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Science and Citizenship

DURING the past generation, scientific men have generally adopted an attitude of indifference to politics, and active interest or participation in political controversy has been discouraged by the leaders of British science. It must be admitted that there is much to justify a policy of aloofness. The world of political discourse is pre-eminently emotive, and political controversy proceeds with little regard for the standards which make up the professional ethic of scientific workers. The wrong things are done for the right reasons: the right things are done for the wrong reasons. Effective action calls for an opportunism alien to the temperament of genuine research, and the issues which divide political parties have little relation to the creative possibilities of applying science on a larger scale to the advancement of human welfare.

The position of agriculture is a sufficient illustration of this irrelevance. Within the framework of competitive private enterprise British agriculture has declined, while a lop-sided mechanical technology has brought forth increasing urban congestion increasingly vulnerable to chemical and aerial warfare. That biotechnology would receive a powerful impetus, and that science in general would benefit from the collectivisation of agriculture as part of a rational population policy, is a view which would receive a sympathetic hearing from many scientific workers who are not collectivists in principle. Also this is probably the last thing which our political collectivists would ever think of doing.

Of late there have been signs that representative leaders of the scientific movement realise a new danger in repudiating the responsibility of the scientific worker as citizen. The retiring address of Sir Frederick Gowland Hopkins from the

presidential chair of the Royal Society, Sir John Orr's recent book and articles, and pronouncements by Prof. F. Soddy, Sir Daniel Hall, Dr. Julian Huxley, Prof. J. B. S. Haldane and others are symptomatic of a new orientation; and there is little doubt that they have the ear of the younger men of science. For various reasons—the betrayal of scientific freedom in present-day Germany, the frustration of medical progress by large-scale unemployment, the impetus which biological research has received from collectivist agriculture in the Soviet Union, and the shadow of a war which may destroy civilisation—there is a new awareness of social responsibility among the rising generation of scientific workers. There are no doubt many who agree with the views expressed in the letter on "Scientific Workers and War" which appeared in *NATURE* of May 16, in addition to those who signed it.

In great formative periods of British science, the man of science has been keenly alive to the social implications of his work. The "Invisible College" was formed by men inspired, as Spratt, its first historian tells us, by Bacon's eloquent plea: "The true and lawful goal of science is that human life be endowed with new powers and inventions." Boyle himself reiterated the common objective that "the goods of mankind may be much increased by the naturalists' insight into the trades". The British Association was formed to carry on the same task. Neither the character of political controversy nor the shortcomings of present parties is a sufficient reason for the attitude repudiated in an address entitled "Science in a Changing World" delivered at the Royal Institution on May 15. The man of science is a citizen as well as a scientific worker. If contemporary political discussion takes little stock

of the possibilities of human welfare which science can offer, it is his special responsibility to emphasise it by popular exposition or in an expert advisory capacity to any parties which will listen and act accordingly. The suggestion that he is neglecting his serious business if he does so is reminiscent of the Wee Free Minister who said that a man who plays golf neglects his business, neglects his wife and neglects his God. No one ventures to criticise the efficiency of a man of science because he is caught red-handed in the act of golf.

There are several ways in which scientific workers can exercise their responsibilities as citizens without committing themselves to a party label. One way is to co-operate with such organisations as the Next Five Years Group, P.E.P., the Malnutrition Committee, or the Engineers' Study Group, whose activities have been referred to in these columns already. Another is to press the claims of new personnel equipped with knowledge to bring the method of science into the field of social inquiry.

In his purely professional capacity the scientific worker remains an integral part of the society in which he lives, whether he chooses to accept responsibility for the uses to which science is put or prefers to make the plea that it is not his fault if poison gas is used against human beings instead of locusts. The extent to which pure

science is subsidised is a measure of social confidence in its capacity to provide fresh food for applied science. In its turn, the encouragement of applied science depends on the social machinery for distributing as well as producing its amenities. What is called over-production is a misleading synonym for under-consumption, and under-consumption means that existing social machinery is embarrassed by "new powers and inventions". The continued progress of science therefore depends on the organisation of consumption.

The popular appeal made by the proposal for a moratorium on inventions is a real danger which now threatens scientific progress. The undercurrent of press criticism which places the blame for unemployment on a supposedly too rapid growth of technical knowledge is reinforced by fear of the vast destructive potentialities which science has conferred on warfare. To reflect that the responsibility lies with the Government may reassure the conscience of the individual man of science. One may well doubt whether such reflections will satisfy the plain man, or save science from the wreckage, if events shape as Mr. Wells forecasts. Brilliant cultures have been eclipsed in the past, and followed by ages of darkness. This may be the fate of our own social culture. If so, social aloofness may prove to have been the betrayal of the scientific movement.

Lowell: Traveller and Astronomer

Biography of Percival Lowell

By A. Lawrence Lowell. Pp. x+212+5 plates. (New York: The Macmillan Co., 1935.) 12s. 6d. net.

THE life of Percival Lowell by his brother, the president of Harvard College, tells of a very attractive and enthusiastic man. His parents, who belonged to the aristocracy of Boston, brought him up to see that, whether rich or poor, he ought to do a life's work. Born in 1855, he graduated with distinction in 1876, and after a year's travel spent six years in business as the head of a large cotton mill. He resigned this post in 1883, and went to Japan to study the language and manners of the people. With Prof. Perry he made a trip from Tokio over the mountains to the other side of the island and was struck by the influence of the West on the political conditions of the country. On his return he accepted with diffidence an appointment as foreign secretary and counsellor

to a mission from Korea to the United States. On his return to Japan he accompanied the mission to Söul. He gives an account of this journey with a study of the Koreans in his first book "Chösou—the land of Morning Calm—A Sketch of Korea".

A most interesting chapter taken from an article by Lowell in 1886 in the *Atlantic Monthly* describes the retreat of the Japanese Embassy from Söul after a Korean *coup d'état*. In 1888 he wrote "The Soul of the Far East" and contrasted the 'impersonalism' of the East with the individuality of the West. This book was translated into many languages and was greatly appreciated by such different critics as Dr. Pierre Janet, the French neurologist, Lafcadio Hearn and Dr. Clay Mackenzie, a Unitarian missionary to Japan.

Lowell made two further visits to Japan. One of these coincided with the murder of Mori, a progressive Japanese minister, of which he gave

an account in the *Atlantic Monthly*. In his next visit, in 1891, with his friend George Agassiz, he climbed the sacred peak of Ontake and collected materials for a work on Shintoism, published in 1895 with the title "Occult Japan or the Way of the Gods".

Lowell's interest in astronomy was awakened by Schiaparelli in 1891, and in 1893, at forty-eight years of age, he definitely forsook Japanese for astronomical researches. He was blessed with extraordinarily good eyesight, and wisely determined to find a site for an observatory where the atmospheric conditions would admit of its use. He sent Mr. A. E. Douglass with a six-inch refractor on a tour of investigation, and on his report decided on Flagstaff in Arizona at an altitude of 7,250 feet. Here an eighteen-inch refractor made by Brashear was set up and, after a year's observations in 1894, he concluded that Mars had intelligent inhabitants. The site was found to be so satisfactory that a permanent observatory was decided upon and a very fine 24-inch refractor by Alvan Clark was installed.

Here Lowell worked assiduously with W. H. Pickering through the greater part of each night on Mars, while Mercury and Venus were observed in the evening or early morning by A. E. Douglass. Schiaparelli discovered 140 canals, while between 700 and 800 were found at Flagstaff, a wonderful result when it is realised that, with the highest magnification, Mars is seen no better than the moon with the naked eye. His conclusions were embodied in two works "Mars as the Abode of Life" and "Mars and its Canals". Barnard, with an equally good eye, and with a large telescope which at moments of good seeing was equal to that at Flagstaff, denied the existence of these geometrical lines, but found short diffused hazy lines running between the black spots on the

planet. The present position is summed up in Russell, Duggan and Stewart's "Astronomy" (p. 336).

"It is generally recognised that there exists an objective basis for the canals in the form of fine detail on the surface of Mars, and it is widely believed that these details have, in a general way, the streaky character of the canals; but the existence of a geometrical network is doubted or denied by a great majority of astronomers."

We cannot agree with the author on the value of Lowell's mathematical researches. His mathematics appears to us rather shaky. As an example we may refer to his paper on the oblateness of a rotating planet in *Phil. Mag.*, 19, 708. But we are indebted to this shaky mathematics for the discovery of Pluto. The discovery of Neptune by Leverrier and Adams resulted from a well-recognised discordance of 2' from its theoretical place. On the contrary, the discordances of Neptune from its theoretical positions amounted to only a few seconds, which could be explained by a slight adjustment of the elements of its orbit. Comparison of Pluto's brightness with the satellite of Neptune leads to the conclusion that its mass is probably about one-tenth of the earth, and its effect on Neptune inappreciable. We must, however, express our admiration of the confidence Lowell had in his prediction, with which he inspired the search for the planet found in January 1930, more than thirteen years after his death.

Lowell added to the Observatory admirable spectroscopic equipment, and took part himself in observations for the rotation of the planets. He chose assistants of great ability, who have added to the renown of Lowell's Observatory. An appendix by H. N. Russell, giving an account of the later researches at Flagstaff, concludes this attractive biography. F. W. D.

Universities of the British Empire

The Yearbook of the Universities of the Empire, 1936

(Published for the Universities Bureau of the British Empire.) Pp. xxxi+1080+26+vi. (London: G. Bell and Sons, Ltd., 1936.) 15s. net.

THIS annual, which 'came of age' last year, having been first published in 1914, is now so well known that little needs to be said about the current year's issue beyond that it maintains the high standard of its predecessors. By far the greater number of its eleven hundred and odd pages are devoted, as usual, to university staff directories,

general information about the several universities and reports of events of the past year. Among the appendixes, those relating to post-graduate scholarships and grants for advanced study and research, and to centres of scientific research and information, have notably expanded in recent years, and now take up a tenth of the whole book. The problem of setting out the information collected on these subjects in a form readily intelligible and adapted for quick reference has been very satisfactorily solved.

The Yearbook is sparing in the matter of comparative statistics. Rows and columns of figures

are conspicuously absent. One knows that statistical tables are often worse than useless besides being costly, but the vacant space on page 18, for example, seems to cry aloud for a judicious summary of some of the returns published by the University Grants Committee. The nearest approach to a table of comparative statistics is Appendix xxv—students from other countries in the universities and university colleges of Great Britain and Ireland. This is compiled from returns received from all universities and university

colleges with the exception of Trinity College, Oxford. (Why this particular college abstains does not appear.) An interesting fact revealed in this appendix is that German students (430) largely outnumbered the representatives of any other country except India (1,181), the United States (578) and South Africa (542). Most of them (257) were in the London colleges. Four years ago, German students numbered only 141. Of European countries France and Poland were the next largest contributors, with 78 and 64.

Copper Resources of the World

XVI International Geological Congress
Copper Resources of the World. Vol. 1. Pp. vii+441+22 plates. Vol. 2. Pp. vi+443-855+ plates 23-41. (Washington, D.C.: XVI International Geological Congress, c/o U.S. Geological Survey, 1935.) 5 dollars each vol., 9 dollars the set, to Members; 6 dollars each vol., 10 dollars the set, to non-Members.

COPPER is one of the earliest metals known to man, and has always been an important commodity. Next to iron, it is the most valuable of base metals. In the early part of the nineteenth century, the world supply was obtained from the British Isles, chiefly from Cornwall, Devon and Anglesey, but about the middle of the century Chile became chief producer. During the last decade of the century the United States came to the front, a position she has maintained, although it appears that Africa attained a higher output figure in 1934.

