the Association of Technical Institutions, the Association of Principals of Technical Institutions with representatives of the Royal Institute of British Architects and the Institute of Builders and a member of the staff of the Board of Education is therefore to be specially welcomed, particularly at the present time when the demands for buildings for technical education are so marked (London : Association of Technical Institutions and the Association of Principals of Technical Institutions, 1935. 3*s*.) The volume, consisting of some 150 quarto pages including plans and illustrations, is the work of a representative committee the personnel of which is sufficient evidence of authority. The opening two chapters deal with general requirements including service supplies and accommodation, and these are followed by concise articles on the special needs of specific subjects, some twenty in all, embracing such fields as leather industries, printing and textiles in addition to the more generally taught trade principles. These chapters, which occupy the bulk of the volume, have been compiled by panels of experts intimately associated with the required tuition. The brochure concludes with two chapters illustrated with plans and photographs of recent British and Continental examples of buildings, and should be of great value to all concerned with the development and execution of schemes for technical education.

Temperament in Industry

THE effects of having the wrong type of persons in positions of authority were discussed by Dr. May Smith, senior investigator to the Industrial Health Research Board, in a lecture on May 27 forming part of a course on the temperamental factor in industry arranged by the National Institute of Industrial Psychology. She said that it was not uncommon to find that a high rate of sickness absences was the result of having a supervisor with the wrong temperament for his job. Sickness is also frequently ascribed to overwork, but overwork itself is often the result of having to deal with the unreasonable demands of heads who are irrational and lack emotional balance. After dealing with various temperamental types who cause trouble when they are in important positions, Dr. May Smith outlined the attributes of a good head. Assuming that he has the necessary intellectual powers and technical knowledge, the first requirement is a sense of justice—a capacity for asking, not "Am I receiving justice ?" but "Am I giving it ?" A good head must create the knowledge that everyone under him will receive fair treatment. A second quality is vitality, explaining that she meant not physical exuberance, which is often exhausting to subordinates, but the controlled energy that inspires them. "The 'Weary Willy' and the 'Streak of Misery'," she said, "should have no place at the head." The next requisite is the ability to regard people and things dispassionately, to see them as they really are, and not merely as they happen to appeal to the man himself. A sense of humour is the next requisite, to prevent the head taking himself too seriously. Finally, the good head must be able to rule without straining his powers on one hand or shirking responsibility on the other. Temperamental factors in industry do not receive sufficient attention in Great Britain, and it is a pity employers and departmental managers do not receive training in handling personalities. 'Nagging' might well be made a capital offence !

The Government Laboratory

FEW, apart from those who study the annual report of the Government Chemist, are well acquainted with the character and volume of the work which is carried out at the Government Laboratory. A detailed and illustrated account of the activities of this laboratory has recently been published in the *Chemist and Druggist* ; since much of the information which relates to processes and figures has been supplied to the author, the article can be accepted as an accurate and fully informed review. The Department of the Government Chemist, in its capacity of a protector of the revenue, undertakes the routine analysis of large numbers of samples of dutiable goods, handling, for example, some 5,000 samples of tobacco every week. As a public servant assisting in suppressing adulteration, it acts as a referee when reports of public analysts are challenged. The samples concerned have frequently undergone changes by the time they reach the laboratory—this applies particularly to samples of milk—so that the necessary analytical procedure is much more elaborate than normally. Such considerations involve a good deal of research, leading to the working out of satisfactory analytical methods. Another function

of the Department is that of acting as an adviser to the State on chemical matters, of taking part in international studies on the mass-movement of the sea from place to place, and of examining samples submitted by other Government departments. In addition to the principal laboratory at Clement's Inn Passage, other laboratories under the control of Sir Robert Robertson are the Custom House laboratory, and laboratories at the Geological Survey, at the Army Supply Depot at Deptford, at Park Royal, and at five seaports. The public thinks of these laboratories as places where a great deal of 'testing' is carried out; chemists, however, know that in addition they house a vigorous research organisation, only part of the work of which can, in the public interest, be published in the scientific journals as notable contributions to the common stock of chemical knowledge.

Harrison's Chronometers at the Science Museum

THE Admiralty has kindly lent to the Science Museum, South Kensington, all four of the pioneer marine timekeepers made by John Harrison between 1729 and 1759. With these instruments Harrison was the first to show that it was possible to construct a portable timekeeper which would keep sufficiently accurate time at sea to be of use in determining a vessel's longitude, and thus solved the problem of 'finding the longitude' which had baffled men of science and inventors for more than two hundred years. Harrison's instruments were the first balance-wheel timekeepers to embody any kind of compensation for the effects of change of temperature. In all four of his instruments compensation is provided by varying the effective length of the balance-spring, the mechanical details varying in the different individuals. In the first three timekeepers, the effect of the ship's motion is also compensated by employing two balance-wheels connected together by an ingenious but delicate system equivalent to a frictionless gearing; in the fourth chronometer, however, this system is abandoned in favour of a single small balance-wheel the angular acceleration of which is large compared to the stray accelerations due to the ship's motion. The first three chronometers are large clocks each weighing more than fifty pounds, but the fourth is much smaller, being essentially a large watch about five inches in diameter. All four instruments have been cleaned, repaired and put into working order by Lieut.-Commander R. T. Gould, and they are now on exhibition in the Museum, in going condition.

National Park in Snowdonia

SIX months ago public interest in Snowdonia as a national park was revived by the offer made by Mr. C. Williams-Ellis to the National Trust of 300 acres near Nant Gwynant with covenants to preserve the rest of Hafod Lwyfog farm in its present condition, provided others would co-operate in taking further steps for the preservation of this beautiful area. Since then the Caernarvonshire County Council has taken active steps towards the preparation of a planning scheme covering the whole area. Now, through the generosity of an anonymous benefactor, a scheme has been formulated by the National Trust for the preservation of the Aberglaslyn Pass. The anonymous benefactor has provided the funds for the purchase from the Snowdon Mountain Railway, Ltd., of the east side of the pass, provided the Trust can secure the co-operation of the owners of the land on the west side. The owners of Plas Aberglaslyn on the west of the Pass and Mr. Clough Williams-Ellis as owner of a small area to the south have immediately agreed, and the National Trust is now confidently awaiting the assurances of one or two other contiguous owners before completing the purchase. It is further believed that another offer of land between Gwynant and Pont Aberglaslyn is likely to be made.

Medical Botany of the Eighteenth Century

MR. H. S. REDGROVE contributes an interesting article to the *Gardeners' Chronicle* of May 11 describing a very complete work on "Medical Botany, containing Systematic and General Descriptions, with Plates, of all the Medicinal Plants, indigenous and exotic, comprehended in the Catalogues of the Materia Medica, . . . accompanied by a Circumstantial Detail of their Medicinal Effects, and of the Diseases in which they have been most successfully Employed". This remarkable work was from the pen of Dr. William Woodville (1752–1805). It was published first in monthly parts, but later in three volumes and a supplement (1790–94). Woodville's life is described briefly in the article under review, and his peculiar qualifications for the work are emphasised. One cannot but feel regret, as Mr. Redgrove quotes passages from "Medical Botany", that such herbs as *Potentilla erecta* have passed from medicinal use, for their employment seems to have been determined by very exact knowledge. 210 drawings by Sowerby were included in the work, which was written in a thoroughly scientific spirit.

Common Names for Plant Diseases

DIFFICULTIES of expression by written word are great, even when words have exact literary meanings. The words of a new science like plant pathology have been coined by practical growers in different places and under varying conditions, so it is not a matter of wonder that much confusion has resulted. The second edition of the "List of Common Names of British Plant Diseases" (Cambridge: University Press. Pp. 95. 2*s*. 6*d*. net) represents a serious attempt to standardise nomenclature of disease symptoms and causal agents. It has been compiled by the Plant Pathology Committee of the British Mycological Society. The list is in two columns—first the common name and then the name of the parasite. Synonyms are given where necessary, but the volume is a well-regulated attempt to establish one name for each disease. Many synonyms are being discouraged, whilst in one or two cases fresh names have been introduced for the sake of clarity. The host plants are grouped conveniently into

vegetables, cereals, fruit, ornamental plants, etc., whilst the causal agents are listed in the order—Viruses, Bacteria, Myxomycetes, Phycomycetes, Ascomycetes, Basidiomycetes, Fungi Imperfecti, and Non-parasitic. Foreign names are also given where possible. The comprehensive orderliness of the list should commend it for universal adoption.

Acta Physicochimica U.R.S.S.

THE publication of the *Acta Physicochimica U.R.S.S.* commenced in September 1934, and volume I containing six parts has just been completed. In Russia as in other countries, the ramifications of chemistry, especially in its mathematical and physical aspects, are growing so complex and varied that it is found desirable to have as a medium for publication, in addition to the usual journals devoted to chemistry, a special one devoted to the more advanced aspects of physical and theoretical chemistry. We have noted the recent appearance of the *Journal of Chemical Physics* in the United States, the remarkably effective and somewhat sudden renaissance of the *Transactions of the Faraday Society* in Great Britain, and now the appearance of the *Acta Physicochimica* in Russia. The board of editors of the journal is certainly to be congratulated on the first six parts. It would appear that the referees appointed by the board function admirably in that country in selecting suitable—and presumably also in rejecting unsuitable—material. A number of internationally well-known names, including those particularly well known in England, Profs. Frenkel, Frumkin, Rabinovitch, Semenoff and Talmud, are to be found on the board, and there is a list of some forty permanent contributors distributed over seven cities of the U.S.S.R. Although new journals furnish problems both in budgeting and in library accommodation, these difficulties will be overcome at least for this admirable example of a specialised scientific journal.

Insects of Samoa

THE British Museum (Natural History) has recently issued further instalments of the publication entitled "Insects of Samoa", a work which has been noticed from time to time in these columns. Part 6, Fasc. 8 of the complete work, by Mr. J. R. Malloch, of the U.S. Bureau of Biological Survey, deals with some further groups of Acalypterate flies, namely, the families Drosophilidæ, Ephydridæ, Sphaeroceridæ and Milichiidæ, and is illustrated by 16 text-figures. In Part 6, Fasc. 9, Mr. Malloch discusses certain families of Cyclorrhaphous flies, namely, Phoridæ, Agromyzidæ, Micropezidæ, Tachinidæ and Sarcophagidæ (supplement). Dr. H. H. Knight, of the Iowa State College, deals with the hemipterous families Miridæ and Anthocoridæ (Part 2, Fasc. 5), which comprise 21 genera and 33 species. Part 3, Fasc. 4 is by Mr. W. H. T. Tams of the British Museum (Natural History), who contributes a lengthy section comprising all the Heterocera, excepting the Geometridæ and Microlepidoptera, which have already been reported upon. Mr. Tams's report more than trebles the number of Samoan moths represented in the British Museum. It also contains important observations on nomenclature and upon the grouping of the subfamily divisions of Heterocera.

Field Museum of Chicago

THE economic situation in the United States is bearing heavily upon institutes such as museums which depend largely upon the goodwill and financial aid of the people. The annual report for 1934 of the Director of the Field Museum of Natural History shows this clearly. Income, from endowments, tax collections, admissions and membership, was in each case reduced, so that a total of 491,002 dollars stands against 636,318 for 1933. Visitors have fallen from more than three millions in 1933 to less than two millions in 1934, though the earlier year's numbers were abnormally increased by the opening of the "Century of Progress Exposition" in Chicago. In spite of difficulties, the Field Museum continues to prosecute research in various fields, though these are now limited to privately financed expeditions; it has added notable groups of animals to its public galleries; and it continues by means of lectures (attended by some 662,000 persons, mostly children) and by travelling natural history exhibits (to more than four hundred schools) to educate the youth of Chicago biologically.

Examinations in Milk Processing and Control

THE City and Guilds of London Institute has arranged to hold examinations in the future, commencing May next year, in milk processing and control, with certification of successful candidates. It is hoped that the provision of the examinations will encourage the formation of classes of instruction in these subjects in different parts of Great Britain, so that those engaged in the milk industry who receive such instruction should be in a position to render more efficient service. It is proposed that the examinations should be held at approved centres in Great Britain, Ireland and overseas. The syllabus of the examination for the certificate, which will be in two parts, intermediate and final, has been drawn up by a representative advisory committee, and may be obtained from the Superintendent, Department of Technology, City and Guilds of London Institute, 31 Brechin Place, South Kensington, London, S.W.7.

The Seismological Station of De Bilt

WE have received the valuable report on the earthquakes recorded at this well-known observatory during the year 1932. The instruments include horizontal and vertical component Galitzin seismographs and also Wiechert and Bosch seismographs. In addition to a catalogue of 437 earthquakes, the report contains an appendix on the earthquakes in North Brabant during November 20–28, 1932. The principal earthquake occurred on November 20 and was felt all over the Netherlands, in Belgium and west Germany, and even, it is said, in London. Its epicentre (in lat. 51° 40′ N., long. 5° 35′ E.), as well as the epicentres of three strong after-shocks, lay close to the boundaries of the central rift-valley.

T. K. Sidey Summer-time Award

IT is announced that the second award of the T. K. Sidey Summer-time Medal and Prize will be made by the Royal Society of New Zealand at its annual meeting in May 1936. The award, which comprises a medal and a prize of £100, is made for the most valuable contribution or contributions to human knowledge by research in the study of light visible and invisible and other solar radiations in relation to human welfare. Applications will close with the Secretary of the Society on February 29, 1936. Theses specially prepared or copies of published works may be submitted. The first award of this medal was made to Lord Rutherford in 1933.

Melbourne Meeting of the British Medical Association

THE annual meeting of the British Medical Association will be held in Melbourne on September 9–14, under the presidency of Sir James Barrett, deputy chancellor of the University of Melbourne. The meeting will be divided into the following sections, with the sectional presidents indicated: Medicine, Lord Horder; Surgery, Sir Thomas Dunhill; Obstetrics and Gynæcology, J. S. Fairbairn; Radiology and Radiotherapeutics, H. M. Moran; Diseases of Children, Dr. Robert Hutchison; Neurology and Psychological Medicine, Prof. E. Bramwell; Ophthalmology, Dr. A. J. Ballantyne; Orthopædics, Prof. E. W. Hey Groves; Oto- Rhino-Laryngology, Francis Muecke; Pathology and Bacteriology, Prof. A. M. Drennan; Pharmacology, Therapeutics and Anæsthesia, Sir William Willcox; Public Medicine, including History of the Development of Medicine in Australia, Sir Henry Gauvain; Dermatology, Dr. S. Watson Smith; Medical Sociology, Dr. E. Kaye Le Fleming. The honorary local general secretary is Dr. J. P. Major, Medical Society Hall, Albert Hall, East Melbourne, C.2.

Announcements

DR. E. J. BUTLER, director of the Imperial Mycological Institute, has been appointed secretary to the Agricultural Research Council, in succession to Sir William Dampier. Sir William will be appointed a member of the Council as from the date of his resignation of the secretaryship on September 30.

THE Medical Research Council has awarded Dorothy Temple Cross Fellowships for the academic year 1935–36, under the terms of the benefaction in that name for research fellowships in tuberculosis, to the following:—Dr. G. B. Brook, senior assistant veterinary officer, Derbyshire County Council; Dr. J. W. Craig, assistant medical officer, King Edward VII Sanatorium, Midhurst, Sussex; and A. H. B. Rhodes, house physician, Brompton Hospital, London.

BUSTS of Robert Koch and Conrad Röntgen have recently been placed in the Deutsches Museum at Munich on the occasion of the tenth anniversary of its foundation.

AMONG various other works of anti-aircraft defence, the Municipality of Prague has decided to build a subterranean hospital containing several hundred beds.

DR. ARTHUR MEYER, head of the publishing firm of Johannes Ambrosius Barth at Leipzig, has been awarded the Goethe Medal by the German Chancellor in recognition of his services to German scientific literature. He has also been made a doctor *honoris causa* by the medical faculty of the University of Leipzig.

THE German Society of the History of Medicine, Natural Science and Technique will hold its annual meeting at Bamberg on August 29–September 2. Further information can be obtained from the secretary, Dr. Walter Artelt, Institut für Geschichte der Medizin und Naturwissenschaften, Universitätsstrasse 36, Berlin, N.W.7.

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

A chief lecturer in engineering in the Bournemouth Municipal College—The Director of Education, Town Hall, Bournemouth (Aug. 17).

A technical officer in the Meteorological Office—The Secretary (S. 2. E.), Air Ministry, Adastral House, Kingsway, W.C.2 (Aug. 22).

An inorganic chemist on the staff of the British Scientific Instrument Research Association, 26, Russell Square, London, W.C.1—The Director of Research (Aug. 23).

A lecturer in mathematics in the University of Reading—The Registrar (Aug. 26).

Lecturers in mechanical engineering and mining engineering in the Denbighshire Technical Institute, Wrexham—The Director of Education, Education Offices, Ruthin (Aug. 26).

A dairy bacteriologist at the County Council Farm, Hutton, near Preston—The Director of Education, County Offices, Preston (Aug. 30).

An assistant lecturer in zoology in the University of Leeds—The Registrar (Aug. 31).

An assistant Government analyst in the Straits Settlements—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (Aug. 31).

A secretary to the Institution of Naval Architects—Council, Institution of Naval Architects, 2 Adam Street, W.C.2 (Aug. 31).

A head of the Engineering Department and the Junior Technical School, Municipal Technical College, Blackburn—The Director of Education, Education Offices, Blackburn.

A dairy instructor at the Farm Institute, Sparsholt, near Winchester—L. G. Troup, Agricultural Organiser, 82 High Street, Winchester.

A municipal engineer at Jaffa—Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1, quoting M/3786.

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. 226.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Dentition of *Ornithorhynchus*

IN 1888 Poulton, when examining some sections of the head of a young platypus, made the very important discovery of true calcified teeth. In the upper jaw he found evidence of four teeth, and he believed that four would also be found in the mandible. He also says: "I think that it is probable that the rudiments of teeth may be found anterior at a much earlier stage".

Oldfield Thomas and C. Stewart showed soon after Poulton's discovery that the calcified teeth are functional until the platypus is about half-grown.

In 1907 Wilson and Hill, by the study of two stages earlier than Poulton's specimen, added much to our knowledge of the developing teeth. They found evidence of four upper and five lower teeth, and also of a small calcified tooth of an earlier set than the functional teeth—clear evidence of a dental succession.

FIG. 1. Sections across (*A*) bud of supposed anterior lower incisor, (*B*) enamel organ of supposed lower canine, in very young *Ornithorhynchus*. × 180.

I have recently been examining sections of the head of a stage a little older than Wilson and Hill's younger specimen, and have just discovered a few interesting new facts. In what may be called the molar region, there seems little doubt that there is evidence of six teeth in both the upper and the lower jaws. Following the nomenclature of Wilson and Hill, these may be called *u*, *v*, *w*, *x*, *y* and *z*, and the functional teeth of the adolescent animal are *w*, *x*, *y* above and *x*, *y*, *z* below. Connected with *v* above and below there is clear evidence of a tooth of an earlier set, as found by Wilson and Hill, and I think the condition of the epithelium at the necks of *w* and *x* show indications of a *dw* and *dx* both above and below.

The most interesting discovery I have made, however, is some anterior teeth which have not, so far as I can learn, been previously seen.

In the upper jaw there is no dental lamina or any indication of teeth in front of the tooth germ *u*. But in the lower jaw in front of *u* we have a short distance with no dental lamina, and then an anterior portion of dental lamina with apparently the germs of three teeth. As might be expected in dealing with rudimentary structures, there is a slight difference in the two sides. On the right side the most anterior germ, which may be called *a*, is a well-marked little dental bud. Behind it is a second, *b*, and then we have a much better tooth germ *c*. This latter has quite a distinct enamel organ. On the left side, the tooth germ *a* is less developed and the tooth *c* a little better developed.

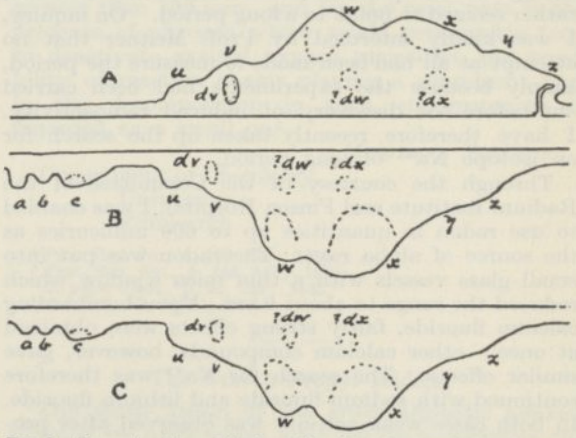

FIG. 2. Reconstruction of the dental laminæ of young *Ornithorhynchus*, length from snout to tip of tail about 90 mm. Dental laminæ of (*A*) upper jaw, (*B*) right mandible, (*C*) left mandible (reversed). × about 40.

These anterior teeth cannot, I think, belong to the premolar or molar set, and are evidently either three incisors, or more probably two incisors and a canine.

Fig. 1 includes a section through the right *a* and the right supposed canine. It will be observed that in the canine there is evidence of the dental lamina in addition to the enamel organ, and there is also evidence of the dental lamina by the side of the rudimentary supposed incisors. So that it seems probable that, in the case of both the supposed incisors and canine, there has been a dental succession in the ancestor.

The full dentition of *Ornithorhynchus* seems to be:

$$i\,\frac{0}{2}\,c\,\frac{0}{1}\,pm\,\frac{4}{4}\,m\,\frac{2}{2}.$$

This evidence does not help us very much towards the solution of the problem of the affinities. But it seems to show that *Ornithorhynchus* is descended from a form which had a full dentition, such as an Ictidosaurian or a Pantothere, rather than from a Multituberculate which had early lost the canines.

Transvaal Museum, Pretoria. R. BROOM.

Induced Radioactivity of Fluorine and Calcium

In an earlier paper[1], I have shown that sodium and phosphorus become radioactive under bombardment with alpha rays, presumably corresponding to the creation of Al^{26} and Cl^{34} respectively. In the case of phosphorus, chemical separation of the active body, kindly carried out by Prof. S. Sugden, gave strong support to this picture. Between these two unstable isotopes lies a third one, P^{30}, found by Curie and Joliot[2]. It was pointed out that another link of that chain, Na^{22}, should be produced by bombarding fluorine with alpha rays. Since the periods of the three above-mentioned bodies decrease rapidly with atomic number, a very short period was anticipated for Na^{22}. The search for this substance was unsuccessful, however, although periods so short as one tenth of a second would have been detectable by the method applied.

About that time, the emission of positrons from fluorine under alpha-ray bombardment was reported in a paper by L. Meitner[3]. The positrons were observed only during bombardment, and no life period was given. This was generally taken as evidence for a very short period. However, the very low energy of the positrons, as measured by Meitner, rather seemed to point to a long period. On inquiry, I was kindly informed by Prof. Meitner that no attempt at all had been made to measure the period, simply because the experiments had been carried out before the discovery of induced radioactivity. I have therefore recently taken up the search for an isotope Na^{22} of long period.

Through the courtesy of the Committee of the Radium Institute and Finsen Hospital, I was enabled to use radon in quantities up to 600 millicuries as the source of alpha rays. The radon was put into small glass vessels with a thin mica window which reduced the range to about 6 cm. Upon bombarding calcium fluoride, fairly strong effects were obtained at once; other calcium compounds, however, gave similar effects. The search for Na^{22} was therefore continued with sodium fluoride and lithium fluoride. In both cases weak activity was observed after prolonged bombardment. A chemical separation, kindly carried out by Prof. G. von Hevesy, showed that the active body follows the reactions of sodium, and therefore is presumably Na^{22}.

In striking contrast with the first anticipations, the outstanding feature of this new activity is its long period. One sample has been under observation for three weeks, with no evidence of decay. It may be concluded that the half-period must be at least six months. This explains the apparent weakness of the effect; indeed, with a few days' bombardment, only a fraction of the equilibrium activity is obtained. On the other hand, a reasonable assumption about the equilibrium activity leads to an estimated life of from one to several years.

The particles emitted from Na^{22} were shown by magnetic deflection to be positrons. They are rapidly absorbed in aluminium, the half-value thickness being about 0·03 gm./cm.^{2}. This corresponds to a mean energy of about 2×10^5 electron-volts, in good agreement with the results of Meitner.

The activity produced in calcium has also been studied. The half-period is 4·4 hours, with a possible error of ten per cent. The particles emitted are positrons, and their half-value thickness of aluminium is about 0·06 gm./cm.^{2}. From the great intensity, one may say that the effect is due to the main isotope of calcium, Ca^{40}. Capture of the alpha particle, with subsequent emission of a proton or neutron, would lead to the formation of Sc^{43} or Ti^{43}, respectively. A chemical separation, kindly carried out by Prof. G. von Hevesy, showed that the active body follows the reactions of scandium. Therefore the 4·4 hours activity certainly corresponds to Sc^{43}. Of course, it cannot be excluded that in the first instance Ti^{43} may be formed, and quickly transformed into Sc^{43} by emission of a positron. No short-period activity, however, could be detected.

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July 3.

[1] Nature, 133, 712; 1934.
[2] Nature, 133, 201; 1934.
[3] *Naturwiss.*, 22, 420; 1934.

The Rate of Photosynthesis

The recent correspondence on photosynthetic rates[1,2,3] has emphasised numerous significant facts now known about the process. A few important ones still remain. They can be roughly summarised by saying that the equations proposed seem to contain no term for the plant.

In the proposals of Burk and Lineweaver[2] the symbol (CO_2) is used without qualification, and the authors say that their equation provides for hyperbolic relations between y (rate) and (CO_2) "in accordance with experiment". Presumably, therefore, (CO_2) is to be read as the external and measurable concentration of carbon dioxide. But this cannot be the effective concentration in their reaction (I)

$$\text{Chl} + CO_2 \rightleftarrows \text{complex}.$$

I have been able to show[4] that the rate of photosynthesis can be made to vary considerably when all other conditions are kept constant and only the method of supply of carbon dioxide varied. Shortening the external diffusion path increases the rate, but there always remains the distance (measurable in μ) between the outer cell surface and the chloroplast. With moderate carbon dioxide concentrations and intensities of light, this is never negligible[5]; moreover, even the conception of a constant concentration right up to the cell surface is entirely 'ideal' and not realised with any plant. Allowing for these conditions, the equation

$$C_e = \frac{RK'}{A-R} + dR$$

will give a close fit to the observed rates, where C_e is the initial external concentration; R the rate; K' the dissociation constant of the chlorophyll-CO_2 complex; A, a constant independent of C_e, but varying with light, and d a resistance term including, but probably not solely depending on, the resistance to hydro-diffusion. The full derivation of this equation I have already given elsewhere[6].

A further difficulty resulting from structural considerations occurs in the absorption of light. A linear relation between light intensity and rate of the primary photochemical reaction may be a permissible approximation in simple cases; but it is more doubtful whether we are entitled to carry over this assumption to a wide range of plants with their exceedingly complex light-absorbing surfaces. We are here also faced with a complication, first

pointed out, I believe, by G. E. Briggs[7]. It is highly improbable that photosynthesis depends on a single photo-reaction of unit quantum efficiency, since it would appear that there is no quantum in the visible spectrum large enough to meet the minimal energy requirement. Experimental measurements[7,8] indicate a possibility of a value as low as 0·2 for the overall reaction. It seems to me that we must, therefore, assume either a photo-reaction not obeying the Einstein rule, or a series of n photo-reactions (n might be as high as 5), or a gain of energy in a thermal reaction. Since the great bulk of the light falling on a leaf is transformed to heat, there is no difficulty about a source of such energy. The first two of these alternatives certainly would, and the third might, necessitate changes in the proposed schemes.