World production in 1800 was about ten thousand tons per annum, but in the years preceding the Great War it had risen to close upon a million tons. During the War years this was increased by approximately a further half-million tons. For the first few years of the post-War period there was a slump owing to surplus stocks on the market, but in 1923 improvement set in and in 1926 the maximum War-time production had been exceeded. In recent years development of extensive deposits, for example, the so-called porphyry coppers, on a large scale by up-to-date methods has tended rather towards over-production, in spite of an ever increasing demand. The greater part of the copper used to-day is taken up by the electrical industry, and much of the remainder is used in alloys. In most of its uses copper has no substitute.

The two volumes under review constitute the sixth work of its kind compiled under the auspices

of the International Geological Congress; the earlier publications dealing with iron, coal, phosphates, pyrite and gold. The present work was undertaken at the sixteenth Congress held at Washington in 1933, and its production was entrusted to a committee of well-known American authorities. It forms a comprehensive reference work, dealing primarily with the mode of occurrence of the various deposits. In the majority of cases the descriptions have been contributed by Government officials concerned or by authorities personally familiar with the occurrences, though naturally this has not been possible in all cases. An attempt has been made to give a fair expression of the available reserves of copper, though for obvious reasons such estimates are not claimed to be complete.

It is realised by the editors that methods of exploitation play a large part in controlling the relative importance of deposits. The scope of the work has not permitted this question to be dealt with systematically, but a section is devoted to methods adopted in some North American districts, with the intention of giving a view of current practice.

Although primarily a work on mining geology, it contains articles that give, from a more general point of view, a review of copper resources, dealing with the development of the industry, economic history and estimated world reserves. Maps accompanying the article on development, showing the movements of exports and imports, make the discussion more instructive to the average reader.

An idea of the present world distribution of sources of copper is conveyed by the statement on p. 21 that: "Of this record production [48 million tons since 1801], the United States has contributed about half, and 95 per cent of that has come from 15 districts in 9 States. Of the foreign fields, South America has four areas, three in Chile and one in

Peru. Canada has six, Mexico three, Africa four, and the remainder of the world about a dozen". A world map showing the distribution and relative magnitude of the various occurrences would have been helpful, not only in connexion with the above statement, but also to assist the reader in his perusal of the work in which the important deposits are described, as well as localities of classical and scientific interest which are no longer of economic importance.

The first volume is a memoir on the deposits of

North America, while the second deals with South America, Europe, Asia, Africa and Australasia, and contains a full index. Of the books themselves all that need be said is that they are up to the usual high standard set by America. The few photographic illustrations are excellently reproduced in collotype, and the figures, maps, etc., though they must have been collected from many sources, are uniformly printed, clear and without that unnecessary decoration that gives a false impression of detail.

Vitamins Applied

Vitamins in Theory and Practice

By Dr. Leslie J. Harris. Pp. xix+240. (Cambridge: At the University Press, 1935.) 8s. 6d. net.

IN this volume, informative in spite of its comparative brevity, meticulously accurate in its presentation of fact despite its simplicity of exposition, Dr. Harris has expanded four lectures given by him at the Royal Institution in 1934. In expanding them, he has clearly taken the opportunity of making the revisions rendered essential by the progress registered in even twelve months' work on the vitamins.

The informal atmosphere of the original lectures has been very skilfully maintained in the written form, the author having used diagrams, graphs and photographs in just the way that the good lecturer uses his lantern slides, that is, as a means of lightening his exposition by helping the listener—or reader—to visualise the facts recorded.

Dr. Harris has attempted, with undoubted success, to do several things in this book. It is no mere bibliographical summary of what we know to-day about vitamin chemistry, though this knowledge is admirably surveyed. The author has also been able to dispose of a number of nutritional old wives' tales. He makes short shrift of the instinct-merchants, of the *laudatores temporis acti*, who say that all was well before people bothered their heads about dietetic science, and he shows his iconoclastic tendencies by vigorously assaulting what Carlyle would presumably have called "The Hero as Scientist". He stresses in the appropriate places the co-operative and international nature of scientific progress, and he makes it clear to all able to read between the lines that the successful applications of scientific progress can only be achieved on a similar non-individualistic basis. He has further been able by means of several carefully chosen examples to illustrate the methods of

biochemical research and the application of its results to clinical observations.

In a book of this kind, however jealous the author may be of scientific integrity, there are many occasions when he must express a purely personal opinion, give a purely personal interpretation of facts themselves not yet actually proved beyond a peradventure. Dr. Harris has, on such occasions, been nearly always most careful to indicate that he is expressing a view, not abstracting an experimental result. It is only on such occasions that one can differ with Dr. Harris, mildly or violently, and the difference itself must of necessity be one of opinion. It would be of little value, and it would take an unwarrantable amount of space, to enumerate these occasions here, and to state alternative views; but it may perhaps be permissible to mention one or two of such points of controversy.

Dr. Harris, in my opinion, still adheres with unnecessary rigidity to the purely dietary view of vitamin activity. The chemist seems to have suppressed the pharmacologist, who must surely recognise the possibility—the probability even—that substances of an intense physiological activity may have therapeutic activities comparatively remote from their 'normal' modes of action. Dr. Harris himself mentions the use of vitamin D "for callus formation or in tuberculosis", and one might parallel this by citing the treatment of purpura and certain other conditions with ascorbic acid. Only by an unjustifiable extension of the normal meaning of words could one describe these conditions as "vitamin deficiencies", and even Engelkes's suggested phrase, "*conditioned* vitamin deficiencies", seems rather to beg the pharmacological question.

It is from considerations of this kind that I have always felt some doubt about the deductions occasionally drawn from Dr. Thomas Moore's post-mortem examinations of the vitamin A reserves in human livers, quoted in this book. The presence

of these reserves is stated, in effect, to prove that administration of vitamin A could not have benefited the patient; this is surely to make quite a number of unproved assumptions about availability and mobilisation and the *site* of vitamin A action, as well as to rule out entirely a possible pharmacodynamic action of intensive vitamin A therapy. A similar consideration might be advanced about the curiously specific action of parenteral vitamin D treatment for certain skin allergies.

However, these matters take us a little far from Dr. Harris's mainly dietary contentions. About these there can be no cavil. Dr. Harris, as director of the Medical Research Council's Nutritional Laboratory at Cambridge, is, in a sense, a civil servant. It is to be hoped that his administrative colleagues in the Departments involved will read and mark his last chapter in particular, and outwardly digest for their respective ministers its devastating implications. The force of these implications is the greater in that Dr. Harris writes solely as a man of science, either stating proved facts or expressing opinions on matters about which objective and agreed judgments both can and will be reached sooner or later. Any political, and therefore subjective, consequences are not Dr. Harris's concern—at any rate as the author of this book.

Dr. Harris says in his penultimate paragraph that the co-existence of want and surfeit is not the fault of science; there are, however, many, and Dr. Harris is perhaps one, who are feeling less and less inclined to accept the comfortable corollary that no fault lies with scientific workers.

A. L. BACHARACH.

The Translocation of Solutes in Plants:

a Critical Consideration of Evidence bearing upon Solute Movement. By Prof. Otis F. Curtis. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiii+273. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 18s. net.

THIS excellent monograph should be in the hands of every plant physiologist. Prof. Curtis is a recognised authority on the difficult problem of translocation in plants, and he is to be congratulated on the production of this book.

The first chapter is a specially well-balanced consideration of the historical side of the subject. Prof. Curtis has decided views on the particular functions of the different channels of transport in the higher plants, and considers that the phloem alone is sufficient not only for the downward translocation of elaborated metabolic products from the centres of synthesis; but that it is also the main channel for the upward translocation of mineral salts from the soil. On the latter point he will find the majority of plant physio-

logists against him. His survey of the brilliant series of investigations of Mason and Maskell on translocation in the cotton plant is on the whole fair, but tends to be biased by his own views on the function of the phloem.

The peculiar condition of 'negative gradients' of crystalloid nitrogen described by Mason and Maskell for the stem of the cotton plant, interpreted by them as a static gradient of crystalloid nitrogen mainly composed of asparagine, on which is superimposed a dynamic gradient of crystalloid nitrogen, finds a different interpretation at the hands of Prof. Curtis, who considers that it is "more likely to be due to a retention of the carbohydrate-filled tissues, of nitrogen that has never reached the leaves". This suggestion presumes that synthesis of organic from inorganic nitrogen can take place in regions other than the leaves, for example, the roots. This is quite possible, and there is experimental evidence to support the view. In face of these diametrically opposite interpretations of the same facts, further work is desirable on the matter.

The general appearance of this monograph is attractive and the diagrams clear and explicit. The text is not marred by misprints. The book can be thoroughly recommended as an up-to-date survey of the subject.

E. B. W.

The Quantum Theory of Valency

By Dr. W. G. Penney. (Methuen's Monographs on Chemical Subjects.) Pp. vii+95. (London: Methuen and Co., Ltd., 1935.) 2s. 6d. net.

As there are notably few text-books available dealing primarily with modern valency theory, a concise handbook is more than welcome. The object of the present monograph is "to explain in simple language the view-point of quantum mechanics on valency and related topics such as the architecture of molecules and the activation energies of simple reactions".

After an explanation of quantum numbers and the wave function of the electron, the hydrogen molecule is treated at some length on the basis of the Heitler-London electron-pair bond theory. A chapter follows on the method of molecular orbitals as applied to the hydrogen molecule and the general diatomic molecule, and another on the problem of the shape of molecules by the generalised Heitler-London method of localised pairs, illustrated for various radicals and molecules. The final chapter deals with activation energy, the three- and four-electron problem, the ortho-para conversion, and resonance.

Although present-day views on valency have developed largely through interpretation of molecular spectra, the author manages to avoid reference to spectral considerations. The text is explanatory and excludes mathematical deductions, but is by no means easy reading since it is, of course, highly condensed and its tone is mathematical throughout. The work is addressed especially to chemists, and those who have kept themselves equipped with a reasonable knowledge of quantum mechanical progress will value this concise treatment of a matter of essentially chemical interest.

N. M. B.

A Description of Sherborne Scenery,

its Nature and History in its relation to the Underlying Rocks; the particular Contribution to this Scenery made by the several Outcrops of Limestone, Clay or Sand; the Faults which displace the Rocks and thereby affect the Scenery; the peculiar manner in which the Hills wheel round about Sherborne; the Origin of Dry Valleys; the History of the River Yeo and the Formation of its Valley at Sherborne. By Joseph Fowler. Pp. iv+88+12 plates. (Sherborne: The Author, Sheeplands, 1936.) 6s.

THIS is a capital book written by a geologist for the people about Sherborne in Dorset. The treatment of the different formations is the main object, but it is told in such a manner that everyone can understand; and the make-up is well thought out—not too long and overcrowded.

Mr. Fowler has, in his introduction, described the aims and objects of the geologist. He finds the story that the rocks tell him more romantic than the most thrilling fiction, and to have the great advantage that it is true. The book is full of incident, but it never loses sight of its main geological object. His description of the Vale of Spackford is inimitable. The vale grey with the Lias, and the apple orchards far and wide, are different as possible from the Norman castles and the general hilliness of Dorset. His digressions are numerous, but will have some thread connecting with the main story; and although these digressions have a bearing on a theme which is quite another subject.

It is to this charming break up of the matter that the book owes its distinction, and doubtless Mr. Fowler will find many readers who are attracted by the subject, besides the geologists he caters for. Kestrels, sunken roads, snails, a promenade along the high Oolitic scars with the glorious view below stretching over the greater part of Somersetshire: when we compare this with the painfully accurate geological descriptions the contrast is very great. The print is very clear and well placed, and the reproductions of sketches clean and very charming. In conclusion, we may hope that Mr. Fowler will continue to write. There are plenty more subjects in the West of England which he might well take in hand.