It is impossible to contemplate this field of work without wondering whether the present position justifies the application of some of the kinetic assumptions employed. Realising the approximations and 'idealisations' inevitable, it is amazing that prediction gets as near the truth as it sometimes does. In such complicated systems the possibilities of errors compensated into rough agreements appear manifold. Recent careful work[9] even makes doubtful the existence within the plant of the 'steady states' which are the very basis of the analyses quoted by the correspondents in NATURE. It is clear that 'diffusion', 'reaction' and other 'constants' cannot here be given their usual significances, if only because they differ from plant to plant. It would appear that much pedestrian work on specific plants remains to be done before we can approach accurately based semi-quantitative generalisations.

W. O. JAMES.

Department of Botany,
Oxford.
June 21.

[1] Baly and Morgan, NATURE, **133**, 414; 1934.
[2] Burk and Lineweaver, NATURE, **135**, 621; 1935.
[3] Emerson and Green, NATURE, **134**, 289; 1934.
[4] James, *Proc. Roy. Soc.*, B, **103**, 1; 1928.
[5] van den Honert, *Rec. Trav. Bot. Néerl.*, **27**, 149; 1930.
[6] James, *New Phytol.*, **33**, 8; 1934.
[7] Briggs, *Proc. Roy. Soc.*, B, **105**, 1; 1929.
[8] Warburg and Negelein, *Biochem. Z.*, **103**, 118; 1920.
[9] Harder, *Planta*, **20**, 699; 1933.

Thermal Decomposition of Ozone

RECENTLY, H. J. Schumacher[1] has given his reasons for regarding the interpretation of the results obtained by me[2] as incompatible with the findings of other investigators. The essential difference between these results[2] and those of Glissmann and Schumacher[3] lies in the absolute rates of decomposition. It is possible that in the vessel employed, part of the measured decomposition was due to surface activation, the ratios of rates for the different temperatures yielding an apparent heat of activation (19,000 cal.) less than the recognised endothermic heat of reaction of the gas reaction (24,000 cal.). The 'inert gas' effects, however, both accelerating and retarding, can scarcely be related to a surface decomposition in itself, but must be gas phase processes.

The calculation of the heats of activation Q_2 (reaction $O + O_3 = 2O_2$) and Q_3 ($O + O_2 + O_2 = O_3 + O_2$) from my data was based on the assumption that the number of effective collisions was given by $Ze^{-E/RT}$, the steric collision factor being taken as unity. The values thus obtained are maximum values; correspondingly, if the heat of activation of the ternary collision is zero, the heat of activation of the secondary reaction is 9,000 cal. The correspondence between this figure and that cited by Schumacher from photochemical data (5,000 cal.) was taken as support for the oxygen atom theory, in view of the fact that the former value was calculated on principles of diffusion not involved in the photochemical decomposition.

The region in which the postulated diffusion effect can be experimentally realised is a small one, determined by temperature as well as by pressure and vessel dimensions. The interpretation of the present results is not regarded as incompatible with the photochemical decomposition from this point of view.

It appears from the summary of Schumacher[4] that the possibility of reaction chains involving excited oxygen molecules depends largely on the nature of the oxygen atom, in the sense that the excited oxygen atom produced by photo-dissociation of ozone by light of short wave-length is more likely to start a chain than is the normal unexcited atom. When the heat of activation is close to the endothermic heat of reaction, one cannot deduce with certainty that a chain mechanism must play a large part in the thermal decomposition. Since my experiments were carried out with pressures of ozone not greater than 100 mm., and for the most part in the presence of nitrogen which would presumably tend to deactivate excited oxygen molecules, the possibility of reaction chains playing a prominent part in the decomposition in such circumstances is regarded as a small one.

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[1] *Proc. Roy. Soc.*, A, **150**, 220; 1935.
[2] *Proc. Roy. Soc.*, A, **146**, 848; 1934.
[3] *Z. phys. Chem.*, B, **21**, 323; 1933.
[4] *J.A.C.S.*, **52**, 2377; 1930.

The Free n-Propyl Radical

THE clean fission of the lower aliphatic ketones effected by ultra-violet light led us to examine the symmetrical di-n-propyl ketone with the object of preparing the n-propyl radical.

We allowed the ketone to stream through a transparent silica tube, and irradiated it over a restricted area with the unfiltered light from two quartz mercury vapour arcs. Free radicals were produced, and rapidly removed metallic mirrors situated 10 cm. from the nearer edge of the illuminated zone.

The volatile products resulting from the action of the radicals on mercury were passed into mercuric bromide, the excess of ketone distilled off, and the solids subjected to fractional sublimation in a vacuum. The three head fractions melted at 137°–138° (mercury n-propyl bromide, m.p. 138°)[1]. The melting point of the fourth fraction was not depressed by admixture with an authentic specimen of mercury n-propyl bromide.

It is thus concluded that di-n-propyl ketone is decomposed in ultra-violet light with the formation of free n-propyl radicals.

T. G. PEARSON.
R. H. PURCELL.

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June 27.

[1] Goddard, *J. Chem. Soc.*, **123**, 1168; 1923.

Units and Symbols

THIS letter is intended to be provocative. A volt (or ampere) is denoted V (or A): a millivolt (or milliampere) mV (or mA): a microvolt (or microampere) μV (or μA). A farad is known as F, a microfarad as μF (though misguided people write it mfd. or mF., which, if anything, should mean millifarad): a micromicrofarad (10^{-12} farad) is μμF. A millihenry is mH, a microhenry μH. A gram is g., a milligram is mg., but some (and not the least worthy) biochemists use a symbol which few others understand, and call a microgram not μg. but γ. A second (of time) has the symbol sec. (not ″): a millisecond is msec.: a microsecond is μsec. Why do physiologists (and they alone) persist in using the symbol σ to represent, not—as it might less unsuitably do in view of μ and γ—a microsecond, but a millisecond? And why are they permitted, instead of writing 7 msec. (which others could understand) to use 7σ, or 7 sigmas (in America) or 7 sigmata (in Oxford)?

A metre (not meter) is m. (m means milli): a millimetre is mm.: a micrometre (not micrometer!) is μm., a micron or by courtesy μ. A millimicron therefore is mμ, a micromicron is μμ. It is all quite simple, yet otherwise law-abiding people (physicists this time, who ought to know better, not physiologists or biochemists) call a millimicron a μμ (see E. N. da C. A., "Encyclopaedia Britannica", 14th edition, Vol. 18, p. 874) or apply the same symbol to the same thing, now called a "micromillimetre" (Vol. 17, p. 877) which, with this name, is clearly not μμ but μmm. Fortunately milli- and microwatts mean what they say: but 1,000 millibars amount (nearly) to atmospheric pressure, which some people (chemists this time!) insist on calling a 'megabar' (compare megohm, megacycle) because they say that a bar is 1 dyne per sq. cm. Calories (at the beginning of a sentence, or in books on nutrition) may mean either Calories (10^3 cal.) or calories (cal.): it would be just as simple to refer to kilocalories (kcal.) as it is to kilograms (kg.) or kilocycles.

The moral is clear. Let us use our symbols logically and consistently and not make other people's tasks more difficult by inventing pet-names of our own. How can nations be expected to settle their differences, even as to the dates of Summer Time, when we men of science cannot agree on μμ, or bar, or μF, and insist on hiding our meaning by σ's and γ's which are unintelligible to the majority?

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July 22.

Should Scientific Publication be Controlled?

AFTER a delay of many years, the great work (576 pages, 67 plates) on the Caddis flies, by Cornelius Betten, has at last been published by the New York State Museum at Albany. It is reviewed by Dr. C. H. Kennedy in *Annals of the Entomological Society of America*, June 1935. The reviewer remarks: "This much needed volume has finally appeared. The reviewer saw the 'revised' manuscript at Cornell in 1915. It had been practically completed nine years before. Projects of more immediate use to the tax-payer used the Museum funds that had been planned for its publication. One new species after another was scooped by various casual students of the order. The last scoop was accomplished by one who had had the privilege of studying the manuscript and who rushed two papers through by publishing privately after the present volume was on the press."

Deplorable as was the delay, it must be admitted that the so-called casual students of the order were perfectly justified in publishing their work; that it is wholly unreasonable to expect publication on a group of insects to be halted for a quarter of a century because an important monograph has been prepared but cannot be published. When it became obvious that the publication would be indefinitely postponed, the new species should have been published separately. But what is described as the "last scoop" is in a different case. I do not know what it antedates in Betten's work, but I have seen a copy, and it is a much abbreviated summary, just sufficient to validate a number of specific names. It is printed by one of those duplicating machines, now so widely used for class work in colleges. I do not think it can be considered to be merely mimeographed; it seems to represent what must be considered printing in the sense of the rules. It is published privately, but is offered for sale, and the copy I saw, in the library of the California Academy, had been purchased.

A good many years ago, a certain entomologist, a student of parasitic Hymenoptera, printed privately a series of small papers containing descriptions of new species. These he advertised for sale in one of the scientific magazines. I bought a set, which I later divided between the U.S. National Museum and the British Museum. Apparently I was the only purchaser, and the author himself, who had in the meanwhile gone to Australia, lost his own copies, and wrote begging me to return those I had.

All zoologists and botanists are aware of the trouble caused by irregular publications, and of the controversies which have arisen as to what constitutes a publication. The rule requiring that a work must be placed on sale is ambiguous, and not always observed. Thus the splendid memoirs of the U.S. National Academy are not for sale, until they come on the second-hand market. With the newer methods of duplication, as indicated above, anyone can get out a small publication and offer it for sale, though it may not be obtainable through the usual channels, and may be almost unknown.

I have lived to see many taxonomic proposals, at first derided, eventually gain acceptance and become commonplace. I should consider it a great evil if all publication were controlled by the older men, or indeed by any particular group. But it does not seem unreasonable to suggest that certain definite channels for the publication of new taxonomic proposals should be established, and that there should be some control over the manner of these proposals, so that, sound or not, they should be intelligible. It might not be unreasonable to require that a type specimen should be deposited in some museum, where it could be examined. In short, some regulation is evidently needed, and we ought not to be so afraid of unjustifiable interference that we will not do anything. Whatever is done, should have the support of 'common sense', and not merely arbitrary rules. In addition to the matter of publication, we would commend to the International Commission another growing evil, the publication of erratic names. Great liberties have been allowed,

and I think quite properly, but there is a point when a name is so peculiar, or so badly constructed, that it almost suggests a lapse from sanity. There is surely no necessity for these aberrations.

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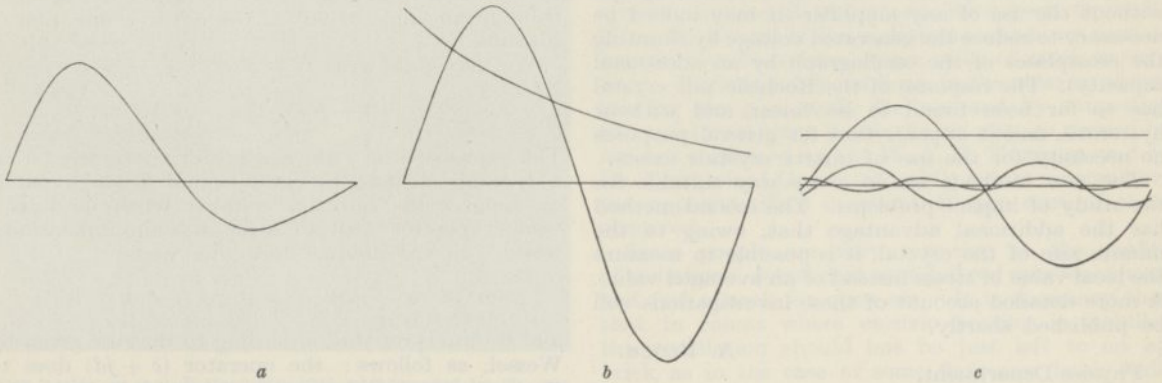
June 20.

Failure of Fourier Analysis applied to Vowel Vibrations

THE curve in Fig. 1*a* was produced by multiplying each ordinate of the curve $y = a \sin wx$ by the value or the corresponding ordinate of the curve $y = e^{-\delta x}$.



a *b* *c*

FIG. 1.

The two component curves are shown in Fig. 1*b*. The equation for the curve in Fig. 1*a* is

$$y = ae^{-\delta x} \sin (\sqrt{w^2 - \delta^2})x \qquad (1)$$

The Fourier harmonic analysis produces a constant plus a series of sine functions with pulsatances in the relations 1, 2, 3 . . . and with amplitudes that diminish from a maximum for the first one and continue in ever-decreasing amounts to infinity. The constant and the first three sine functions are shown in Fig. 1*c*. According to this analysis the equation for the curve in Fig. 1*a* would be,

$$y = A_0 + A_1 \sin (x + \theta_1) + A_2 \sin (2x + \theta_2) + A_3 \sin (3x + \theta_3) + \ldots \qquad (2)$$

As a mathematical formula, the result is perfectly correct; as an indication of the character of the curve or of how it was derived, it is a failure. It may be objected that the analysis is not intended to show how the curve was derived; the reply is that this is just what everybody who has applied it to vowel curves supposes that it does.

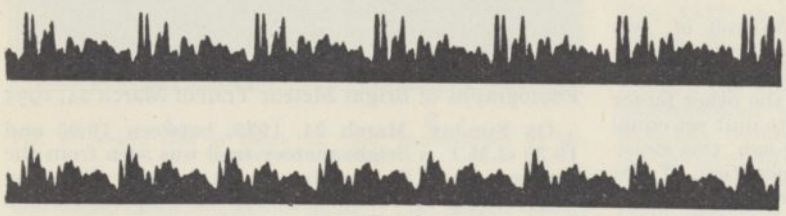


FIG. 2.

Portions of sound film tracks of *a* in *ash* and *oo* in *choo* are reproduced in Fig. 2. Each of them consists of a series of contiguous vibration bits. Each bit contains waves that begin strong and diminish rapidly to zero. The vibrations are plainly affected by strong factors of decrement. If we assume that the curve in a vibration bit is the sum of a series of sine curves, we are entitled to suppose that these sine curves have decrements and are of the character of that shown in Fig. 1*a*. A Fourier analysis, however, produces a long series of sine functions without decrements. The assumption that this indicates the manner in which the vowel vibrations were produced leads to the advocacy of the Wheatstone overtone resonance theory of the vowels, and the rejection of the Willis-Helmholtz-Hermann theory according to which a vowel consists of a series of short free vibrations. A glance at the vowel tracks in Fig. 2, however, is sufficient to show that this latter theory is the one that accords with the facts.

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June 13.

New Methods for Measuring Mechanical Stresses at Higher Frequencies

THE existing methods for measuring mechanical stresses due to vibrations are (with few exceptions, applicable only in special cases) dependent upon special devices clamped to the structure to be examined. For the purpose of measuring stresses due to impact near to the point of impact these methods are generally useless, as the measuring device then makes movements relative to the structure, so introducing errors in the stress record. These errors were examined by me in the case of two stress-recorders of the latest types and were found to be of such serious magnitudes that I had to abstain from using this kind of apparatus in my previous investigations[1].

During my stay at Trinity College, Dublin, I developed two new electrical methods, which are free from these faults.

The first is based on the change in electrical resistance in a specially prepared carbon coating which is directly applied to the surface of the structure to be tested (in the case of a metallic structure, after covering the surface first with a thin insulating layer.) If the underlying surface of such a coating

is stretched, the carbon particles move apart (and vice versa, if the structure is compressed) and so the resistance of the coating changes in the same way as the resistance of a microphone. If the coatings are properly prepared, they behave in a sufficiently stable manner and also give a linear response without hysteresis. An ordinary two-stage amplifier is required to operate a cathode ray oscillograph.

The second method uses a piezoelectric crystal (quartz or Rochelle salt), cemented to the surface of the structure to be examined. If the structure is stretched or compressed, the crystal must follow this deformation proportionally and liberates therefore corresponding charges. If a Rochelle salt crystal is used, a small crystal of a few millimetres dimensions is sufficient to operate a cathode ray oscillograph without the use of any amplifier (it may indeed be necessary to reduce the generated voltage by shunting the crossplates of the oscillograph by an additional capacity). The response of the Rochelle salt crystal has so far been found to be linear and without hysteresis, and it appears that for general purposes no necessity for the use of quartz crystals exists.

The new methods are in every way suitable for the study of impact problems. The second method has the additional advantage that, owing to the minute size of the crystal, it is possible to measure the local value of stress instead of an averaged value. A more detailed account of these investigations will be published shortly.

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June 26.

[1] A. Bloch, Zur Mechanik des Hemmschuh—Stosses und verwandter Vorgänge des Eisenbahnbetriebes. (Dissertation, Technische Hochschule, München. 1933.)

Graphical Representation of Complex Numbers

A SEARCH of the older texts has revealed an error in the analytical treatment of the graphical representation of complex numbers by Wessel in his original memoir on the subject to the Royal Academy of Denmark in 1797. The error has been perpetuated by many subsequent writers. Wessel, in proposing the representation which we now use, refers explicitly to 'operations' on right lines, and he represents any line, algebraically, by the expression $(a + eb)$, where $+ 1$ is the unit vector in a given direction and $+ e$ a unit vector in a direction inclined to that of the $+ 1$ vector at an angle of 90°. The $+ 1$ does not appear explicitly in his analysis.

Wessel goes on to consider the product of 'two right lines'. He says*: "It shall be possible in every case to form the product of two right lines from one of its factors in the same manner as the other factor is formed from the positive or absolute unit set equal to unity". Although written so long ago, this statement describes the present-day conception of the complex number as a *vector operator*.

The product is written by Wessel as follows:

$$(c + ed)(a + eb) = ac - bd + e(ad + bc)$$

which is a form to be found in most textbooks. Unfortunately, it contains a serious inconsistency of symbolism. As indicated above, the expression $(a + eb)$, when it appears alone, should be written, strictly, as $(a.1 + b.e)$. Now, the product form, $(c + ed)(a + eb)$ or $(c.1 + d.e)(a.1 + b.e)$, cannot be interpreted according to the rule just quoted from Wessel, unless we agree to give the symbols $+ 1$ and $+ e$ *operational* interpretations where they occur in the first, or (c,d), factor, and the original unit vector interpretations in the second, or (a,b), factor.

The inconsistency is easily avoided, of course. Let $+ 1$ and $+ e$ have the unit vector interpretations assigned by Wessel, and let any right line (or vector) be written $(a.1 + b.e)$, where a and b are numerics. Without loss of generality we may assume $+ 1$ and $+ e$ to be equal in magnitude. Now, let us put $e = j1$, where the j (or i, if preferred)† is a *rotational operator* that rotates the vector, to which it is applied, through an angle of 90° in the positive direction of rotation.

We may now write:

$$(a.1 + b.e) = (a + jb)1.$$

The expression $(a + jb)$ is a vector operator. It has a dynamic meaning precisely similar to the dynamic meaning of the ordinary number when used as a vector operator with a vector in a uni-dimensional world. In the product form, we write:

$$(c + jd)(a + jb)1 = [ac - bd + j(ad + bc)]1$$

and we interpret this, according to the rule given by Wessel, as follows: the operator $(c + jd)$ does to the vector $(a + jb)1$ what the operator $(a + jb)$ does to the unit vector, $+ 1$. The rule is easily justified from the definition of j and by the acceptance of the symbolic representation employed above; j is then identified with the number $\sqrt{-1}$.

In practice, the unit vector is omitted from most textbooks, and the expression $(a + jb)$ is called a vector. Herein lies a stumbling-block for many students who are not mathematical specialists—and, perhaps, for some who are!

The error does, in fact, amount to a serious inconsistency in nomenclature and symbolism, and attention is directed to it in the hope that textbook writers may help to clarify the position in future editions of their books.

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July 3.

* From the translation of the original paper given in D. E. Smith's "Source Book of Mathematics".

† Were it not for the present use of i by mathematicians, it would be better, in the following expressions, to use i as an 'identity' operator, and so write $(a + jb)$ as $(ia + jb)$ or $(ai + bj)$.

Photographs of Bright Meteor Trail of March 24, 1935

ON Sunday, March 24, 1935, between 19.05 and 19.30 G.M.T. a bright meteor trail was seen from the greater part of Holland in a north-westerly direction.

According to some observers, the trail was formed by a very luminous fire-ball, falling nearly perpendicularly to the earth. In about five minutes the white trail assumed strange forms, showing in this manner great differences in wind velocity in the higher levels of the atmosphere.

Mr. van Stralen, at Grouw (Frisia), had the good fortune to photograph this phenomenon, and we are glad to be able to give here (Fig. 1) an enlarged

reproduction of his very rare photograph (19.10 G.M.T.; exposure time, 3 minutes; diaphragm $f/4{\cdot}5$; $f=14{\cdot}6$ cm.). Mr. Groenewold, at Bedum, also obtained two photographs of different phases, reproduced in Fig. 2 (*A*, between 19.00 and 19.05 G.M.T., *B*, between 19.10 and 19.15 G.M.T.; magnification, 10; exposure 20 seconds; diaphragm $f/6{\cdot}3$; $f=10$ cm.).

From the *Astronomische Nachrichten* we learn that the phenomena was also seen in north-west Germany,

FIG. 1. Meteor trail of March 24, 1935, photographed by Mr. van Stralen at Grouw.

and Prof. C. Størmer (Oslo) informed us that he received very many observations from Denmark and Norway.

Mr. van Stralen's photograph, and some exact observations from other places, have enabled us to calculate the approximate position of the trail.

For Grouw (53° 5′ N., 50° 49′ E.) the azimuthal direction of the most luminous part was N. 60° 59′ ± 9′ W. The distance from Grouw is about 500–520 km., which gives a position over the North Sea, near

A *B*

FIG. 2. Meteor trail of March 24, 1935, photographed by Mr. Groenewold at Bedum.

the coast of southern Scotland. The height above sea-level of the luminous part must have been 70–75 km. as deduced from the photograph, and from the time at which the light of the trail disappeared, being the moment of sunset for the reflecting particles high up in the atmosphere. Low and medium clouds did not permit any observation in the British Isles. Also the illumination of the sky was perhaps too great.

The movement of the trail was apparently very slow; from some observations we deduce that the wind direction in this high layer must have been from the east.

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July 5.

Ventilation and Domestic Heating

IN a note on domestic heating (NATURE, July 6, p. 16) it is said, "We do not agree with Prof. Bone that a chimney is necessary for the suitable ventilation of bed and living rooms", and add, "Many systems for ventilating rooms have been devised". Now, the nature of the radiations which are used to heat a room have been shown to be of much importance. Dark and dull red heat, in the absence of cool moving air, give stuffy feelings and by congesting the nasal membrane lessen the air-way, as proved by me and confirmed by Dr. W. A. R. Thomson, and by Dr. Dishoeck of Groningen, while bright sources have the opposite effect in about 50 per cent of those observed.

Some people are very sensitive to the quality of radiations, detest dark and dull red sources of heat, and feel a need for open air. It is necessary then that in rooms where electric heating is installed the ventilation should not be just left to an air brick as in the case of some flats now being built for those who are poorly off. Moreover, the air brick may be stopped up, and the electric heater replaced by an oil stove, and the tenants then live in an unwholesome atmosphere. We know that with insufficient ventilation 'droplet' infection becomes much greater. The chimney always secured an unseen ventilation, and allowed of alternative methods of heating. It is, I think, wrong to take this advantage away. We usually lose vigour in winter owing to our stuffy heated rooms, which give us the greenhouse effect in place of sun and cool air. We should not intensify the mischief; and where electric heating is used and no flues built, an efficient means of artificial ventilation would have to be added.

LEONARD HILL.

I THINK that most people prefer a cheerful glow to a dark or a dull red heat. Experiments have recently been carried out by the Department of Scientific and Industrial Research and the Medical Research Council (see *World Power*, **20**, 229–304, Dec. 1933) to inquire into Sir Leonard Hill's statements on the 'nose opening' rays due to bright incandescent sources such as lamps, coal-fires and modern gas fires, and the 'nose closing' rays due to non-luminous sources. No evidence was obtained that any difference on 'nose opening' is due to the temperature of the source, either bright or dull, but 'nose-closing' rays were found with the clinical gas lamp specially recommended by Sir Leonard Hill. The conclusion is reached that nose-closing is due to rapid heating of the skin and is independent of the quality of the radiation.

I entirely agree with Sir Leonard Hill's remarks on ventilation. Unfortunately, it is not cheap, but its cost is only a fraction of what would be saved by building houses without chimneys.

THE WRITER OF THE NOTE.

Relation of *Botrytis* spp. to the 'Chocolate Spot' Disease of Beans (*Vicia Faba*)

IN view of the considerable losses in bean crops sustained by farmers in parts of England and Wales during the present season, it appears expedient to summarise the present position of our knowledge of 'chocolate spot' disease.

Chocolate spot disease may attack both broad and field beans, and is characterised by the appearance of chocolate brown lesions on the shoot system. Sardina[1] has described two diseases of beans in Spain which he attributed to distinct species of *Botrytis*. One of these diseases is probably identical with 'chocolate spot'. Ikata[2] considers that *Botrytis Fabæ*, Ikata, is responsible for the disease in Japan. Nattrass[3] has just reported that a species of *Botrytis* is responsible for the disease in Cyprus.

Work has been carried out on all aspects of this disease at Cambridge since 1931 under the direction of Mr. F. T. Brooks. As early as April 1933, experiments carried out at the Cambridge Botany School showed conclusively that several forms of *Botrytis* are responsible for the major part of the disease in Britain, but full publication of the results of these investigations will be delayed.

In the field the disease may assume two forms: (1) a lethal attack resulting in blackening and death of a part or the whole of the shoot system, (2) a non-lethal attack resulting in 'chocolate spot'. Both types of attack have been reproduced by artificial infection in field plots.

Chocolate discoloration of bean shoots is also caused by aphis exudates and other agencies.

A. R. WILSON.

Botany School,
University of Cambridge.
July 24.

[1] J. R. Sardina, *Bol. Pat. y Entom. Agric. Madrid*, **5**, 59–80; 1931.
[2] S. Ikata, Abstract in *Jap. J. Bot.*, **7**, 1–2, 6; 1934.
[3] R. M. Nattrass, *Cyprus Agric. J.*, **30**, 2, 57–58; 1935.

Dissociation Energy of the CO Molecule

IN the last lines of my letter in NATURE of June 29, p. 1077, I erroneously wrote $C(^1D) + O(^3P)$ instead of $C(^3P) + O(^1D)$. This, together with a typographical error, obscured the meaning of the last sentence. It should read: "The alternative possibility that it would correspond to dissociation into $C(^3P) + O(^1D)$ and that therefore $D_{CO} = 9{\cdot}105$ v.e. will be discussed in detail elsewhere."

B. ROSEN.

Institut d'Astrophysique,
Université de Liége,
Belgique.

Points from Foregoing Letters

DR. R. BROOM has discovered tooth germs in the lower jaw of a young specimen of the Platypus, which are considerably anterior to the teeth already known. They are believed to be two incisors and a canine. If this determination of the germs be correct, *Ornithorhynchus* would seem more probably to have been descended from an Ictidosaurian reptile or a Pantotherian mammal in which there are large canines, than from a Multituberculate in which the canines were early lost.