F. J. S.

Leitfähigkeit, Elektroanalyse und Polarographie

Bearbeitet von W. Böttger, J. Heyrovský, G. Jander, O. Pfundt, K. Šandera. Pp. xii+343. (Physikalische Methoden der analytischen Chemie. Herausgegeben von W. Böttger. Teil 2.) (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936.) 28 gold marks.

THIS volume begins with an account of conductometric titrations by Drs. G. Jander and O. Pfundt. Recent improvements in this field, for example, visual readings instead of telephone sound minima, have extended its applications, and conductometric methods now take their place with potentiometric and volumetric practice.

The second section, by Dr. K. Šandera, is concerned with the application of these conductometric methods to industrial analyses. They are convenient for

testing the purity of organic preparations and of sparingly soluble salts, and for estimating inorganic salts in the presence of such soluble non-electrolytes as sugars.

Prof. Böttger's own contribution on electro-analysis occupies more than half the volume. He is thus able to deal fully with the methods he selects, which are those he recommends from wide personal experience. Many useful points, such as rapid ways of drying electrodes, are mentioned in connexion with individual estimations. Descriptions of the latest means of separating metals by electrolytic deposition will be of special interest to those concerned with these analytical processes.

The last section, on polarography by Prof. J. Heyrovský, gives a comprehensive survey of the researches with the dropping mercury cathode which began some fifteen years ago, and upon which more than two hundred papers have been published. It is stated that so little as 0.005 c.c. of solution can be examined, and that the method is sensitive to something like 10^{-5} gm. mol., per litre. As the utility of polarographic methods comes to be appreciated, they will doubtless find wider applications as a delicate means of analysis.

Practical Bacteriology:

an Introductory Course for Students of Agriculture. By Dr. A. Cunningham. Second edition, revised and enlarged. Pp. viii+203. (Edinburgh and London: Oliver and Boyd, 1934.) 7s. 6d. net.

THE appearance of a second edition of this book affords evidence of the need that exists for a simple laboratory text-book outlining a course of work that will give students of agricultural science some grounding in microbiological methods. On the whole the book succeeds in this object. It seems a pity, however, that the new edition should include so little reference to newer methods of research. Thus, some of the microbiological methods for the estimation of plant nutrients in soil such as Winogradsky's 'plaques moulées' method are eminently suitable for the student, to whom they would give some appreciation of the nutritive requirements of micro-organisms in the soil. It is also no longer true to say (p. 149) that "for the accurate determination of the numbers of micro-organisms in soil, microscopic methods are of little value". A method has now been developed that gives estimates of numbers more reliable than can be obtained by plating methods.

The mere qualitative examination of films of soil suspension, dried and stained with erythrosine, would give the student a useful idea of the appearance of micro-organisms in the soil itself, while the technique needed is simple and much quicker than is the Rossi-Cholodny technique that is given.

Chap. ii gives a clear and useful description of the microscope, but it is unfortunate that the student is not told how to obtain critical illumination. Ignorance on this point is unfortunately widespread, and it is of first importance that students who may later be engaged in research involving the use of high magnification should be taught to use correct illumination.

Weights and Balances in Ancient Egypt

IN the study of ancient weights there has been a tendency to broaden the application of inference from comparison of different standards, until it has grown from the attempt to trace the origin of later standards to the modern field of research. The main objectives now are the far-reaching character of international trade and the common basis of exchange at a very early date and a closer linking up of the derived standards of later, and even present, days with the earliest originals.

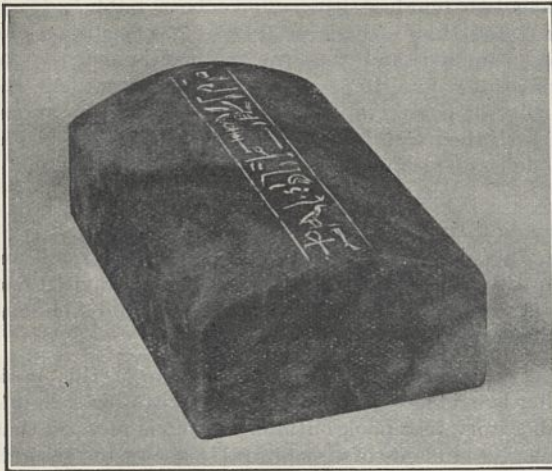


FIG. 1. Green felspar weight of Herftu; value, 100 units Beqa standard (c. 2000 B.C.). (University College)

Prof. S. R. K. Glanville, in his Friday evening discourse at the Royal Institution on "Weights and Balances in Ancient Egypt", delivered on November 8, 1935, and now available in printed form, while recognising the wider aims of modern metrological studies, confined himself of set purpose to indicating what we are justified in inferring, from the actual contemporary weights and from the pictorial representations of balances, as to the practice of buying and selling in private and public life throughout the dynastic period in Ancient Egypt.

The pioneer in the study of ancient weights is Sir Flinders Petrie, whose "Inductive Metrology" (1875) is a classic text-book; and by far the largest number of known Egyptian weights were discovered by him. A majority of them, some 3,000 in number, until recently formed a part of the Egyptological collections of University College, London, and a large representative selection is now on loan at the Science Museum, South Kensington. They range from less than 10 grains to more than a quarter of a hundredweight. Over

the lower weights the series increases by decimal points of a grain and after that by grains, so that there are very few places in the sequence of the unit weights between 100 and 11,000 grains not represented by a specimen. The shapes vary as do the materials, most, however, being of stone of one kind or another. Petrie suggests that eight standards were current in Egypt from dynastic times, these representing a series of unifications of a much larger number of earlier standards. Two only were indigenous to Egypt, the Beqa (Fig. 1) and the Qedet, the remaining six being traced to various points of origin in the Near Eastern area. The archaeological remains of even the pre-dynastic period are of sufficiently diverse character and origin to warrant a conclusion pointing to a volume of early international trade such as this variety of standard implies.

Turning to the balances, there must have been some primitive contrivance from pre-dynastic times. A beam of a balance at University College is made of limestone and may be of pre-dynastic date, but need not be later than the third dynasty (3000 B.C.), for with the tray of numbered weights depicted on the wall of the Third Dynasty tomb of Hesy at Saqqara, two exactly similar objects are shown. With the succeeding dynasty we reach a series of representations of balances, usually of the standard type, showing an improvement as the Old Kingdom develops. The most primitive is from a Fifth Dynasty tomb at Gizeh, in which the beam is a solid arc-shaped piece of wood slung from a joist between two uprights and having at either end what look like pans suspended from a single piece of string. The single string seems to be characteristic of representations of the balance in the Old Kingdom, the cord having a hook at the end. The standard balances, with this single exception, show one upright only, to which the beam was attached. An example of this period, figured in Davies's "Deir-el-Gebrawi", shows the plummet for the first time (Fig. 2). It appears that the string of the plummet is not attached to the upright, as it should be, but hangs from a long board, which in the New Kingdom became a neat tongue, rigidly attached to the beam and moving with it.

One other important representation of the Fifth Dynasty shows the simple beam suspended by a loop held in the hand. This is the only representation of a balance in the Old Kingdom not used for weighing out precious metals. The craftsman weighs the finished object to show that none of

the precious metal has gone astray. This raises the question of the use of the balance. All representations are in scenes in the tombs of great officials with responsibilities to the Crown, and all depict the exact measurement of precious metals. This fact, together with the evidence of representations of market scenes in which no balances appear and

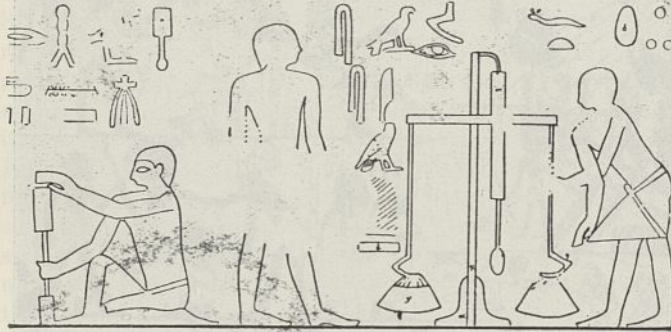


FIG. 2. Old Kingdom balance showing plummet (c. 2500 B.C.).
By courtesy of the Egypt Exploration Society.

exchange is evidently by barter, and the early conception of the land as a single estate belonging to the king, justify the inference that for ordinary business no medium of exchange was in use in the Old Kingdom. The first evidence for the use of metal as a medium of exchange by the man in the street appears in the Eleventh Dynasty in the letters of Kekaneht to his son in Thebes, referring to the renting of land and the purchase of grain, linen and other essential commodities. It is implied that transactions are to be carried out with the aid of some medium of exchange, presumably copper.

With the restoration of Pharaonic control under the Twelfth Dynasty, the estate system under the immediate control of the monarch was again in full swing and the balance, less frequently depicted, is still found weighing gold and silver for official purposes. The best examples indicate the next advance in balance technique in the form in which the single suspender at the end of the beam gives place to a proper pan suspended by four strings looped together through a hole in the beam (Fig. 3).

Though little remains of the period of the domination of the foreigner, the Hyksos kings, in the Seventeenth and Eighteenth Dynasties the legacy of the foreigner is made plain. Foreign standards show a considerable increase in use; the balance reaches its highest point of efficiency; but far more important are the changes in administration introduced in the early centuries of the new empire. In the height of imperial power no important tomb is without some reference to the

importation of foreign goods. Although these goods to a great extent were prizes of war, it is highly probable that a large part of the scenes representing the importation of precious metals and manufactured goods show only one half of a picture of organised international trade. This is borne out by references in the Amarna letters to the gifts of gold from Egypt to rulers of western Asia. By this time the term *ynt* 'to bring', from which the term for gifts is derived, had acquired the meaning 'to buy'. On the other hand, the financial privileges granted to the priesthood indicate that the ruler no longer had a financial monopoly. In the light of these two influences on the economics of the New Kingdom, it is not surprising to find innovations in the detail of weights and balances.

The balance is represented more frequently than ever in tomb paintings and is usually of the standard type; but at least one example survives of the small hand balance, a beam and two pans now in the Science Museum (c. 1350 B.C.). The paintings show strong stands with carefully joined uprights with metal fittings for strength. Weights change form considerably, and bronze specimens in the form of ox, hippopotamus and gazelle become common, probably as a result of Asiatic influence. The type of balance now continued more or less unchanged until superseded by Roman instruments.

In the Eighteenth and Nineteenth Dynasties the balance continued to be used for weighing out gold to workmen within an official estate, or for the receipt of 'tribute' from foreign countries, or of duties, etc., within the State. The one exception is



FIG. 3. Middle Kingdom balance with suspension cords (c. 2000 B.C.).
By courtesy of the Egypt Exploration Society.

from a tomb now lost, which depicts the arrival of foreign boats from the Asiatic coast at an Egyptian port and includes representations of two hand balances (Fig. 4). It appears to be the first and only example of the use of the balance for private buying. Other evidence of a different kind, for example, a papyrus of accounts in Cairo,

points in the same direction; but documents of the Twentieth and Twenty-first Dynasties indicate on one hand a breakdown of the old system sufficiently complete to allow of the development of a currency of sorts (the *shati*), and on the other

commodity, for example, fish, of which this weight indicated their allowance. It may be asked if this evidence should not be taken to indicate that in earlier times also weights were used for such a purpose. To us it must seem extraordinary that



FIG. 4. Egyptian harbour scene: the balance in use for private transactions (c. 1250 B.C.). After a Theban tomb painting.

the essence of the old estate-cum-barter system being used by the Crown as in earliest times in its relations with the workmen employed on its monuments, who receive payment in food and commodities. Weights have been recovered with the names of the workmen and the name of the

weights should have been used for more than two thousand years for one purpose only, before they were adapted for the direct weighing of commodities as we use them to-day. Until further information is available, it is unwise to speculate on this point.

The British Association

A FIVE-YEARS' RETROSPECT, 1931-35

FIVE-YEARS' PLANS are popular nowadays, and some of their begetters may have cause to remember with a wry smile Johnson's remark to Reynolds that "There are two things which I am confident I can do very well: one is an introduction to any literary work, stating what it is to contain, and how it should be executed in the most perfect manner; the other is a conclusion shewing from various causes why the execution has not been equal to what the authour promised to himself and to the publick".

The British Association has never, so far as we know, committed itself to any grandiose scheme of planning; but with the beginning of its second

century, it has adventured upon a new course. As each quinquennium passes, the Association proposes to issue a review of its work—especially that work which arises out of the activities of the annual meeting, and is carried on in the intervals between the meetings. The first number of the series has just appeared.

The descent of two or three thousand members on a town in early September always causes something of a commotion. The livelier dailies blaze out into headlines which tell how a "Woman Scientist Amazes her Male Colleagues"; the sedater journals reflect on the potency of the weapons which science puts into the possession of

communities not, perhaps, as yet competent to use them wisely; the week passes, and the Association fades from public view.

Many of its members, even, fail to realise that the activities of the Association are, in the language of this retrospect, perennial. Its Council meets six times in the year, and deals carefully and exhaustively with various resolutions and recommendations which have been sent in from the Sections at the annual meeting. Many of these resolutions involve difficult points of local and national policy, and the consideration of the best methods of implementing them involves much labour on the part of the officers and of the Council. In the quinquennium under review, such diverse topics have been discussed as an inland water survey for Britain, the preservation of the countryside and national parks, the extermination of the musk-rat, the revision of Ordnance Survey maps, the aerial photography of topographical features, the diseases of the cricket-bat willow and the interchange of museum specimens—a selection which covers but a small fraction of the resolutions put forward in this period.

The work of the Association's research committees goes on steadily throughout the year; its volume and importance are, perhaps, scarcely appreciated at their true value, and the summary which appears in this retrospect is specially welcome.

The average number of research committees appointed or reappointed at each annual meeting during the period 1931–35 was no less than fifty-two, and the total expenditure on grants to research committees during this period was £6,174 (the average quinquennial expenditure on grants since 1831 has been £4,900.)

The Seismology Committee, with hospitality and some financial assistance from the University of Oxford, has continued the publication of the International Seismological Summary initiated by the late Prof. H. H. Turner. A catalogue of earthquakes from 1925 to 1930, based on the Summary, has been compiled by Miss E. F. Bellamy and published by the Association.

The Mathematical Tables Committee has earned the gratitude of all working mathematicians; the tables calculated and published under its direction have been issued in five volumes, the latest of which is a massive volume of factor tables published in 1935. Three volumes of tables of Bessel functions are in preparation, the first of which is in the press.

The freshwater biological station at Wray Castle, Windermere, originated in proposals put forward at the 1927–28 meetings of the Association, and the Association continues its support of the researches carried out here, at the marine labora-

tory at Plymouth, and at the zoological station at Naples.

It is impossible in a brief review even to catalogue the names of the committees. Committees on documentary and educational films, on the reliability of the criteria for the assessment of the value of vocational tests, on educational training for overseas life, on the teaching of general science in schools, on an inland water survey, on the reduction of noise—these may serve to show the variety and importance of the problems under consideration. It will be seen that many of these problems demand for their solution collective, sometimes national, action, and the Association's reports have in many instances served to influence and to direct the course of action to be taken. It is to be remembered that the reports of these committees are not only critical surveys of, and deductions from, existing knowledge. In a number of cases (the Committee on Noise, for example), the committees initiate and carry out definite schemes of experimental research.

One of the most congenial, if most responsible duties of the Association is that of guardian of Down House which, through the generosity of Sir Buckston Browne, it holds in trust as a national memorial. An average of 7,000 visitors is recorded for each year of the quinquennium, and the Genetical Society has set an example to other societies by holding one of its meetings at Down House in 1934.

Darwin's study seems more uncannily alive than ever. His books, which have been lent to Down House by the professor of botany in the University of Cambridge, have now been restored to the study which, in the careless order amongst disorder of its arrangement—specimens and opened letters on the table, microscope on the broad window-ledge, couch drawn into a convenient position for reading—might almost be in daily use. An onlooker, absorbed in the atmosphere of the room, would scarcely be surprised were he to hear the clink of the snuff-jar lid in the hall outside the study.

Down House is an invaluable national asset; it is a constant reminder of the work and personality of one of the greatest and most lovable minds that the nineteenth century produced. But it is the desire of the Association to make Down House something more than this, and the Association hopes to see the house a centre for appropriate regular scientific research. A beginning has been made, and in the next quinquennial report the Association hopes to record the fact that such work is well established.

In respect of its membership, the Association has outstripped all previous records, for in all its history there is no other succession of five years

in each of which its members have exceeded two thousand. The statistics for the quinquennium are shown in the accompanying table :

Year	Meetings of the Association		Membership
	Place	President	
1931	London	Gen. Smuts	5702
1932	York	Sir Alfred Ewing	2024
1933	Leicester	Sir F. G. Hopkins	2268
1934	Aberdeen	Sir J. H. Jeans	2938
1935	Norwich	Prof. W. W. Watts	2521

It is a remarkable record and one that may well stimulate the Council to widen the already wide activities of the Association, and it is no secret that the Council has in consideration the possibility of a considerable increase in the Association's work. Regular research at Down House and the initiation of quinquennial reports on the progress of science—reports which shall elucidate to the non-specialist recent developments in scientific knowledge—are two instances out of many possibilities.

But increasing activities mean increased liabilities, and such liabilities emphasise the necessity for increased endowments. In the quinquennium under review, the Association has received legacies of £2,000 from Sir Charles Parsons, £500 from Sir Alfred Ewing, £1,000 from Mr. Bernard Hobson, and a gift of £1,000 from the local Committee for the Leicester meeting. On the other hand, the Centenary Fund appeal, coming as it did at a time of financial stress, failed in its object, and the gift of £10,000, made in 1926 by Sir Alfred Yarrow, was made under the condition that it should be completely expended not later than 1947. The remark of Sir Josiah Stamp that "further endowment will be essential to consolidate the position which the Association has attained at the end of its first century" is very pertinent.

The Association is to be congratulated on the production of an interesting and valuable survey of the work of five very full years.

Obituary

Prof. J. Stoklasa

WITH the death in Prague on April 4 of Prof. Julius Stoklasa, agricultural chemistry has been deprived of one of its most active and distinguished exponents. Born on September 9, 1857, at Leitomischl in Bohemia, Stoklasa early showed his interest in science, and when only eleven years old was appointed curator of the school natural history collection. At the early age of sixteen years he developed an interest in plant nutrition and carried out experiments on the water culture of plants; the results he obtained were communicated to the famous plant physiologist Prof. J. Sachs, who replied at some length and encouraged the young worker to continue his experiments with the view of publishing them.

At about this time, Stoklasa commenced a study of the effect of sulphurous acid, hydrochloric acid and hydrofluoric acid on plants, which study proved to be a forerunner of the work published fifty years later under the title of "Beschädigung der Vegetation durch Rauchgase und Fabriksexhalationen". During the same period of his life, Stoklasa became interested in geology, and as a result of this he undertook a study of the weathering of rocks. Leaving school, he proceeded to the Agricultural Institute in Lieberwerd, where his knowledge of inorganic chemistry, acquired at school, stood him in good stead and enabled him to take up the investigation of the quantity and quality of the salts valuable to plants which were carried away yearly by the River Elbe.

From Lieberwerd, Stoklasa went to the Agricultural College in Vienna, where, working in the laboratory of Dr. Zeller, a son-in-law and a former assistant of

Liebig, he published several investigations on plant biochemistry. On becoming *Privatdozent* at the University of Vienna, he worked in the plant physiological institute of Prof. Wiesner. Leaving Vienna, he went to Leipzig to study under Pfeffer and Ostwald, and obtained his doctorate for a thesis on the physiological properties of the water-soluble compounds of phosphoric acid contained in superphosphates. Recognising the importance of bacteria in the soil, he proceeded to Paris to study bacteriology at the Pasteur Institute, and on his return to Vienna he began to study the assimilation of atmospheric nitrogen by bacteria and plants.

For the next few years, Stoklasa was engaged in investigating the influence of phosphates and basic slag and other artificial manures on plant life. Starting an experimental station for beet sugar production in Prague, he became director of the section dealing with the physiology and pathology of the sugar beet; this gave him ample scope for his talents, and he proceeded to undertake an intensive study of nitrogen fixing and of denitrifying bacteria, and published a monograph on the phosphorus cycle in the soil.

Stoklasa's studies on intra-molecular respiration and the isolation of zymase from plants and animal sources were of fundamental importance. A study of soil fertility led him to investigate the significance of soil respiration in cultivated areas, and in 1926 he published a book entitled "Biophysikalische und biochemische Durchforschung des Bodens". He made important contributions to our knowledge of the physiological significance of phosphorus, sulphur, selenium and other elements, and published lengthy papers on the importance of potassium to the sugar

beet, and on the distribution of aluminium in Nature and its significance in the cultivation and metabolism of plants. In later years he studied the influence of iodine on the growth and development of plants and also the effect of radioactivity upon metabolic processes in plants and animals.

Stoklasa was professor at the Technical High School in Prague, director of the State agricultural experimental station and vice-president of the Czechoslovak Academy of Agriculture.

Prof. Georg Wiegner

It is with great regret that we have to announce the death on April 14 of Prof. Georg Wiegner, of the Agricultural Institute, Eidgenössische Technische Hochschule, Zurich. He had for some time been suffering from gastric ulcers, and underwent an operation which appeared to be successful, but peritonitis set in and ended fatally.

Wiegner was born in Germany, and received his training under Zsigmondy in Göttingen, then went straight to Zurich as professor of agricultural chemistry. Here he remained all his life, excepting that during the War he was temporarily in Germany for military service, and was wounded at least once. It is an open secret that he had been invited to a much more important chair outside Switzerland, but he preferred to remain in Zurich where, he said, he had been cordially received as a young and unknown man, and had familiarised himself with the agricultural problems of the Swiss farmers and discovered ways in which he could help them.

As might be expected from his training, Wiegner turned early to the study of the colloidal properties of the soil. It was at that time widely supposed, as the result of investigations by Way and by van Bemellen, that base exchange and some at any rate of the colloidal properties were due to zeolites in the soil. Wiegner took advantage of the possibility of obtaining permutite and other zeolites in quantity to make detailed studies by the new methods on base exchange, its nature and relation to the colloidal properties of the zeolite and of the clay, especially dispersion and flocculation, and he was able to work out an electrical hypothesis which threw considerable light on the whole phenomena. In the end it was shown in his laboratory that clay did not behave like permutite, and his hypothesis enabled him to explain the differences.

In 1930 Wiegner was invited to England to lecture at certain of the agricultural institutions so that members of the staffs might have the advantage of hearing his views and discussing problems with him. His lectures were published in the *Journal of the Society of Chemical Industry* for 1932 and constitute an admirable summary of the more important properties of clay and of zeolites.

In addition to these colloid investigations, Wiegner found time to study animal nutrition, choosing practical problems such as the drying and ensiling of grass, a very important matter in Switzerland; the evaluation of feeding stuffs with special reference to

starch equivalents and gains in weight; and other subjects of farming interest. This work had the same high quality that characterised his soil investigations.

It was, however, as a teacher that Wiegner was supreme. He would come into the laboratory, call his research students together and start discussing some new idea, either his own or one of theirs, or he would sketch out some new experiment, and he would expect everyone to join in as eagerly as himself. On Saturday afternoons he would take a number of his postgraduate students for an excursion during which long discussions took place, lasting sometimes six hours or more, much of it in a village inn over beer, bread and cheese. The subjects were not necessarily scientific, but might even be political, and as his students came from many different countries and felt themselves entirely free and unconstrained, the discussions were often extremely interesting.