BY bombarding fluorine compounds with alpha rays, Dr. O. R. Frisch has obtained a radioactive element of long life emitting positrons. It follows the reactions of sodium and is probably Na^{22}, though from the behaviour of Cl^{34}, P^{30} and Al^{26}, Na^{22} should have a short period. A radio-element of half-period 4·4 hours, probably Sc^{43}, has also been obtained by Dr. Frisch by the action of α-particles on calcium.

The rate at which carbohydrates are formed by plants from carbon dioxide and water in the presence of light depends, according to Dr. W. O. James, upon structural considerations which affect the amount of carbon dioxide reaching the chlorophyll granules; also, the energy absorbed from the light is greater than one quantum per reacting molecule. Hence the simplifying assumptions made in some of the formulæ put forward to explain the reaction appear unjustified.

Dr. M. Ritchie gives some explanations in answer to H. J. Schumacher's criticisms of his experiments on the rate of decomposition of ozone by heat ($O_3 \rightarrow O_2 + O$) and the deductions therefrom.

Prof. A. V. Hill directs attention to divergencies in the use of symbols representing various physical magnitudes, and appeals for greater consistency in the derivation of such symbols.

Prof. E. W. Scripture gives an example showing that, by analysing a curve according to Fourier's method, one does not necessarily obtain the true components. He supplies illustrations of sound-film tracks representing vowels, the outlines of which support the Willis-Helmholz-Hermann theory of a series of short free vibrations rather than Wheatstone's theory of overtone resonance.

Two new methods for measuring the mechanical stresses due to vibrations are described by Dr. A. Bloch. One is based upon the change in electrical resistance in a specially prepared carbon coating which is directly applied to the surface under examination, and the other upon electrical changes in a crystal of quartz or Rochelle salt cemented to the structure to be examined.

W. F. Floyd directs attention to an error in the analytical treatment of the graphical representation of complex numbers by Wessel in 1797, due to inconsistency of symbolism. The error, Mr. Floyd states, is still found in many textbooks.

Dr. W. Bleeker submits two photographs taken in Holland of a 'fire-ball' which, calculations show, fell in the North Sea near the coast of southern Scotland on March 24; it was not seen in the British Isles, owing to clouds.

ERRATUM. In the penultimate and last lines of the note in NATURE of August 3, p. 187, on the communication by A. Emmerie, the phrase "constituents responsible for the Carr and Price reaction" should read "constituents which cause a reaction simulating the Carr and Price reaction".

Research Items

Further Investigations at Hoxne, Suffolk

FURTHER exploratory work at Hoxne was undertaken by Mr. J. Reid Moir in 1934 on behalf of the American School of Prehistoric Research (*Bull.*, 1935, No. 11). Excavations were made both on the old brickfield site and also on the recent extension of the area of exploration to Oakley Park. In both, the present investigation exposed a section showing the stratification which affords evidence of climatic change. An addition to the fauna of the brickfield area was (?) *Sus scrofa*, associated with Clacton III, and also with other mammalian remains which show no signs of a cold climate. The Oakley Park excavation opened up an impressive section, from which it was plainly evident that the uppermost and lowest deposits were laid down under intense glacial conditions, while the intervening beds were accumulated during a temperate period. These latter are, therefore, to be regarded as inter-glacial, and represent the epoch when Late Acheulian and Early Mousterian man inhabited East Anglia. The Late Acheulian and Early Mousterian floors are associated with seams of peat, of which samples have been sent to Dr. G. Erdtman, of Visby, Sweden. His report shows that the Early Mousterian floor was laid down in temperate conditions. Dr. Erdtman, however, states that the most interesting fact revealed by his preliminary analysis is the presence of *Abies*, which had not previously been reported in the Quaternary deposits of Britain. It represents a family which has living representatives in eastern North America, China and Japan, but in Europe is represented only by fossil species (Tertiary or earlier). *Picea* and one, or several, other species not previously found in European post-Tertiary deposits also appear. Dr. Erdtman suggests a measure of caution in immediate acceptance of this evidence at its face value.

Ear Exostoses

IN a study of ear exostoses by Dr. Aleš Hrdlička (*Smithsonian Misc. Collect.*, **93**, No. 6), it is pointed out that few subjects in racial pathology have received more attention than this. The term is here used to cover all bony excrescences or tumours within the external auditory canal, though these have received a number of names. The existing literature contains material of distinct anthropological value, though it is defective for certain areas, notably Africa, China, India and Malaya and less markedly the Pacific. Ear exostoses are relatively frequent among Polynesians; but taken as a whole, they are scarce among European and American whites, while among American Indians their frequency is marked. Dr. Hrdlička has not only reviewed existing records, but also has added the results of a personal examination of 7,814 skulls, forming part of the Division of Physical Anthropology, United States National Museum. From this material he concludes that the abnormality is one of considerable antiquity, going back about four thousand years to XIIth Dynasty Egypt. No example has yet been found in early man or even in neolithic times. Its frequency among American Indians, however, suggests a higher antiquity than that for which there is evidence at present. The tendency to ear exostoses is probably a pan-human condition, though there is considerable local variation. It does not occur among the anthropoids. The underlying process is probably not a degeneration, but a somewhat inadequate central control of the neuro-vascular system of the parts involved, with bony abnormalities as a secondary manifestation. It is suggested that in the rapid progress and differentiation which has accompanied man's astoundingly rapid evolution, the central trophic control of the external meatal region in the greatly enlarged, altered, and still altering skull has not regained the full life-long adequacy that it possessed before.

Intelligence Tests on Japanese

REPORT No. 25 of the Institute for Science of Labour, Kurasiki, Japan, is an account of a "General Intelligence Test and its Norm", by Dr. Hoken Kirihara. Four tests were used, namely, rote memory, recognition, completion and analogy, and Rybakow's figure tests. The problems were completely non-verbal, apart from the instructions, and it is hoped that they may serve as a basis for comparing racial differences in intelligence. The results from applying the tests to about 12,000 Japanese males and females, aged from 6 to 40 years, are given in this report, and certain occupational standards have been worked out. Correlating the mental ages of 230 boys and girls derived from this test with those derived from the Binet-Simon test gave a coefficient of $+ 0{\cdot}723 \pm 0{\cdot}0213$. It was found to be too difficult for children below the age of nine years. The rote memory sub-test was not reliable for children more than twelve years old. The results have shown the developmental growth of intelligence in the different phases of childhood, pre-pubescence and pubescence. The development of the female appears to be a year ahead of that of the male, to stop a year sooner, and to be corresponding up to the twelfth year, but throughout pubescence to be absolutely less than the male. This report outlines an extensive investigation.

Chinese Starling in America

ABOUT 1897 the crested myna or Chinese starling was set free in British Columbia, and although increase in numbers was slow, it became well established. By 1925 the Vancouver colony included more than 20,000 individuals, and wanderers had been found across the international boundary in Washington State (T. H. Scheffer and C. Cottam in *U.S. Dept. Agric. Tech. Bull.*, No. 467; 1935). Further distribution has been limited, partly because climatic conditions do not favour undue increase, and partly because physical barriers—mountains on the north, extensive forests in the interior, and ocean straits to west and south—check dispersal except in an easterly or south-easterly direction. The authors, having examined the food, state that the potentiality for harm of such a gregarious and omnivorous bird, which plays havoc with fruit, is high; and that consequently every precaution should be taken to check the spread of this species and to prevent its establishment in the United States. But with introductions this is often more easily planned than accomplished.

Reptiles and Amphibia of the Antilles

LESS than five years after the publication of his List of Antillean Reptiles and Amphibia, Thomas Barbour finds it necessary to compile a new one, so many additional discoveries having been made that the old list is completely out of date. The new list contains names of species and races, with, for each, a brief note upon locality or habitat (*Zoologica*, **19**, No. 3, June 1935). The variety of life in these islands, which comprise the West Indian Islands, except Trinidad, Tobago and the islands off the coast of South and Central America, is astounding. Compare the 86 forms of Amphibia and 370 reptiles, the latter including 266 lizards, 98 snakes, 3 chelonians and 3 crocodiles, with the corresponding fauna of Britain as tabulated in the new Vertebrate List, 7 amphibia, 9 reptiles!

Pearl Organs in Fishes

DR. Y. OKADA notes the occurrence of bead-like organs or tubercles in certain Japanese cyprinoid fishes (Science Reports, Tokyo Bunrika Daigaku, Sect. B, No. 28; 1934), the so-called pearl organs. The occurrence of these organs is apparently well known in the nuptial males of cyprinoid fishes, and previous authors have indicated that these secondary sexual characters have some special purpose in the breeding season, possibly being used for preparing the surface of the rocks on which the eggs are laid. The pearl organs of the Japanese cyprinoid fishes develop mostly on the tip of the snout or on the side of the face, but are also often found on the fins, the ventral surface of the caudal peduncle and the posterior part of the body. The author suggests that the tubercles may serve as contact organs, holding the mating pair entangled by the roughened surfaces. The pattern and position of the organs are different in the various species and occur in *Cyprinus*, *Carassius*, *Tribolodon*, *Acheilognathus*, *Ischikauia*, *Zacco*, *Opsariichthys* and *Sarcocheilichthys*. These tubercles are so like the so-called sensory papillæ of the Gobiidæ, and the arrangement in some cases is so much the same, that there seems to be some relationship in these organs. The gobies also lay their eggs on rocks or shells, and possibly the organs have a similar function as suggested above in the clearing of surfaces preparatory to egg-laying.

Oyster Culture in Norway

A DETAILED account of oyster culture in Norway has been published by Torbjørn Gaarder and Paul Bjerkan ("Østers og østerskultur i Norge, utgitt med bidrag av Fiskeridirektoratet", Bergen, 1934). The first part of this work consists of a clear description of the anatomy of the north European oyster *Ostrea edulis* and its young, including its chemical composition, biology and the risks that it runs, including its enemies. The second part deals with oyster culture in general, and there is a special account, occupying more than half the work, on oyster culture in Norway. The natural oyster banks along the Norwegian coast are now almost empty and little used, but the natural pools more or less connected with the fjords are ideal for oyster culture. These are of two kinds, the almost closed pools for breeding and the open basins for rearing. The hydrographical conditions make them specially suitable; there is abundance of good food and they are sheltered from wind and waves. Although much has already been done, a great deal more is expected, and the present interesting paper shows what has already been accomplished and indicates the way to further progress. Good illustrations accompany the text, both photographs showing the types of pools and line drawings showing the oysters and gear.

Table-Poultry Production

THE Ministry of Agriculture and Fisheries has issued an account of experiments in table-poultry production carried out as part of the National Poultry Institute scheme begun in 1923 (Bulletin No. 91, H.M. Stationery Office. Pp. 59. 1*s*. net). The experiments dealt with the best methods of feeding and marketing table poultry and with the relative values of the breeds generally kept by commercial egg farmers. Feeding investigations showed that dry mash gave better results than wet mash (though not better than wet and dry combined) and had the further advantage of a saving in labour costs. Reduction in expenses could also be made, without reducing the bird's gain in weight or the quality of the flesh, by substituting barley meal and maize for Sussex ground oats, and by reducing the dried milk constituent by 50 per cent.

Downy Mildew of Millet

A DESCRIPTION of "Mycological and Pathological Studies on the Downy Mildew of Italian Millet" by Makoto Hiura has recently been published (*J. Fac. Agric., Hokkaido Imp. Univ.*, **36**, Part 2, March 1935). Symptoms of the disease on Italian millet (*Setaria italica*) are given in very great detail. Systemic infection from oospores in the soil produces large chlorotic spots on the leaves, which bear conidia. These either germinate directly, or produce zoospores, which bring about secondary infection and give limited yellow spots. Oospores are produced in the leaves and flowering spikes; the former are quickly shed from the plant, whilst the latter are much deformed. The causal fungus is *Sclerospora graminicola*, and the paper under review describes the size and mode of germination of the conidia, zoospores and oospores, the influence of atmospheric conditions upon their shedding and germination, the host range of the fungus, and various methods of infection. Control methods are not described, but it should not be difficult to evolve them from the detailed study here presented. Six excellent plates illustrate symptoms and characteristics of the fungus.

Irrigation of Market Garden Crops

THE practice of irrigating growing crops is very ancient, and was probably used in the Nile basin as soon as human beings commenced the art of growing plants in garden or farm. Many modern horticulturists use the water-can or hose-pipe in summer, but the provision of water for extensive outdoor crops is a new development in England. Mr. F. A. Secrett has published a very interesting paper on "Irrigation for Horticultural Market Crops" (*J. Roy. Hort. Soc.*, **60**, Part 7, July 1935), in which he describes an apparatus for irrigating four acres of ground at one time. A centrifugal pump of suitable capacity delivers water to a system of permanent mains laid on the farm. Valves are provided every 40 ft., and connexions may be made from these to the spraying lines, which are long pipes with nozzles 2 ft. apart. Water is thus made to descend upon the crop as a gentle rain. Provision is also made for aerating the water, and an ingenious arrangement

adds minute quantities of fertiliser at any predetermined rate. A crop must never be irrigated unless it shows signs of distress; heavy soil or poor ground lacking humus will not respond to the addition of extra water, and certain crops must only be watered at night. Many other practical points are given in the paper.

Refrigeration Hygrometry

THE scientific investigation of the conditions under which food of various kinds may best be kept for long periods, without deterioration in quality, has shown that for each food there is a best temperature, a best composition of the atmosphere surrounding it and a best moisture content of that atmosphere. The question of the standardisation of hygrometers for measuring the moisture content of the air in cold storage chambers has been examined at the request of the Food Investigation Board of the Department of Scientific and Industrial Research by Mr. J. H. Awbery and Dr. Ezer Griffiths, of the National Physical Laboratory, and the results of their work are published in the July issue of the *Proceedings of the Physical Society*. The indications of a wet- and dry-bulb hygrometer were compared with those of a special dew point instrument and of a gravimetric absorption apparatus, all enclosed in a large metal chamber the temperature of which could be maintained constant at 0° C. down to − 19° C., and the air within at any desired humidity. The results are embodied in a table of humidities in terms of dry-bulb temperatures 0° to − 19° C. and wet bulb depressions 0° to 4·2° C., which differs considerably at temperatures of the dry bulb below − 8° C. from those previously available.