At the Congresses and Commission meetings of the International Society of Soil Science, Wiegner was always an outstanding personality; his geniality and kindness towards his colleagues and his students endeared him to all who knew him. He added lustre to the Technische Hochschule of Zurich and he will long remain in the memory of his friends.

E. J. RUSSELL.

WE regret to announce the recent death at the age of fifty-eight years of Dr. Ernest Lobstein, dean of the faculty of pharmacy and professor of *materia medica* at Strasbourg, member of the Paris Academy of Medicine, and author of studies on the biology of the tubercle bacillus and chemical analysis of the mineral waters of Alsace, Bulgaria and Palestine.

WE regret to announce the following deaths:

Dr. William Bradley Coley, formerly professor of clinical surgery at Cornell University Medical College, New York, well known for his treatment of sarcoma by means of erysipelas and prodigious toxins, aged seventy-four years.

Prof. L. Frédéricq, emeritus professor of physiology in the University of Liège, aged eighty-five years.

Dr. Alfred Palmer, one of the founders, and from 1926 until 1930 president of the Council, of the University of Reading, on May 20, aged eighty-three years.

Sir Robert Rait, C.B.E., principal and vice-chancellor of the University of Glasgow since 1929, on May 25, aged sixty-two years.

Mr. Arthur J. Weed, known for his work on seismology in the University of Virginia, on April 15, aged seventy-five years.

ERRATA. Obituary of Prof. Karl Pearson (May 23, p. 857): Mr. Udny Yule informs us that the dates of Prof. Pearson's books should read as follows: "Grammar of Science", 1892; "Chances of Death, etc.", 1897; "Ethic of Free-thought", 1888.

News and Views

Linnean Society of London: New Foreign Members

THE following have been elected foreign members of the Linnean Society of London: Prof. M. L. Fernald, Prof. B. A. Fedtschenko, Prof. P. Pelseener, Prof. K. F. von Tubeuf and Prof. W. M. Wheeler. Prof. M. L. Fernald, curator of the Gray Herbarium, Harvard University, is well known for his highly critical work on the flora of eastern North America and for his studies in geographical botany, especially on the relations between his special area and Europe, which has had considerable influence on recent ideas about plant distribution. He has also published several important monographs on genera. He is editor of *Rhodora* and, with B. L. Robinson, edited the last edition of Gray's "Manual". Prof. B. A. Fedtschenko is professor of botany in the University of Leningrad and curator of the herbarium in the Botanic Garden. His chief work has been on the flora of Asiatic Russia, especially Turkestan. In a long series of floras and monographs he has dealt both with the purely taxonomic aspects and with more general vegetation studies. He was formerly editor of the *Journal Botanique Russe* and has long taken a leading part in influencing taxonomic botany in Russia.

PROF. P. PELSENEER, who is permanent secretary of the Royal Academy of Sciences of Belgium, is well known for his long and continued researches on the Mollusca: his volume in Ray Lankester's "Treatise on Zoology" is still regarded as the classical authority on the anatomy and classification of the group. His later work on variation and heredity in Mollusca, carried out under very difficult conditions during the German occupation of his native country, is a mine of information, as is also his recent treatise on the ethology of the group. Prof. K. F. von Tubeuf is professor in the University of Munich. His name became prominent in Great Britain forty years ago on the appearance of W. G. Smith's translation of his "Diseases of Plants induced by Cryptogamic Parasites", a work still much used. Since then he has been mainly occupied with the study of the diseases of forest trees, and from 1915 has been associated with the editorship of the *Zeitschrift für Pflanzenkrankheiten*. His other chief interest is the genus *Viscum*, of which he published a large monograph in 1923. Prof. W. M. Wheeler, professor of entomology, Harvard University, is outstanding for his work on social insects and particularly on ants. Among his more important writings are "The Ants of the Baltic Amber" (1914), "Social Life among the Insects" (1923), "Les Sociétés d'Insectes" (1926) and "The Social Insects, their Origin and Evolution" (1928). He has also translated and published Réaumur's work on ants with the title "The Natural History of Ants" (1926).

Sir Hector Hetherington

SIR HECTOR HETHERINGTON, vice-chancellor of the University of Liverpool, who has been appointed principal of the University of Glasgow in succession to the late Sir Robert Rait, has many associations with Glasgow, in that he is a graduate of that University, and was lecturer (1910-14) and professor (1924-27) of moral philosophy there. In the intervening years he held academic posts of importance elsewhere, being lecturer in the University of Sheffield in 1914-15, then professor of logic and philosophy in University College, Cardiff in 1915-20, after which he was invited to become principal and professor of philosophy in the University College of the South-West of England, Exeter. During the Great War he worked in the Intelligence Division of the Ministry of Labour and was chosen for work in connexion with the Treaty of Versailles. Following its signature, he went to Washington as one of the British assistant secretaries of the International Conference of the League of Nations. Sir Hector thus went to Liverpool with an outstanding record as a scholar and administrator, and for the past nine years he has been indefatigable in his service for the University in particular and for the general cause of education and social progress, and for hospital co-ordination. Among numerous other offices, he was elected in 1930 to serve on the Unemployment Insurance Commission. His knighthood this year was a just acknowledgment of his fine academic work and public service.

U.S. Stratosphere Balloon Explorer II

A MORE complete account of the scientific results achieved in the stratosphere flight of November 11, 1935, has now been published in the May number of the *National Geographic Magazine*. The tube counter directional system for cosmic rays was described in *NATURE* of June 29, 1935, p. 1083, and it would now appear that some modification must be made in the results from *Explorer I*. At an altitude of 72,000 feet covering 96 per cent of the earth's atmosphere, the rays show no directional preponderance from the vertical to the horizontal. It follows that as those rays coming from the more horizontal directions increase with height, these are influenced by the earth's magnetic field. Swann's explanation of the distribution is that most, if not all, the rays observed are secondaries. The Stoss chamber for observing bursts did not show any abnormal increase in their number with height. The following numbers are given for cosmic ray activity: at 40,000 ft., 40.1 times that at sea-level (*Explorer I* on July 28, 1934, gave this number as 42.3); at 53,000 ft., 51.5 (Piccard in autumn of 1934 gave 53.2); at 57,000 ft., 55, a maximum, and at 72,395 ft., 42. A Wilson chamber was not taken up, but the next best method, of recording in the body of the photographic emulsion

of a plate, gave a track of an α -ray of energy 10^8 electron volts. The ion content of the air roughly follows the cosmic ray activity at great heights. Previous records only went up to 30,000 ft. In these experiments, the maximum was observed at 61,000 ft. of 81 times that at sea-level, and at the greatest height of 72,000 ft. this figure fell to 50. There may be some connexion between this and the observed decrease in the strength of radio signals received on the ground from above a height of 60,000 ft. Other results quoted are that 20 per cent of the ozone content of the atmosphere lies below 72,000 ft., the composition of stratosphere air is insignificantly different from that at sea-level and above 60,000 ft. only moderate wind velocities ranging up to 42 miles per hour are met with. From the temperature-altitude chart given, it appears that the temperature ranged round about -70° F. from 35,000 ft. to the maximum heights from 9.40 a.m. to 2 p.m.

The Impact of Science on Social Organisation

THE twenty-eighth Moncreu Conway Memorial lecture was delivered on May 20 by Prof. Lancelot Hogben, who dealt especially with the impact of scientific knowledge on contemporary social organisation. The democracies of Western civilisation, Prof. Hogben said, have reached a crisis with which a social personnel of government trained in a humanism without roots in scientific technology are not equipped to deal. Current political thought is permeated with a body of economic doctrine which includes within its scope no prospectus of emergent technological forces reshaping national policy and international relations. The result is a growing distrust of the powers of education and rational persuasion. In the long run, the stability of Western democracy must depend on whether we can devise an education adapted to the conditions of a society which makes increasing demands on technical knowledge. The necessary reorientation of cultural values and of research in social studies can only be brought about by enlisting to the task a new personnel with naturalistic training and the executive competence which laboratory experience calls forth. The primary business of social inquiry should be devising the social machinery to make available for human welfare the plenty which science offers. The lecture is published by Messrs. Watts and Co., 5 and 6 Johnson's Court, Fleet Street, London, E.C.4 (price 2s. net; by post, 2s. 2d.).

Chemistry of Crystals

THE thirty-fourth Bedson Lecture was delivered at Armstrong College, Newcastle-upon-Tyne, on May 8, by Dr. C. H. Desch, his subject being "The Chemical Properties of Crystals". Dr. Desch said that a solid metal is a crystalline mass of which the chemical, as well as physical properties are anisotropic; acid attack, for example, not being uniform, but producing geometrically shaped pits indicating the symmetry of the constituent crystals. This constitutes a part of the evidence for a secondary or mosaic structure in crystals. The boundaries between the

individual crystals have different chemical properties from the mass. Their form corresponds with that of foam cells, being determined by surface tension, and in certain alloys they can be separated by the action of specific reagents. Certain brasses containing aluminium, for example, fall to pieces, the grains separating like sand, when placed for a few seconds in a solution of mercurous nitrate. In the stainless steels, such intercrystalline disruption is explained by the segregation of carbides, but in other instances no boundary constituent has been detected. The stability of iron, aluminium and stainless steel in air is explained by the presence of a surface film of oxygen or oxide. The greatly increased chemical activity of a metallic surface under high local pressures, as in abrasion, was also discussed. The effect known as 'corrosion fatigue' is caused by the combined action of alternating stresses and chemical attack, in which the properties of the film and of minute cracks both play a part. Dr. Desch concluded with an account of the transformations within solid solutions, including the work of Prof. W. L. Bragg on the changes from disorder to order in a lattice.

Lectures to Secondary School Pupils

WITH the object of bringing young people from secondary schools into contact with some aspects of progressive science and its applications, the British Science Guild arranged last year for two lectures by Mr. C. C. Paterson, director of the research laboratories of the General Electric Company, to pupils from secondary schools for girls in the London area. The lectures were delivered at the Institution of Electrical Engineers, and the subject was "The Electron Liberated: its Industrial Consequences". Sir Albert Howard, the honorary secretary of the Guild, has provided for the continuance of this successful enterprise under the title of the Gabrielle Howard Memorial Lecture; and on Tuesday and Wednesday last, May 26 and 27, Prof. W. L. Bragg delivered this lecture upon the subject of "Telegraphs and Telephones". The lecture on the first day was to boys from London Secondary Schools, and on the second to girls from London Secondary Schools. On both occasions, the lecture was given at the Royal Institution, by kind permission of the Managers. Through the courtesy of Messrs. G. Bell and Sons, the young people who attended the lectures were able to take away with them a pamphlet containing a reprint of the chapter on telegraphs and telephones from Prof. Bragg's book on "Electricity" just published by Messrs. Bell.

Whirlpools and Vortices

AT the Friday evening discourse at the Royal Institution on May 22, Prof. E. N. da C. Andrade discussed "Whirlpools and Vortices". The best example of what is ordinarily thought of as a vortex is the whirlpool that is formed where the water runs out of a bath or basin. There is a widespread belief that this always spins one way, clockwise or counter-clockwise, and that this is due to the rotation

of the earth. Actually, however, if the water is allowed to come to complete rest in a vessel where the hole is accurately in the middle, and if the plug is carefully withdrawn, no whirlpool is formed. The whirlpool that is generally observed is due to some slight rotation given to the water near the edge of the vessel, which, by the laws of fluid motion, becomes very much accentuated where the water runs out. The direction of the spin depends on the direction of this slight motion. If the spin is actually always in the same direction in a particular bath, it is because of some chance influence, such as the position of the taps. The spin of the earth should actually give rise to a rotation of the water where it runs out, but the effect is far too small to be observed with a bath or basin. Where a large still sheet of water runs out through a vertical pipe, as at the intake of a water turbine, the effect should, however, be large enough to observe. It is, in fact, found that under these conditions whirlpools form, and that the spin of the water is in an opposite direction in the northern and in the southern hemisphere, as it should be. The consideration of vortices is extremely important for aircraft or other bodies moving through the air, and the whole object of stream-lining is to avoid the formation of vortices, which fritter away energy. The sensitive flame, which ducks in response to sounds, is, it turns out, an example of vortex motion, the vortices being produced as a consequence of the sound vibration.