A Novel Optical Gauge

AN interesting brochure on optical gauging and inspection has recently been published by Messrs. Adam Hilger, Ltd. In the course of the many years' experience of this firm in the manufacture of high-grade optical instruments, it is only natural that it should have developed optical methods for testing and inspection in the engineering section of its work. In addition to the various interferometric methods, required only for work of the highest precision in gauge-testing, the booklet describes a new tool termed the 'Angle Dekkor'. It consists of a sturdily made modification of the autocollimating telescope, by means of which a reflected scale image is observed at right angles to a fixed scale in the eyepiece, thus measuring the tilt of the reflector from the normal direction. The scale of the standard instrument has a range of 25′, on each side of zero, in the direction of the fixed scale, and the image scale measures a range of ± 20′ in the perpendicular direction. On both scales, each division corresponds to a tilt of one minute of arc, and a fifth of a division can be estimated without any difficulty. When the Angle Dekkor is used in conjunction with an accurate quartz or glass set-square, a pentagonal prism or a screw-pitch attachment, a very large variety of engineering gauges and other products can be quickly tested. For example, it affords a rapid means of checking the truth of the various motions in a universal milling machine and the relations of these motions to each other. The importance of this new tool lies in the fact that the order of magnitude of the errors it conveniently measures is that commonly met with in ordinary engineering practice.

Theory of the Ionosphere

H. G. BOOKER (*Proc. Roy. Soc.*, June 1) has published calculations of the behaviour of vertically propagated wireless waves in an ionised medium in which both the concentration of the ions and the chance of collision between them varies with height. The calculation is made first for the core in which the earth's magnetic field is neglected. A simple variation of ionic density and collision frequency is assumed and it is shown that waves below a certain frequency are not reflected. As the frequency is raised from the critical value the strength of the reflected wave rapidly increases, reflection taking place at progressively increasing height. Very long waves may be specularly reflected by a different mechanism. In the presence of the earth's field there are two characteristic waves for which the complex refractive indices are different. Two approximations are available corresponding roughly to propagation along and across the lines of force, and it is shown that these approximations cover a large number of the possible cases. For frequencies near the characteristic magneto-ionic frequency, the extraordinary wave is nearly suppressed. A region of absorption may exist below the deviating region, and the dependence of absorption on frequency for high frequencies is different according to whether the absorption takes place in this lower region or in the neighbourhood of the reflecting layer.

Yale Stellar Parallaxes

WE have received the second edition of Schlesinger's "General Catalogue of Stellar Parallaxes", published by the Yale University Observatory. The second edition contains all trigonometric, spectroscopic and dynamical parallaxes available through publication or correspondence in January 1935. The convenience of having such a catalogue is self-evident, and the practice of issuing editions as frequently as is financially practicable is obviously commendable. The main catalogue lists the star's name, R.A. and Dec. for 1900, magnitude and spectrum, parallax (both trigonometric and spectroscopic), the proper motion and the DM number. Dynamical parallaxes are found in a supplementary catalogue. Prof. Schlesinger is to be heartily congratulated on the appearance of the second edition of his Catalogue.

Greenwich Stellar Parallaxes

H.M. STATIONERY OFFICE has published the "Observations of Stellar Parallax", Vol. 2, from photographs taken and measured at the Royal Observatory, Greenwich, under the direction of Sir Frank Dyson. The Greenwich parallax programme is limited to stars north of declination + 64°, that is, to the Greenwich astrographic zone. The plates were exposed in the Thomson 26-in. photographic reflector, of focal length 22 ft. 6 in., and each star was photographed at five epochs, at least four plates being secured at each epoch. The probable error of the average parallax is estimated at 0·0085″. The publication of the present volume brings the total of Greenwich parallaxes to 516 of which Nos. 267–516 appear in the present volume. The largest parallax found so far is 0·247″, and there are 37 parallaxes which exceed 0·050″. The present volume presents tables showing the distribution of absolute magnitude with spectral type. Details of each photographic plate are given in the main table in the volume, and the parallaxes, relative to the comparison stars, are tabulated in a catalogue at the end of the volume.

Work of the Chemistry Research Board

THE report of the Chemistry Research Board* drawn up by the present director, Prof. G. T. Morgan, summarises the work carried out in the Government Chemical Research Laboratory during the first ten years of its existence, and is an impressive record of a large amount of valuable research in various fields. Much of the work has an industrial bearing, and there has been useful collaboration with several firms, members of the staffs of which have been attached to the laboratory. A list of more than a hundred published papers is given, together with particulars of some thirty patents.

The first part of the report deals with researches on the corrosion of metals, which have had reference to the mechanism of corrosion in its relation to the prevention of rusting, tarnishing and corrosion of metals in industrial use. An anodic oxidation process for aluminium, in which the metal is protected by an oxide film produced electrically, was worked out, and a means of colouring aluminium has been adopted in industry. The protection of magnesium and its alloys, which are used in the aircraft, motor-boat and automobile industries, against corrosion by sea-water and motor fuels, is being studied, as well as the corrosion of locomotive boiler tubes, zinc and purified iron and steels.

The report then deals with high-pressure investigations, including the synthetic production of alcohols from carbon monoxide and hydrogen, and acetic acid from carbon monoxide and ethyl alcohol. The starting point of these syntheses is represented by materials obtainable from coal. The equipment recently constructed is designed for work at 3,000 atm. at a temperature of 200° C.

New methods of carbonising coal have led to the production of tars which differ considerably from those familiar in industry. New methods of separation have made possible the identification and classification of the components of tars produced by various methods. Certain tars contain phenolic constituents readily separable by distillation, and these, in solution in caustic soda, form a very efficient and cheap wetting-out agent for use in the textile industry, which is now marketed under the name of 'shirlacrol'. The application of high-pressure technique to coal tars has produced new compounds which have been tested for possible use in the dye industry.

A large amount of work has been done on synthetic resins, and a tough transparent resin has been obtained which resembles glass and may find application as a material for artificial dentures. Experiments with the object of making synthetic resins direct from tar oils indicate the possibility of simultaneously separating the valuable hydrocarbon oils. Resins formed in this way have been used for impregnation purposes, as they prevent the growth of mildew.

Since 1931, work has been proceeding in co-operation with the British Road Tar Association for the improvement in the efficiency and quality of road tars. It has been found that light, as well as air, may be important in connexion with the life of tar applied to roads.

Several problems concerned with micro-organisms have been dealt with. A method of preparing acetone-alcohol mixtures, useful as liquid fuel and otherwise, from straws and waste vegetable matter by fermentation has been demonstrated, and other investigations in this branch include the effects of micro-organisms in the deterioration of fabrics and in tainting live fish in rivers, and the degumming of silk by lower fungi instead of acids.

The preparation and testing of synthetic drugs in co-operation with the Medical Research Council, the production of a base-exchange material for water-softening from British clays, the action of drinking water on lead, and investigations of the rarer metals are other branches of work described in the report.

* Department of Scientific and Industrial Research. Report of the Chemistry Research Board for the Period ended 31st December 1934: with Historical Introduction and Report by the Director of Chemical Research. Pp. v+94. (London: H.M. Stationery Office, 1935.) 1*s*. 6*d*. net.

Conifers of the Balipara Frontier Tract, Assam

IN the *Indian Forester* of May 1935 (61, No. 5, *Civil and Military Gazette* Press, Lahore), Dr. N. L. Bor, of the Indian Forest Service and at present political officer, writes on "The Conifers of the Balipara Frontier Tract, Assam". As a forest officer in Assam, Dr. Bor has taken full advantage of exceptional opportunities to study the forest flora of the more unknown parts of the country; some of his best work in the almost unknown region of which he is now in charge is briefly described in the article under review. The flora of this section of the Himalaya was practically unknown up to recent times and he set to work to collect, the considerable results of his activities being now under examination at the Royal Botanic Garden, Sibpur.

The area of the Eastern Himalaya in question covers an enormous tract of country exhibiting every variety of climate from that of the sweltering plains of Assam to the arctic climate of the eternal snows. Its northern boundary is the lofty Sela Range which sweeps north-eastward from the Tibet-Bhutan border and divides the Balipara Frontier Tract from Tibet proper. It contains a number of peaks more than 21,000 feet in height. Several travellers, Bailey and Moreshead, Kingdon Ward and others, have crossed the Sela pass into Tibet, but the southern slopes to the east are unexplored.

Dr. Bor gives details of the configuration of the region, its extraordinarily variable climate, its geological features and inhabitants. A study of the latter

would appear a sufficiently heavy task, for from west to east "are to be found Sherchokpas, Sherdukpen, Tembangias, Khoas, Akas, Mijis, Miri Akas, Daflas, Apa Tanangs and Miris, all differing in language, custom and dress. . . . The Western tribes are peaceful and well disposed to us. The Daflas and Apa Tanangs are, however, inclined to be truculent and it is impossible to tour in their country without an escort".

The conifers discussed in the paper are *Pinus excelsa*, *P. longifolia* (in extensive pure forests), *Abies delavayi*, in pure crops on the northern slopes of Piri, between 9,000 ft. and 10,727 ft.; its home is in Szechuan, China, this being a new record of its presence in Assam. Associated with it are species of *Rhododendron*, oak, etc.

Perhaps the most interesting of the investigations carried out are those recorded in connexion with *Pinus excelsa*. This conifer occurs in two places only —the Tenga valley in the west and the Apa Tanang country to the east, two localities which are some 150 miles apart. In the Tenga valley the climate is dry, and the tree flourishes at between 5,000 ft. and 9,000 ft. Regeneration of the *P. excelsa* is very satisfactory if protection from fire is afforded.

The most interesting information with reference to this species comes from the Apa Tanang country. Here the rainfall is much higher, the elevation being 6,000–7,000 ft. The tree reaches a great size, 150 ft. in height with a girth of 14 ft. The wood of *P. excelsa* is used largely by the Apa Tanangs as fuel and for building material.

The most striking feature of this valley is the fact that the pine grows pure on the inner slopes only of the bowl, and pine trees are not found beyond the lip. On all sides the evergreen forest is apparently encroaching upon the pine, and dead pine trees can be seen emerging high above the evergreen forest on the inner side of the lip. A meticulous search in the pure pine forest failed to reveal a single seedling, showing that the pine seed cannot germinate and develop in the present conditions. It seems as if the pine is a remnant of a very large area of pure pine which is slowly dying out. In any event, it is clear that the *Quercus-Michelia-Acer hylium* is advancing upon it and will eventually prevail. This view is confirmed by certain of the Apa Tanang's elders, who told Dr. Bor that the area under pine has decreased even within their time, and that their forefathers had come to the same conclusion as that outlined above, and had as a consequence with considerable foresight ordered the tree to be raised in plantations. Seed is broadcast on hoed ground and the area protected from fire.

In the Zhob country of the Baluchistan frontier, the Sheranis attach equal value to the *Pinus gerardiana* both for its seed and timber, and endeavour to protect these forests from fire. But Dr. Bor's account of an aboriginal tribe successfully raising plantations by the cheap measures recorded must be unique.

Broadcasting in India

THE growth of radio broadcasting during recent years has been so marked that in most of the larger European countries, in the United States of America, in Australia and in Canada, the number of registered listeners exceeds five per cent of the population. Actually, the number of licensed listeners in Great Britain and Northern Ireland at the end of 1934 amounted to about 15 per cent of the population. In India, however, with its population of more than 350 millions, the number of registered listeners is less than 12,000, or about 0·003 per cent. This fact, with many others illustrating the very elementary stage attained by radio broadcasting in India, is given in a paper by Mr. K. Sreenivasan entitled "Development of Nation-wide Radio Broadcasting in India", published in *Electrotechnics* for April 1935.

After reviewing the ideals and objects of a national broadcasting service in any country, Mr. Sreenivasan discusses the status of broadcasting in various parts of the world, illustrating the main facts with a useful table of statistical data. He then passes on to the consideration of a broadcasting scheme suitable for India to replace the three existing transmitting stations. The suggested scheme involves the installation of about five national transmitting stations and sixty regional stations, with an additional five short-wave transmitters for international long-distance broadcasting. The proposed distribution of these stations is illustrated by a map, and the scheme is considered to be adequate to serve all interests and requirements, having due regard to the various languages involved. In the matter of power allocation, each of the national transmitters would have 250 kw. in the antenna, the regional stations would vary between 25 kw. and 75 kw., while the short-wave stations would be of 50 kw. rating. This gives a total power of nearly 5,000 kw., or about one watt per square kilometre for India, as compared with the existing figure of about 2·3 watts per square kilometre for Great Britain.

With regard to the distribution of receivers, Mr. Sreenivasan considers that, owing to the low standard of living prevalent in India, particularly in rural districts, there is no satisfactory alternative to community ownership of receivers and community listening. Even so, it is estimated that some $3\frac{1}{2}$ million receivers will be required as an immediate objective.

The paper then proceeds to a consideration of the outline of an organisation of an autonomous public utility type for the provision, maintenance and operation of this national broadcasting service. It is suggested that a central broadcasting council should work under a Minister of Communications, and in co-operation with a number of provincial broadcasting commissions. Further sections are devoted to proposals for financing the project and to the policy underlying the programmes to be provided. In conclusion, the author modestly expresses the hope that his paper will help to create a correct perspective of the vast problem involved in the matter of broadcasting in India, and will provoke reasoned discussion on this national question.