New Guinea Exhibition

AN exhibition of ethnographical objects from New Guinea and the islands of the Malay Archipelago under the auspices of the Royal Anthropological Institute opened at 10 Grosvenor Square, London, S.W., on May 26, and will remain open for three or four weeks. The specimens were collected by Lord Moyne during a cruise on his yacht *Rosaura* between November and February last, and with them is a remarkable series of photographs taken at the same time by Lady Broughton. The section of the exhibition which will afford the greatest interest is that illustrating the culture of the newly discovered Aiome, a light-skinned pygmy race inhabiting the hills near the Middle Ramu River in the mandated territory of New Guinea, who had not previously had any contact with white civilisation. Their skin is only slightly darker than that of a well-sunburned European, and their hair a very dark brown. The average height is 4 ft. 6½ in., male, and 4 ft. 2 in., female. They are surrounded by dark-skinned tribes of normal stature and the general New Guinea type. Their appearance is well illustrated in a number of photographs, which show the mode of wearing the articles of adornment included in the collection, such as bands made up of stems of *Dendrobium* and threaded grass seeds, and tree-bark head-dresses. A collection of skulls comes from a deserted village, in which they were stored in bundles outside or inside the houses. This collection includes two very distinct types of head, one large and one small. The former is distinctly Australoid in appearance, with prominent

brow ridges and receding forehead. It is remarkable as coming from New Guinea. No explanation of the abandonment of the village was obtained, though it was found to be full of the possessions of its former inhabitants, including a number of objects of the greatest cultural interest, among them drums, carved shields and curious head-dresses of possibly ritual purpose.

Homer's Troy

A THIRD, and possibly final, stage in the archaeological exploration of Troy has been reached with the excavations organised by the University of Cincinnati under the field direction of Dr. Carl Blegen, formerly assistant director of the American School of Archaeology at Athens. It is remarkable that of the three great sites of Homeric civilisation, Troy, Mycenæ and Tiryns, the first-named, which inspired the excavation of the archaeological sites of the eastern Mediterranean, should still, at the last, afford a problem in the exact determination of its chronological and cultural relations. Schliemann's final identification of the Sixth City at Hissarlik, and not the Second, as the Homeric Troy in 1890, and Dorpfeld's demonstration of a sequence of nine phases in the history of the city, extending from the Early Bronze Age to Roman times four years later, satisfied a generation which knew not Knossos and the history of Helladic culture. It has since become evident that the Sixth City, notwithstanding Mycenæan contacts, is neither completely contemporary with, nor its culture identical with that of, the Mycenæan age. The work of the American expedition, as is indicated by Mr. E. J. Forsdyke in his lucid summary of the present position of the archaeological and historical problem in *The Times* of May 22, has confirmed this by showing that the Sixth City goes back to Pre-Mycenæan Middle Helladic, and that "the Achæan moment", the period when the Achæan military aristocracy held sway, fortified by matrimonial alliances with Mycenæan heiresses, which corresponds with the conditions of the Homeric world, is represented by an inferior reconstruction after the Sixth City had been destroyed by earthquake about 1300 B.C., in which the walls were repaired in rougher masonry and the houses irregularly built with odd stones from the ruins. About 1200 B.C. this Seventh City was destroyed by fire. It was rebuilt and inhabited, presumably, by the Achæan conquerors.

Co-ordination of Research

THE Research Co-ordination Committee, which was formed a few months ago as the result of an informal meeting of persons connected with organisations interested in the application of science to present-day problems (see NATURE, February 22, p. 311), reported on its activities at a meeting on May 23 to the group from which it arose. The Committee, after making a preliminary list of problems which need co-ordination, decided to consider one or two in detail and to work out a technique of co-ordination that could be generally

employed. This, it is claimed, has been achieved. Given two persons sufficiently interested in co-ordinating the material relating to an important problem, and ready to devote to it one full evening a week, the Committee will undertake to help them in elucidating the various aspects of the problem and in bringing together the organisations concerned. The Research Co-ordination Committee has been fortunate in obtaining the co-operation of many organisations interested in various aspects of the housing question. Among these are the Housing Centre, Architectural Association, Modern Architectural Research Association, Architects and Technicians Organisation, Society of Women Estate Managers, Kitchen Planning Centre, Women's Gas Council, Institute of Sociology, etc. The Building Research Station of the Department of Scientific and Industrial Research and the Housing Section of the Ministry of Health have also provided assistance.

Lighting and Heating Research

A CONFERENCE on lighting, space heating and hot water supply in low-cost housing, arranged by the Housing Centre, 13 Suffolk Street, S.W.1, was held on May 25 and 26. In the opening address, Lord Elton referred to cheapness, efficiency and health requirements as the main directives in modern low-cost house building and contrasted them with the durability, dignity and individuality of the Tudor period. In the discussion that followed, Prof. Patrick Abercrombie, who was in the chair, pointed out that standardisation can be applied to desirable as well as undesirable features, and other contributors suggested that perhaps dignity and individuality can now be transferred from the individual house to a planned estate as a whole. Sir Richard Paget, in his address as chairman of the business part of the Conference, gave a broad view of some of the avenues opened by scientific research in the utilisation of our national fuel assets, and pointed out several cases of present wastage. He directed attention to Sir Richard Gregory's remarks at the Royal Institution on the mission of science in the changing world of to-day. He also stressed the urgent need of an impartial investigation of the monetary system, and ended by pointing out the value of technical conferences in bringing together experts and enabling them to synthesise their ideas into one connected whole.

THE relative merits of gas, electricity and other forms of heating were brought out in a series of papers contributed by the British Commercial Gas Association, British Electrical Development Association, Coal Utilization Council, London and Counties Coke Association and by other organisations and individual specialists. The convergence upon a common problem of these diverse interests has been a valuable feature of the Conference. The need for an impartial body to collect and collate the data supplied by the various parties was brought out, and both the Housing Centre and the Research Co-ordination Committee have expressed their willingness to help in this work. The immediate task of such a body would be, first, to find out what the

consumer actually uses and is likely to expect with an increased standard of living and, secondly, how far his requirements can be satisfied with existing methods and appliances, or such improved forms as the advance in technique renders possible.

Radium Research at Birmingham

FOR some time the Physics Department of the University of Birmingham has had charge of 0.5 gm. of radium, which has been used for supplying local hospitals with radon. This radium, which belonged to the Radium Commission, has recently been allotted to the General Hospital of the City for a special purpose. It therefore appeared likely that the Radon Laboratory of the Department of Physics at the University would be put out of action. Thereupon Sir Gilbert Barling issued an appeal for a fund to provide the University with a supply of radium of its own. The appeal met with a most generous response, and with the accruing money it is proposed to buy for the University 1 gm. of radium, so that the Radon Laboratory will be able to continue to supply radon to hospitals as before, and the Physics Department will have radium available for scientific research. The Pro-Chancellor (Mr. Walter Barrow) has expressed on behalf of the University his warmest thanks to Sir Gilbert Barling for his energy and initiative and to the donors for their generous response.

Conference on Atmospheric Pollution

THE half-yearly Conference of representatives of local authorities and other organisations co-operating with the Department of Scientific and Industrial Research in the investigation of atmospheric pollution was held in the offices of the Department on May 25. The Conference received from Dr. G. M. B. Dobson, chairman of the Atmospheric Pollution Research Committee, a report on the progress of research. He announced that the Committee has decided to undertake an intensive survey of the pollution in and around an industrial centre and has selected the city of Leicester, the geographical position of which in relation to the surrounding country and neighbouring centres of population appears to render it particularly suitable. The Conference noted with interest that the London County Council has intimated that it is extending its investigations and that it is arranging for observations at a rural institution and a seaside institution belonging to it. Reports from Glasgow and from Sheffield and Rotherham were presented on comparative determinations of sulphur in filtered and unfiltered air. Measures for reducing pollution due to the emission of ash and grit from chimneys were also discussed. At its previous meeting, the Conference considered a proposal by the London County Council that the machinery of the Conference might be used to secure financial contributions for investigations into means for reducing this type of pollution. A committee, which was appointed to meet representatives of the Department for the discussion of practical measures, presented a report for discussion by the Conference.

Borax as a Fertiliser

It has long been known that a group of about ten elements plays an essential part in plant nutrition, but it is only during recent years that it has become recognised that other elements are of equal importance, though in such small amounts that their presence was previously unsuspected. Manganese and boron are the outstanding examples of these minor elements—'minor' only in the sense that the requisite quantity is so small. Copper, zinc and other substances may also play an essential part in specific cases, and active research is in progress. The case with regard to boron is of definite economic importance. The pioneer work of Agulhon (1910) and Warington (1923) established the fact that in the entire absence of boron certain species, at least, are unable to develop properly. The necessary amount of boron is so small that most soils contain sufficient for the normal development of plants. During the last few years attention has been focused on certain obscure plant diseases for which no adequate explanation was forthcoming, and in many cases amelioration has been obtained by the application of boron compounds to the soil. Heart rot of sugar beet and brown heart of turnips are notable examples of this, and it is becoming a recognised practice to include a small quantity of boron compounds with the fertiliser, 12–20 lb. of borax per acre representing the safe limit, beyond which there is danger of injuring the plants by poisoning them. The great economic importance of this point has led to the establishment of a Boron Agricultural Bureau under the aegis of Borax Consolidated, Ltd., for the purpose of collecting and distributing information with regard to the use of borax for agricultural purposes. A word of warning may not be out of place. The beneficial results so far obtained by the application of borax as a specific against certain plant diseases may lead to undue optimism, and to a tendency to attribute every obscure plant disease to lack of boron, without adequate inquiry. The necessity for continued research must be emphasised, as it seems possible that the correct use of various 'minor' elements may lead to definite and valuable progress in agricultural practice.

Cotton Industry in Northern Nigeria

An interesting account of the future possibilities of the cotton industry in Nigeria was given by Mr. G. Browne, manager of the English Cotton Growing Corporation's Seed Farm in Northern Nigeria, at a recent meeting of the Administrative Council. The farm was started ten years ago, and has been chiefly occupied with testing out new strains of cotton prior to their distribution to the native farmers. In addition, a study has been made of intercropping with some plant other than cotton, the evidence going to show that better results are secured if two crops follow each other instead of being grown almost simultaneously. The question of the maintenance of fertility inevitably arises with this practice, and as green manuring proved unsuccessful, an entirely new method, namely, the introduction of cattle, was tried.

At first high mortality rates occurred, due partly to tsetse fly trouble and partly to lack of experience as to the conditions under which cattle can be kept in good health in this district. Now, however, that the preliminary difficulties have been overcome by bush clearance and regular use of dip, etc., the cattle are already playing an important part in the agriculture of Northern Nigeria, and a new era of expansion seems probable. New implements, notably a steel plough, have also been introduced, and further, the Corporation is hoping, by the example of its own farm as well as by other means, to aid in this future development of the agricultural industry in Northern Nigeria, of which an increased output of cotton should be an outstanding result.

Dialling Ships at Sea

WHEN the radio telephone was first applied to ships at sea about 1929, the ship receivers, connected either to a loud speaker or an operator's headset, were always 'on the air' and thus heard all calls. Stations were called by name, and all other stations listening on the same frequency would hear the call. With the increasing use of ship to shore radio service, a method of signalling one ship only became highly desirable, as this would obviate the necessity of keeping the loud speakers or telephone receivers 'on the air' all the time. In the *Bell Laboratories Record* of April a method of doing this is described. With this system, each ship has a three digit number assigned to it. When the operator at the telephone switchboard wishes to place a call, he merely dials the number of the ship wanted. This sends out a series of tone pulses which are received by all the ships within range. The called ship is the only one that receives an audible signal. On this ship a telephone bell rings and the operator picks his handset off the hook and replies in the usual way. When a call is answered, the handset is removed from its switchhook, thus operating the transfer relay. This removes the selector set from the radio receiver and connects the telephone receiver in its place. It also stops the bell ringing. When the telephone conversation is finished, the handset is returned to its hook and this releases the relay. The signal receiving set is automatically reconnected in preparation for receiving calls. This system is now being used by a number of coasting and harbour ships in America, but it promises to become applicable to a much wider field.

Meteorology and the Sea Service

THE *Marine Observer* of April (13, No. 122) contains an article by Capt. L. A. Brooke-Smith, superintendent of the Marine Division of the Meteorological Office, Air Ministry, entitled "Observation and Weather Forecasting and Some of their Bearings on the Sea Service". The author comments on the great improvement in accuracy of observations of barometric pressure at sea since the Great War, and attributes this to the growing realisation on the part of ships' officers that weather forecasting is not only possible by a few specially trained meteorologists in observatories ashore, and to the increasingly

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successful efforts in this direction that have resulted from that realisation. It fell to Capt. Brooke-Smith to explain to a committee of the Chamber of Shipping of the United Kingdom in 1921 some of the advantages which might accrue to navigation from the more general use of reliable thermometers as well as reliable barometers, and the report of that committee to the Chamber of Shipping included recommendations in respect to both these items. Apart from their value in forecasting, reliable measurements of atmospheric pressure at sea should eventually become important for pilots of aircraft when far from land, who will rely on them for obtaining correct indications of height from their altimeters, and for that purpose will have to obtain them by wireless from ships.

AN equal improvement in thermometers, Capt. Brooke-Smith states, has not yet taken place. He points out, however, that the information about temperature required at sea can generally be obtained from the broadcasts made on 2100 metres wave-length by British *A* class selected ships, which broadcasts have a range of 1,500 miles; such ships are to be found on all main trade routes, and all are equipped with thermometers certified by the National Physical Laboratory and exposed in Meteorological Office screens. The thermometers on such ships, when the ship is in port, afford a means whereby, through the courtesy of the captain, other ships may test their own thermometers and ascertain their accuracy. In answer to the frequently made suggestion that more British merchant ships should be equipped with instruments provided through the Meteorological Office, Capt. Brooke-Smith points out that the existing meteorological personnel at the ports is not adequate for dealing with such an increase, which would also throw excessive extra work on the divisions of the Meteorological Office concerned with maintaining the marine meteorological equipment, that is, the marine and instrument divisions.

Sixteenth Century Central Europeans in England

IN the *Matice Moravská* (Brno, Czechoslovakia), Prof. O. Odložilík has just published the results of extensive researches among documents and manuscripts from British libraries and those in Holland and central Europe, under the title "Visits from Bohemia and Moravia to England, 1563-1620". He shows how scholars in Britain and the remoter parts of the Continent managed to keep in touch with each other's discoveries, views and writings. This contact was as strong between men of science (astronomers, mathematicians and others) as it was between theologians or historians. The period under review preceded the influx of refugees from the Thirty Years' War, but the question whether Komenský (Comenius) visited England in 1613 (that is, when he was only twenty-one years of age) is again raised. Whilst it is extremely unlikely that the great educationist did come to England prior to 1641, it is clear that many Bohemian and Moravian students and savants (including Peter Vok and Thaddeus Hajek) visited

Oxford and Cambridge, and made contact with such sixteenth century Englishmen as Dr. John Dee, Francis Bacon, Sir Philip Sidney, Lord Burghley and the Earl of Essex. Some, like Charles of Zerotin, acted as diplomats between Bohemian monarchs and the British Crown at this period when culture and science began to flourish again after the Dark Ages.

Flashes of Lightning

ACCORDING to a message from Science Service, flashes of lightning photographed by a cine-camera by J. W. Beams, L. B. Snoddy and E. J. Workman, of the Universities of New Mexico and Virginia, were shown at the recent meeting of the American Physical Society. The progress of the flash was shown to be similar to that of a nail gradually piercing a wooden board step by step under the successive blows of a hammer. Their cameras showed that the first flash extended halfway from the cloud to the earth. A second one followed the path of the first but went six tenths of the way, while a third travelled seven tenths of the distance. The fourth flash reached all the way and struck the earth. Four other flashes from the cloud to the earth followed at short intervals of approximately one hundredth of a second.

Institution of Gas Engineers

AT the seventy-third annual general meeting of the Institution of Gas Engineers which opened in London on May 26 the following medals were presented: Institution Gold Medal, to George Dixon, for a paper on "Problems and Answers in the Reconstruction of Manufacturing and Distribution Plant, Nottingham"; H. E. Jones London Medal, to W. L. Boon, for a paper on "The Preparation, Marketing and Utilization of Coke"; Institution Silver Medal, to T. P. Ridley, for a paper on "Gas Tariffs"; Institution Bronze Medal, to William Hodgkinson, for a paper on "Benzole Recovery and the Production of Motor Benzole". Mr. Stephen Lacey, controller of gas sales, Gas Light and Coke Company, London, was elected president of the Institution for the year 1936-37, and Mr. H. C. Smith, chief engineer, Tottenham and District Gas Company, and Mr. Robert Robertson, engineer and works manager, Bristol Gas Company, were elected vice-presidents.

South African Association for the Advancement of Science

UNDER the presidency of His Excellency the Right Hon. the Earl of Clarendon, Governor General of the Union of South Africa, the South African Association for the Advancement of Science will hold its thirty-fourth annual session on October 5-10 in Johannesburg. It is noteworthy that the meeting coincides with the celebrations connected with the jubilee (fifty years) of Johannesburg, and with the holding there of the Empire Exhibition. Sectional presidents are: A, Dr. E. J. Hamlin, city engineer, Johannesburg ("The Researches of a City Engineer's Department"); B, Prof. E. D. Mountain, professor of geology and mineralogy at Rhodes University College,

Grahamstown, C.P. ("Minerals"); C, Prof. John Phillips, professor of botany in the University of the Witwatersrand ("Biology and Industry : with special reference to Plant Biology and the Mining Industry"); D, Dr. R. Bigalke ("The Naturalisation of Wild Animals with special reference to South Africa"); E, Prof. M. R. Drennan, professor of anatomy in the University of Cape Town ("Human Growth and Differentiation"); F, Dr. I. D. MacCrone, lecturer in psychology in the University of the Witwatersrand ("The Problem of Race Differences"). Prof. L. Fouché, professor of history in the University of the Witwatersrand, is to deliver a public evening lecture on the history of the Witwatersrand. Symposia have been arranged in the various sections, while demonstrations and excursions are included in the programme. A cordial invitation to attend the meetings is extended to visitors from overseas who are connected with, or interested in, scientific pursuits; visiting scientific workers will be made honorary members for the session.

Announcements

THE Government of the Spanish Republic has conferred the decoration of 'Comendador de la Orden de la República' upon Sir Henry Wellcome, the founder of the Wellcome Research Institution, London, in recognition of his outstanding services to Spanish interests.

AN exhibition of photographs organised by the American Institute for Persian Art and Archaeology, including photographs representative of the latest work of the Institute's architectural survey, will be held at the Royal Institute of British Architects on June 9-26. The exhibition will be opened at 3.30 p.m. on June 9 by His Excellency Hussein Ala, the Iranian Minister in London.

DR. ENID CHARLES, of the Department of Social Biology of the London School of Economics, will open a discussion on "Population Trends in Relation to the Housing Problem" at the Guildhouse, Eccleston Square, Victoria (Berwick Street entrance), on Tuesday, June 2, at 7.30 p.m. The discussion has been arranged by the Research Co-ordination Committee in conjunction with the Engineers' Study Group. Those wishing to attend should notify the honorary secretary, Research Co-ordination Committee, Hazlitt House, Southampton Buildings, W.C.2 (Tel. : Holborn 1068). The discussion is part of a concerted plan to approach the housing problem from various angles: sociological, architectural, health, engineering and financial.

THE German Statistical Society will hold its annual meeting at Brunswick on June 25.

THE Chancellor of the German Reich has awarded the shield of nobility to Prof. Gustav Tammann, professor of physical chemistry at Göttingen, and the Goethe Medal to Dr. Reinhold Schmaltz, professor of anatomy, embryology and histology at Berlin.

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

A head of the Building Department in the Gloucester Technical College—The Principal (June 3).

A head of the Engineering Department in the Shrewsbury Technical College—The Secretary for Education, County Buildings, Shrewsbury (June 3).

A University demonstrator in physics in the University of Cambridge—Dr. R. G. W. Norrish, University Chemical Department, Cambridge (June 4).

An assistant lecturer in chemistry in the Robert Gordon's Technical College, Aberdeen—The Registrar (June 5).

A demonstrator in anatomy in the University of Sheffield—The Registrar (June 6).

A lecturer in civil and mechanical engineering in the Woolwich Polytechnic, London, S.E.18—The Secretary (June 6).

A principal of the Norwich Technical College—The Director of Education, City Education Offices, Norwich (June 8).

An electrical engineer in the Armaments Inspection Department, Royal Arsenal, Woolwich—The Under-Secretary of State (C.5), The War Office, London (June 9).

A demonstrator in biology in the London (Royal Free Hospital) School of Medicine for Women—The Secretary, 8 Hunter Street, Brunswick Square, W.C.1 (June 12).

A lecturer in physiology in the Chelsea Polytechnic, London, S.W.3—The Principal (June 12).

A demonstrator in mathematics in the City and Guilds College, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7—The Secretary (June 19).

An assistant lecturer in mechanical engineering in the Municipal College of Technology, Manchester—The Registrar (June 29).

An instructor in mechanical and electrical engineering in the Bulawayo Technical School—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, 429 Strand, W.C.2 (Aug. 21).

A lecturer in geography and nature study in the Bedford Froebel Training College—The Principal, 14 The Crescent, Bedford.

A lecturer in physics in the Heriot-Watt College, Edinburgh—The Principal.

A lecturer in geography in St. Peter's College, Peterborough—The Principal.

A professor of physics in Canterbury University College, Christchurch, New Zealand—The Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

A lecturer in geography in the University of Reading—The Registrar.

A professor of mathematics and a professor of education in University College, Cork—The Secretary.

A district engineer in the Public Works Department of the Sudan Government—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1.

A senior engineer in the Equipment Department of the B.B.C.—The Engineering Establishment Officer, Broadcasting House, London, W.1.

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. 910.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Metabolism of Cold-Blooded Animals in Different Latitudes

WHEN the oxygen consumption of a species of poikilothermal animals is measured at various temperatures, it is found that more oxygen is used at high temperatures than at low. This is partly because the movements of the animals are greater at higher temperatures, and partly owing to a greater non-locomotory oxygen consumption when the temperature is raised. Instead, now, of a single species in a given locality, consider two nearly related stenothermal species of marine cold-blooded animals, one living in cold seas, the other confined to warmer waters. It is a common observation that species of poikilothermal animals in cold climates are as active as related species in hot climates. But what are the oxygen and food requirements of two such species? This question seems never to have been studied.

I have compared a number of species of arctic or northern marine invertebrates with nearly related species from the English Channel. The oxygen consumption of these animals has been studied, and the rates of respiratory movements of crustaceans and of ciliary movement in scallops have been measured, at various temperatures.