Studies of Nematocysts

IN a work of 700 pages (Travaux de la Station Zoologique de Wimereux, 10 and 11. Paris: Laboratoire d'évolution des êtres organisés, 1934. 125 frs. each) Robert Weill describes the results of his detailed observations on the Cnidaria with special reference to their nematocysts. His investigations have been made largely on fresh material derived from 113 species of cœlenterates.

A short historical summary is followed by a careful description of a nematocyst—an ovoid capsule with a circular opening at the narrow end closed by an operculum, and here the wall of the capsule is continuous with the tube enclosed in the capsule; the basal part of the tube is generally wider and straight, the distal part narrow and spirally coiled, and both parts of the tube have on the inner surface numerous spines inserted in groups of three. The tube is discharged through the terminal aperture and the remains of the operculum are usually demonstrable; at the same time the refringency of the capsule is lost, for its contents have been expelled. The author describes the wide variations in size of the nematocysts, from 5μ in length in some Alcyonaria to 1·12 mm. in length in the siphonophore *Halistemma*.

Weill classifies the different types of nematocysts into those with closed tube, of which there are three kinds, and those in which the tube is open at its tip, of which fourteen kinds are recognised. He discusses the question of nerve supply to the nematocyst cell and concludes provisionally that a nervous connexion is unlikely. The author is very decided that the discharge of the tube is not by its unbending, like a spring, but by its devagination, for by retarding the process the stages of extroversion can be followed under the microscope. The tube is longer and wider after discharge—it may be doubled in length—hence its wall is elastic and in the undischarged nematocyst is in a state of disequilibrium. After discussing the mechanism of discharge, the author accepts the view of Iwanzoff (1896) that the discharge is due to swelling of the contents of the capsule. Discharge can be brought about only in presence of fluid which penetrates the capsule, but what determines the endosmosis is not yet known.

The author describes his observations on the development of nematocysts, and traces the migrations of the nematocyst cells, for example, in the Lucernaridæ, from their origin in thickened ectoderm at the edge of the subumbrella to the tentacular knobs. Fully formed nematocysts appear to remain functional indefinitely. About three hundred pages are devoted to a consideration of the taxonomic value of the cnidome, that is, the ensemble of the nematocysts presented by a particular species of cœlenterate. In discussing the Gymnoblastea, considered to be an artificial and heterogeneous group, Weill considers that *Hydra* represents not a primitive but one of the most complex genera, and should be placed near the Tubulariidæ. The study of the cnidome confirms the distinction between the Milleporidæ, which are allied to Gymnoblastea, and the Stylasteridæ, which are near the Calyptoblastea. Incidentally, the author does not accept Willey's observation that the filament of a discharged nematocyst of *Millepora* can be withdrawn or retracted. In their cnidome the Scyphozoa approximate more to the Hydrozoa than to the Anthozoa. Alcyonaria have a homogeneous cnidome different from that of Zoantharia. The bearing of the cnidome on the classification of anemones and corals is discussed.

This important monograph concludes with an extensive bibliography and an index of the genera and species referred to in the work.

British Association at Dublin in 1835

THE fifth meeting of the British Association was held at Dublin during the week beginning August 10, 1835. The president was Dr. Bartholomew Lloyd (1772–1837), provost of Trinity College, Dublin, the vice-presidents, Lord Oxonantown and the Rev. William Whewell, while the local secretaries were William Rowan Hamilton (1805–1865), Astronomer Royal of Ireland, and Humphrey Lloyd (1800–1881), Erasmus Smith professor of natural and experimental philosophy. The scientific proceedings were dealt with in six sections: (I) Mathematics and Physics; (II) Chemistry and Mineralogy; (III) Geology and Geography; (IV) Zoology and Botany; (V) Anatomy and Medicine; and (VI) Statistics, to which was added during the meeting the subsection on Mechanical Science Applied to the Arts. The meeting was largely attended, and there was a great deal of entertaining. Among the most famous men of science who were present were Sedgwick, Ross, Franklin, Agassiz, Dalton, Lardner, Babbage, Murchison, Rennie, Sabine, Wheatstone, Scott Russell and Eaton Hodgkinson. During the meeting the University conferred degrees upon William Smith, Sir Thomas Brisbane, Francis Baily, Prof. Moll and M. Agassiz.

Official reports of the proceedings were communicated to the editors of the *Philosophical Magazine*, and the daily papers gave accounts of some of the meetings. Perhaps the liveliest reports of the meeting were those published in the *Athenæum* of August 15, 1835, and succeeding issues, and from these a few extracts have been taken. The first portion of the report said: "The British Association has received, as we anticipated, a great accession to its members in Dublin, though many who intended to join it have been detained by their Parliamentary duties and by the Assizes. Still so many candidates presented themselves that the local council was compelled to place some restrictions on admission and to refuse, unless under special circumstances, all

applications made after Wednesday, the 5th of August, by persons residing in Dublin. . . . The arrangements made by the reception committee were excellent. . . . Accommodations were provided for a great number of guests within the walls of the College, and arrangements made for their breakfasting and dining together in the College Hall, by which the intercourse between the members has been greatly facilitated. . . ."

On Saturday, August 8, the Examination Hall of Trinity College was crowded. "Sir John Ross, Sir John Franklin, Dr. Coulter, the recent explorer of Mexico, Dr. Dalton, Dr. Roget, Professors Babbage, Powell, Murchison and many other eminent men, were among the crowd, evidently enduring some inconvenience, that they might gratify the curiosity they had excited. . . . In the list of names of members admitted on Saturday were to be found men of every creed, sect and party—Protestant clergymen, Catholic priests, and dissenting ministers—all anxious to gain a respite from agitating controversies, and enjoy a week's repose on the neutral ground of science. Visitors streamed into Dublin by the packet boats on Monday morning but by about eleven o'clock the whole of the Sections were in working order. The General Meeting of the Association took place in the Rotunda where Dr. Lloyd delivered his address and Prof. Hamilton read a report. The last function was a farewell dinner given by the Provost and Fellows of Trinity College to the Lord Lieutenant, Lord Musgrave, and 300 of the members of the Association. Just before the dinner Lord Musgrave conferred a knighthood on Hamilton, remarking in his speech, 'This is an exercise of one of those prerogatives of royalty, of which I am here the representative, most grateful to myself—most in unison I feel assured with the wishes of that august sovereign on whose behalf I act. . . . This act does not so much confer distinction, as place the royal, and therefore national, stamp upon that distinction, which has been acquired by personal qualifications and individual executions.' . . ."

In his summing up of the meeting, the correspondent of the *Athenaeum* wrote: "The meeting of the Association is now over and before we proceed to draw up a record of its proceedings we must say a few words on the general results of the week, and the impression left on our minds. On former occasions hospitality has been shown by the residents of the place of the assemblage to the way-faring visitors, and the business has preserved the 'even tenor of its way'; but in Dublin, notwithstanding the unusual quantity and quality of the scientific communications, business has been positively perplexed by the joyousness and festivities of the occasion. . . . Setting aside the distraction of mind incidental to the crowding together so much business . . . the vast number of all classes and pretensions who have joined the Association, and flocked to its halls, cannot have but disturbed the march of the proceedings. Imagine the Rotunda—a room capable of accommodating from 1,500 to 2,000 individuals—thronged to excess on some of the hottest evenings of this hot and cometary season: the ladies flirting and fanning; the gentlemen casting one eye upon Science and another upon Beauty; and the whole (saving the reader's presence) mopping and puffing and ready to drop with exhaustion and fatigue. . . . Even in the Sections themselves, the scientific men were not left in peace; both sexes were eager to attend them; and the ladies, as they could not be in the whole at once, made the best of their case by crowding in shoals to that particular section where the business was of the most abstract and recondite character. . . . The admission of ladies at the Sectional meetings, in direct opposition to the standing rule of the Association, is so manifestly calculated to destroy the efficiency of the Society, that we trust that there will be no repetition of this impropriety".

The treasurer of the Association in his report said that the receipts of the preceding year in Edinburgh were £1,626, while in Dublin they amounted to £1,750. It was very gratifying to be able to state that grants for the advancement of science of £1,700 had been placed at the disposal of the committee in 1835.

Educational Topics and Events

CAMBRIDGE.—F. R. Parrington, of Sidney Sussex College, has been appointed University demonstrator in zoology, and Dr. R. Knox and Dr. G. P. McCullagh have been appointed University demonstrators in pathology.

The Marmaduke Shield Scholarship for 1935 has been awarded to G. W. Harris, of Emmanuel College.

The offer of the Rev. J. H. T. Perkins, to give to the University a sum for the establishment of a Michael Perkins Fund, the interest of which is to be employed in making grants to young graduates working upon the natural history of animals, has been gratefully accepted.

DR. MARGARET S. SMITH has been appointed lecturer in agricultural chemistry and physics at the Horticultural College, Swanley, Kent, and will take up her duties in September.

THE University of Durham Act, 1935, which has now received the Royal Assent, sets up the following body as the University of Durham Commissioners for making Statutes for the University and its constituent divisions and colleges: The Rev. F. H. Dudden (chairman); Countess Grey; Sir W. Ross Barker; Prof. J. H. Priestley; Mr. C. Williams; Dr. G. R. Murray; Dr. T. F. Sibly; and Dr. A. Wood. Mr. A. C. Dawes will act as Secretary to the Commissioners.

THE New South Wales Ministry of Public Instruction in its last annual report gives information on the progress of its system of correspondence teaching, a system which some authorities in America would adopt in certain sparsely populated areas. The average enrolment of pupils taught by correspondence was 5,300 in primary and 210 in secondary grades, and the system, begun fifteen years ago, is reported to be still meeting with marked success. The provision of secondary education up to the intermediate standard was a new development, the outlook of which is promising. In each section of the primary department a special class of backward pupils receive special treatment. A weekly half-hour broadcast from the correspondence school is a feature said to be much appreciated and is used for answering questions. Associated with the system are voluntary donations by the pupils, amounting up to date to more than a thousand pounds, towards certain charities for the benefit of children.

Societies and Academies

PARIS

Academy of Sciences, June 24 (*C.R.*, 200, 2129–2250). ALFRED LACROIX : The tectites of Indo-China without figured forms. These are not large drops of glass shaped by fusion in the course of their fall, but the debris of larger blocks, probably fractured by shock on striking the ground. GEORGES URBAIN, PIERRE WEISS and FÉLIX TROMBE : A new ferromagnetic metal, gadolinium. The specimen of gadolinium used was pure except for 0·7 per cent of silicon and 0·03 per cent of iron. This metal is ferromagnetic. The absolute saturation reached 253·5 c.g.s. units, that of iron being 221·7. The Curie point is 16° C. LUCIEN CAYEUX : The constitution of the Senonian phosphates of Egypt. JEAN BAPTISTE SENDERENS : The catalytic decomposition of the monobromo derivatives of fatty hydrocarbons. The alkyl bromides behave similarly to the chlorides, except that the temperatures required are higher. GEORGES DURAND-VIEL was elected a member of the Section of Geography and Navigation, in succession to the late Ernest Fournier. A. KULAKOFF : Some theorems connected with Burnside's problem. ANTONIO MONTEIRO : A class of Fredholm nuclei developable in series of the principal nuclei. HENRI MINEUR : The absolute magnitude of *B* stars with emission lines. The results of the analysis show that these stars do not differ from the ordinary *B* stars from the point of view of their absolute brightness, the emission arising from the large extension of their atmospheres. MARC DE HEMPTINNE and JEAN SAVARD : The ionisation potential of the nitrogen molecule. The method of electronic shocks has been utilised and the apparatus calibrated with argon and mercury. The energy of dissociation of the molecule N_2 calculated from the results, 6·72 volts, is in good agreement with the 6·8 volts deduced by Henry by another method. NICOLAS STOYKO and RAYMOND JOUAUST : The velocity of propagation of short radio-electric waves. FRANÇOIS CROZE : The general formulæ of refraction of a light pencil. YEU KI-HENG and YEOU TA : A new method for studying the corrosion of aluminium by soda. The metal is attacked by dilute soda solution in the presence of sodium tartrate, and the reaction followed by measurements of the rotatory power. A higher accuracy can be obtained by following the rotation than by the usual loss of weight method. M. MAHMOUD GHALI : A method for measuring the velocity of fall of spheres in a viscous liquid. A photo-electric cell in conjunction with an electrical recording apparatus is used : the time can be measured to 0·001 second. ANDRÉ PIGNOT and HUBERT GAUDRY : The useful surface of the membranes of pressure regulators. LÉON ARTSIMOVITCH, IGOR KOURTSCHATOV, LÉON MICCOVSKII and PIERRE PALIBIN : Concerning the capture of slow neutrons by a nucleus. IGOR KOURTSCHATOV, LÉON NEMENOW and IVAN SELINOW : The artificial radioactivity of ruthenium bombarded by neutrons. R. GRÉGOIRE : Bragg's curve of the H-rays. A. PERRET and R. PERROT : The cryoscopy of mixtures of nitrogen peroxide and bromine. No evidence could be obtained for the existence of the compound NO_2Br. MARCUS BRUTZCUS : A method for calculating *a priori* the calorific power of a technical combustible. The method is based on the quantity of oxygen required for complete combustion. A. MICHEL and GEORGES CHAUDRON : The influence of magnetisation at a high temperature and of crystallisation on the form of thermomagnetic curves. TCHENG DA-TCHANG and LI HOUONG : The precipitation of titanium as phosphate. Determination of the correct acidity for complete precipitation of titanium as phosphate. CLÉMENT DUVAL : A new method for studying complex compounds. A modified method for the study of the migration of ions under the action of an electric field can be applied to the examination of various complex compounds. Examples of the results obtained are given. EDMOND GRILLOT : Lead acetobromide. L. DOMANGE : The action of steam on some metallic fluorides. The results of experiments with the fluorides of silver, zinc and lead are given. PAUL BRASSEUR : Study of ferric orthophosphate. Description of the preparation and properties of anhydrous $FePO_4$. HENRI MOUREU and CLÉMENT HAMBLET : The mechanism of the reaction between liquid ammonia and tantalum pentachloride. The experiments show that in $TaCl_5$ two of the atoms of chlorine are more readily removed than the remaining three. PIERRE TRUNEL : The electric moments of isobutyl, isopropyl and phenyl chlorosulphites. G. DARZENS and ANDRÉ LÉVY : A new method of synthesis of derivatives of hydrophenanthrene and phenanthrenic hydrocarbons. MARCEL GODCHOT and MAX MOUSSERON : Some derivatives of 1,methyl.2,cyclopentanone and of 1,methyl.2,cyclopentanol. GEORGES BRUHAT and LOUIS WEIL : The measurement of the rotation of the plane of polarisation in oblique crystalline refraction. ANTONIN LANQUINE : New tectonic and stratigraphical observations on the zone of folding of Aups (Var). ANDRÉ DEMAY : The alternating or simultaneous action of magmatic and dynamic phenomena in the northern Cevennes. LOUIS DANGEARD and CHARLES BATARD : The conglomerates interposed in the Brioverian schists, to the north of the Coëvrons (Mayenne and Sarthe), and the nature of the cadomian movements. GILBERT MATHIEU : The tertiary faults of Vendée. MARCEL GESLIN : The influence of a current of warm water on the air and radon dissolved in a cold water. V. FROLOW : The annual component (pluviometry and hydrometry in the Argentine). ALEXANDRE DAUVILLIER : Study of the terrestrial field, of the atmospheric ionisation and of the vertical current at Scoresby Sound during the polar year. MLLE. MADELEINE FRIANT : The jugal dental type of *Pteromys xanthipes*. MLLE. MADELEINE FOURCROY : Modifications of the insertions of the rootlets in wounded roots. PIERRE POTEL and RAYMOND CHAMINADE : The oxido-reduction potential of flours. SERGE TCHAKOTINE : Physiological researches on the Protozoa made by means of the ultra-violet micropuncture. JEAN RIPERT and OLIVIER GAUDIN : The relative toxicity of pyrethrines I and II. ETIENNE WOLFF and ALBERT GINGLINGER : The characters of the intermediate sexual forms obtained experimentally in the embryo of the fowl. PAUL CRISTOL, RAYMOND SEIGNEURIN and JEAN FOURCADE : The absence of dissociation of thiourea and substituted thioureas in dilute aqueous solution.

AMSTERDAM

Royal Academy (*Proc.*, 38, No. 6, June 1935). W. H. KEESOM, J. MAZUR and J. J. MEIHUIZEN : The vapour pressures of solid krypton. Measurements between 78° and 116° K. and their comparison with the theoretical formula. W. H. KEESOM and

C. J. MATTHIJS : Measurements on thermoelectric forces from 17·5° down to 2·5° K. Extension of previous work to other alloys and lower temperatures. W. H. KEESOM and C. W. CLARK : The heat capacity of potassium chloride from 2·3° to 17° K. Measurements for the purpose of testing whether the rapid fall of the θ values for silver at lowest temperatures is due to the heat capacity of the conduction electrons. H. R. KRUYT and TRUUS KRUYT : Investigation on positive and negative carbon surfaces by adsorption of thorium B. The results indicate that OH ions form the surface of positive carbon and COOH that of negative carbon. E. DUBOIS : On the gibbon-like appearance of *Pithecanthropus erectus*. While possessing many gibbon-like characteristics, *Pithecanthropus erectus* fills the previously vacant place between the *Anthropomorphae* and man as regards cephalic coefficient. J. WOUDA : A new type of colorimeter. An apparatus which determines the re-emission of a coloured surface and automatically calculates the colour point. J. F. SCHOUTEN : Foundations of a quantitative four-colour theory (1). H. BULTHUIS : The spectrum of CO^+. Rotational analysis and perturbations of the $^2\Pi \rightarrow {}^2\Sigma$ bands. C. VISSER : On the angular derivative of univalent functions (2). C. S. MEYER : Integral representation of Lommel and Struve functions (1). W. VAN TONGEREN : Chemical analysis of rocks from Pulu Berhala. Analyses of the rocks described in the next paper. J. DRUIF : On rocks from Pulu Berhala (Malakka Strait). J. OUDMAN : Food reception and transport by the leaves of *Drosera capensis*, L. The growing leaves of this insectivorous plant do not form albumen from their food. IDA LUYTEN : The periodic development of *Iris reticulata*. J. B. THOMAS : The regulation of the breathing of *Lumbricus*. Oxygen consumption of worms in atmospheres of diminishing oxygen concentration was determined for normal specimens and for worms the hæmoglobin of which had been destroyed by carbon monoxide. H. DE JONG and A. GALLINEK : On surgical catatonia. The position of the surgical brain lesions which lead to catatonia in cats was determined.

BRUSSELS

Royal Academy (*Bull. Classe Sci.*, **21**, No. 6, June 1935). L. GODEAUX : An observation on the rational correspondences between two algebraic surfaces. J. E. VERSCHAFFELT : The relation between the coefficients of the Ettingshausen and Nernst transverse magnetic effects. A discussion of papers of the same title by Mlle. Dupont. E. DE WILDEMAN : Adventitious buds in *Hæmanthus*. P. MORTIER : Molecular polarisation and association of ethyl alcohol in various solvents. Measurements of the dielectric constant of solutions of ethyl alcohol in benzene, carbon tetrachloride, hexane, heptane and carbon disulphide. L. MARTON : Electronic microscopy of biological objects. Description of apparatus. M. H. WUYTS and MLLE. A. LACOURT : The constitution of the thiohydrazides. These compounds can be methylated both at the α or β nitrogen atom and at the sulphur atom. A. DE WAELE : Researches on the migrations of the Cestodes (5). Study of the infection of the definite host by the hydatic larva. M. and R. BOUILLENNE : The soluble sugars in *Mercurialis Perennis*, L., (2). Nature of the soluble sugars and their respective amounts in the two sexes. P. DUSTIN : Note on the comparative histology of the splenic arterial coatings. Histological experiments to determine the function of the arterial coatings. F. CORIN : Discovery of a spilitic series and of pillow-lavas in Hesbaye.

MELBOURNE

Royal Society of Victoria, June 13. HELEN T. PATERSON : Notes on plant remains from Narracan and Darlimurla, South Gippsland. EDWIN SHERBON HILLS : A noteworthy specimen of *Spaniodon elongatus*, Pictet, from the Upper Cretaceous of Mount Lebanon, Syria. The specimen described shows the caudal half of a small fish (? *Spaniodon* fry) lying in the abdomen of a large individual of *Spaniodon elongatus*. It is argued that the small fish was swallowed by the large, and when fossilised, was lying with its anterior parts digested, in the stomach of the *Spaniodon*. The contents of part of the intestinal tube of the latter are also fossilised, and it is thought that this tube must have been relatively small and straight. The feeding habits of *Spaniodon*, as indicated by this specimen and by its large teeth, are considered to be incompatible with its taxonomic position in the *Engraulinae*.

VIENNA

Academy of Sciences, May 16. JOVAN JURIŠIĆ : Contribution to the knowledge of *Bryophyllum tubiflorum*, Harvey. WOLF JOHANNES MÜLLER and O. HERING : Theory of passivity phenomena (27). Time phenomena in anodic polarisation at smooth platinum in 2*N* sulphuric acid. In this polarisation, the pore surfaces first become coated with oxide, oxygen being evolved only at a subsequent stage. GEORG KOLLER and WALTER MAASS : A component of *Baeomyces roseus*, Pers. A lichen acid, $C_{19}H_{18}O_8$, is described. ALEXANDER KÖHLER : Optical investigations on synthetic mixed members of the felspar group. FRITZ KERNER-MARILAUN : Studies on the winter temperatures in alpine zone seas of the Keuper period. ARMIN DADIEU and HANS KOPPER : Raman spectra of HSD and ND_3. The Raman spectrum of HSD consists of two lines of frequencies 1880 and 2585 cm.$^{-1}$, which correspond with those of the spectra of D_2S and H_2S respectively. The spectrum of ND_3 consists of four lines of frequencies 2341, 2399, 2500 and 1588 cm.$^{-1}$, the relative intensities being 5, 5, 3 and 0 (?). ARMIN DADIEU and WOLF ENGLER : Raman spectra of SeH_2, SeD_2 and SeDH. The spectra of SeH_2 and SeD_2 consist each of a single strong line, the frequencies being 2312 and 1665 cm.$^{-1}$ respectively. These compounds should yield at least two Raman-active frequencies, the appearance of only one being explained by a valency angle of about 90°. The two lines of the spectrum of SeDH have the frequencies 2313 and 1671 cm.$^{-1}$. KARL MAYR : The position of the first positive null points of Bessel's functions of the first type. ROBERT WILLHEIM and CHARLOTTE FRISCH : Chemistry of crab glycolysis (1). Boiled crab juice contains factors which exert a reducing action, so that they disturb oxidative reactions. OTTO KOLLER : Note on a zoological research expedition to the mountains of north-western Asia Minor. ODOMAR GUGENBERGER : Stratigraphical position of the cephalopod fauna of the Casale Mountains, Palermo. EMIL ABEL and L. BLUMENKRANZ : Oxidation of oxalic acid by iodic acid when the stationary condition of the intermediate product is disturbed. ALEXANDER ROLLETT, NIKOLAUS KUNZELMANN and MAGDA BALOG : Investigations on azo dyes.

Forthcoming Events

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

Sunday, August 11

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. J. Smart: "Insects".*

NATIONAL RADIO EXHIBITION, at Olympia, August 14–24.

Official Publications Received

Great Britain and Ireland

Forestry Commission. Fifteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1934. Pp. 102+6 plates. (London: H.M. Stationery Office.) 2*s*. net.

The Academic Assistance Council. Second Annual Report, 20th July 1935. Pp. 14. (London: Academic Assistance Council.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1600: Combined Index to the Technical Reports of the Advisory Committee on Aeronautics 1909–10 to 1918–19. Compiled by H. J. Sayers and G. B. Wardle. Pp. 162. 8*s*. net. No. 1645: Report on Puss Moth Accidents. By the Accidents Investigation Sub-Committee. Pp. 32+15 plates. 1*s*. 9*d*. net. (London: H.M. Stationery Office.)

The Royal Society for the Protection of Birds. Forty-fourth Annual Report (January 1st to December 31st, 1934), with Proceedings of Annual Meeting, 1935. Pp. 54. (London: Royal Society for the Protection of Birds.)

Leeds University: Department of Pathology and Bacteriology. Annual Report, by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research, by Prof. R. D. Passey. Pp. 17. (Leeds: The University.)

London Museum Catalogues. No. 1: London and the Vikings. Pp. 55+10 plates. 1*s*. net. No. 3: London in Roman Times. Pp. 211+61 plates. Paper, 2*s*. net; cloth, 2*s*. 6*d*. net. No. 6: London and the Saxons. By R. E. M. Wheeler. Pp. 201+21 plates. 1*s*. 6*d*. net. (London: London Museum.)

Bericht über die 11 Versammlung der Internationalen Föderation Eugenischer Organisationen, Konferenzsitzungen vom 18 bis 21 Juli 1934 im Waldhaus Dolder, Zürich, Schweiz. Pp. 84. (London: International Federation of Eugenic Organisations.)

British Standards Institution. British Standard Specification for Laboratory Incubator, Water Bath and Oven Thermometers. (No. 619–1935.) Pp. 10. (London: British Standards Institution.) 2*s*. net.

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 9: (a) Some Interspecific Hybrids in the Genus Gossypium, (b) A Hybrid between *G. Davidsonii* and *G. Sturtii*. By A. Skovsted. Pp. 28. 2*s*. 6*d*. No. 10: (a) Homologous Genes for Anthocyanin Pigmentation in New and Old World Cottons, (b) A Third Series of Experiments with the Crinkled Dwarf Mutant *G. barbadense* L.—The Cross *barbadense* crinkled × *hirsutum* crinkled, (c) The Inheritance of Brown Lint in New World Cottons. By S. C. Harland. Pp. 30. 2*s*. 6*d*. (London: Empire Cotton Growing Corporation.)

First Report of the Commissioner for the Special Areas (England and Wales). (Cmd. 4957.) Pp. viii+106. (London: H.M. Stationery Office.) 2*s*. net.

Economic Advisory Council. East Africa Sub-Committee of the Tsetse Fly Committee: Report. (Cmd. 4951.) Pp. 56. (London: H.M. Stationery Office.) 1*s*. net.

The Animal Year Book. Vol. 3. Pp. vi+182+8 plates. (London: University of London Animal Welfare Society.) 2*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1624 (T. 3451): Tests on Models of Armstrong Whitworth Four-engined Monoplane. By W. L. Cowley, Dr. R. Warden and G. A. McMillan. Pp. 13+4 plates. 9*d*. net. No. 1630 (T. 3448–3551): Abstract—An Application of Matrices to Oscillation Problems. By Dr. W. J. Duncan and A. R. Collar. Pp. 5. 4*d*. net. No. 1631 (S. and C. 598): Forces and Moments on a "Puss Moth" Model. By A. S. Batson. Pp. 5+16 plates. 6*d*. net. No. 1643 (Strut. 201): Approximate Method of Determining Aerodynamic Loading on Wings of Monoplane. By A. G. Pugsley. Pp. 8+5 plates. 6*d*. net. No. 1646 (S. 143, 164): Hydrodynamic Forces and Moments on a Simple Planing Surface and on a Flying Boat Hull. By W. G. A. Perring and L. Johnston. Pp. 23+21 plates. 1*s*. 6*d*. net. (London: H.M. Stationery Office.)

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1934 May 1—1935 April 30. Pp. 4. (Cambridge: Observatory.)

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