The cold-water animals were investigated at the Kristineberg Zoological Station on the west coast of Sweden. There the lower water of the Gullmar Fjord, from a depth of 60 metres to the bottom at 140 metres, has a salinity of 33-34 per thousand, an annual temperature varying only from 5° to 7°, and a population of arctic and northern species. The Station has a circulation of cold sea-water in which these animals can be kept alive. The English animals were taken at Plymouth, where they live in water having a normal minimum temperature of 7°-8° and a normal maximum of 14°-15°. The Plymouth animals were studied at Birmingham in sea-water of 35 per thousand salinity.

The oxygen consumptions were compared in the following pairs of species:

Kristineberg	Plymouth
(1) <i>Stichopus tremulus</i>	<i>Holothuria forskali</i>
(2) <i>Ophiura sarsi</i>	<i>O. texturata</i>
(3) <i>Antedon petasus</i>	<i>A. bifida</i>
(4) <i>Phascolosoma margaritaceum</i>	<i>P. elongatum</i>
(5) <i>Pandalus borealis</i>	<i>P. montagui</i>
(6) <i>Spirontocaris securifrons</i>	<i>S. cranchi</i>
(7) <i>Pontophilus norvegicus</i>	<i>P. spinosus</i>

In all seven cases, the oxygen consumptions of the Kristineberg and of the Plymouth species, each at two temperatures, can be represented respectively by curves similar to *k* and *p*₁ (Fig. 1): this means that in every pair of species the oxygen intake of the warmer-water form is higher than that of the colder-water species, just as if a single species, in one locality, had been studied over the whole range of temperatures.

Since the locomotory activities of the warmer- and colder-water species are about the same, I suggest that the oxygen required for locomotion is approximately the same in each, but that the non-locomotory metabolism is higher in the warmer-water species.

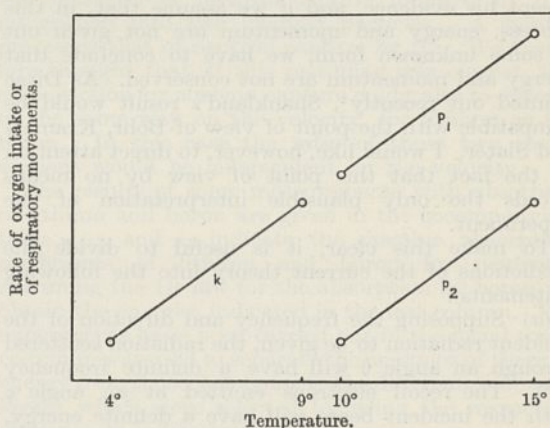


FIG. 1.

A comparison of the rates of ciliary movement in the gills of the scallops *Chlamys septemradiata* (Kristineberg) and *C. varia* (Plymouth) again gave curves like *k* and *p*₁.

But the respiratory movements of the Crustacea gave a different result. The rates of scaphognathite movements were compared in prawns (the two species of *Pandalus* and the two species of *Spirontocaris*), and the rates of the maxillepede epipodites in a pair of *Apsuodes* species (*A. spinosus*, Kristineberg, and *A. latreillei*, Plymouth). In each of these three pairs the results gave curve *k* for the Kristineberg species and *p*₂ for the Plymouth species. It is clear that the respiratory movements of the warmer-water species were no faster than those of the colder-water forms, each at the usual sea temperatures at which the animals live. The rates of respiratory movements seem thus to correspond to the similar locomotory oxygen consumption postulated above.

In addition to comparing stenothermal northern with English species, I have commenced comparisons between members of single eurythermal species living in different latitudes. Here the preliminary results show adaptations within single species. The rates of scaphognathite-beat of a certain species of prawns living both at Plymouth and at Kristineberg give curves *k* and *p*₂ at these two places respectively: the rate at Plymouth at 16° is no faster than that at Kristineberg at 6°. This concurs with the work of Mayer¹, who showed that the

medusa *Aurelia aurita* is acclimatised to different latitudes: in Florida its optimum temperature for pulsation is 29°, whereas this temperature is fatal to members of the same species in Nova Scotia.

The results summarised here will be published in the *Proceedings of the Zoological Society*.

H. MUNRO FOX.

Zoology Department,
University, Birmingham.

May 6.

A. G. Mayer, *Pap. Tortugas Lab.*, 6, 3 (1914).

Interpretation of Shankland's Experiment

THE experimental results of Shankland¹ are in contradiction with the accepted theory of the Compton effect, in particular with the idea of detailed conservation of energy and momentum. If we accept his evidence, and if we assume that, in this process, energy and momentum are not given out in some unknown form, we have to conclude that energy and momentum are not conserved. As Dirac pointed out recently², Shankland's result would be compatible with the point of view of Bohr, Kramers and Slater. I would like, however, to direct attention to the fact that this point of view by no means affords the only plausible interpretation of the experiment.

To make this clear, it is useful to divide the predictions of the current theory into the following statements:

(a) Supposing the frequency and direction of the incident radiation to be given, the radiation scattered through an angle θ will have a definite frequency $\nu(\theta)$. The recoil electrons emitted at an angle ϕ with the incident beam will have a definite energy, $E(\phi)$.

(b) Simultaneously with each recoil electron, there appears one quantum of the scattered radiation, and vice versa.

(c) Between the direction of emission of a recoil electron and the simultaneous quantum of scattered radiation there is, again for given direction and frequency of the incident radiation, an unambiguous connexion: the two directions lie in one plane through the direction of incidence, and their angles θ and ϕ are definite functions of each other.

Statement (a) is very accurately confirmed in the X-ray region, but I am not aware of an equally exact confirmation for energies as high as those used by Shankland. This point is of importance, as the fact (a) is the only reason for assuming that no energy is given out in a form unknown at present.

Statement (b) was, for X-rays, subject to a test by Bothe and Geiger³, who found a positive result.

Shankland's experiment is a test for (b) and (c) together, for, as distinct from Bothe-Geiger, his counters subtend small solid angles with the scatterer, and if (b) would hold but not (c), the number of coinciding pairs that would happen to pass his counters would be too small to be detected. If we accept his evidence, we are then forced to abandon either (c), or (b) and (c) together. (One cannot, of course, retain (c) without (b), as without (b) recoil electrons and secondary quanta are not connected in pairs.)

(i) The point of view of Bohr-Kramers-Slater and Dirac would imply that (b) and (c) have to be abandoned. This would necessarily imply that the

Bothe-Geiger experiment was erroneous. On that view, the photon does not exist in the corpuscular sense of the current theory.

An alternative—and, it seems to me, equally plausible possibility—is that (b) still holds; that is, that there is a secondary photon for each recoil electron, but that their directions do not obey the relations required by the conservation laws.

(ii) One may either believe that (c) breaks down for any frequency of the incident radiation, just as Bohr-Kramers-Slater require (b) to break down for all frequencies.

(iii) Alternatively, one may believe that (c) holds, at least approximately, for small frequencies, and that deviations from it become appreciable only for photon energies of the order of a million volts. The latter alternative would, on the existing evidence, give us the freedom to abandon also the exact validity of (a) for high frequencies. This would, in many ways, seem more satisfactory, for (a) is the very direct result of applying the conservation laws. It seems therefore artificial to maintain it where the conservation laws fail. Together with (a), the statistical conservation of energy would fall. That, too, seems satisfactory, once detailed conservation has been abandoned.

Again, if we abandon both (a) and (c) for high energies, there would be a close analogy between the two phenomena in which an apparent non-conservation has been observed, namely, the Compton effect and the continuous β -spectrum, while on the point of view of Bohr-Kramers-Slater or on the assumption (ii) above, these must be widely different phenomena.

A decision between (i), (ii) and (iii) (and possibly other interpretations) can, of course, only be made by further experiments, and a theoretical discussion of advantages and disadvantages of (ii) and (iii) as compared to (i) would, at the present stage, be idle. But their possibility should be kept in mind in order to carry out and discuss such experiments without being biased by one particular non-conservation theory.

R. PEIERLS.

Royal Society Mond Laboratory,
Cambridge.
April 23.

¹ *Phys. Rev.*, 49, 8 (1936).

² *NATURE*, 137, 298 (Feb. 22, 1936).

³ *Z. Phys.*, 32, 639 (1925).

Colour of the Luminous Background of the Extra-Galactic Nebulae

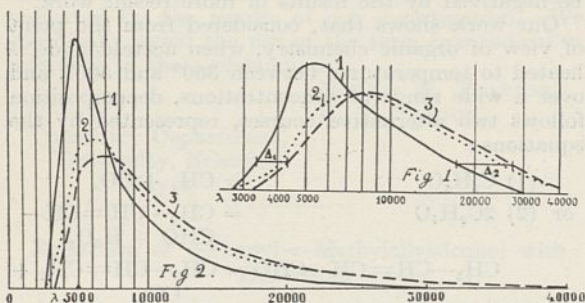
ACCORDING to Milne, the multitude of the distant galaxies form a continuous luminous background. It is interesting to investigate what its colour should be. By Hubble's law, the spectra of the galaxies are shifted towards the red. It is easy to calculate the integral colour of the background if we adopt Milne's view that the galaxies are really receding. Then the light of a galaxy is shifted towards the red according to Doppler's law. The intensity from a receding nebula is less than it would be if the nebula were motionless at the same distance. Indeed, a quantum of light if shifted to the red has less energy than the original quantum; in addition, when a source of light is receding, its quanta fall upon the observer less frequently than they would if the source were motionless. Under the combined action of both causes the intensity is diminished doubly.

Using Milne's formula for this effect (it follows from the electrodynamics of special relativity too), and his picture of the universe, I have calculated the integral spectrum of the background. In such calculations it is more convenient to represent the intensity of spectrum not as a function of the wavelength λ , but as a function of $\ln\lambda$, for then the Doppler effect displaces the curve of the spectrum as a whole, and does not distort it. If $F(\ln\lambda)$ is the spectrum of the sun (that is, of a motionless galaxy), then the spectrum of the background of the galaxies which have velocities greater than V is

$$\int_{x_0}^{\infty} \left(\frac{2x}{e^2 - 1} \right)^2 F(\ln\lambda - x) dx,$$

where x_0 is $\frac{1}{2} \ln \frac{I+V}{I-V}$.

By a very rough graphical integration I have found this integral. The result is shown in Fig. 1. The abscissæ are $\ln\lambda$. Curve 1 is the solar spectrum, Curve 2 is the spectrum of the light from all the galaxies, and Curve 3 is the spectrum of the background of the galaxies which are invisible separately through a telescope. The mean shift of this spectrum $(\Delta_1 + \Delta_2)/2$ is about one half of the length of the visible spectrum. The integral areas of the three curves are made equal. Fig. 2 shows the same spectra drawn as usually, the abscissæ being λ , and not $\ln\lambda$.



We see that more than a half of the radiation with which the universe is filled is infra-red. To a most sensitive eye the background of the galaxies would appear as dark red.

In the calculations, I did not allow for the absorption of light when a galaxy stands in front of another. This absorption must somewhat diminish the redness of the background of the extra-galactic nebulae.

M. LEONTOVSKI.

Astronomical Observatory,
University of Leningrad,
U.S.S.R.
March 22.

Cross-Section Measurements with Slow Neutrons of Different Velocities

In recent experiments¹ we got information about the relative position of the resonance levels for neutron capture in certain nuclei. The levels could be arranged as follows:

Br (18 min.) > I > Ag (22 sec.) > Rh (45 sec.) ~
In ~ Ir :

the level of Br having the highest, those of Rh, In and Ir the lowest energy.

This relation permits a qualitative investigation of the dependence of cross-sections for diffusion and capture of neutrons on the velocity. In connexion with a letter by Frisch and Placzek², who assume the cross-section for neutron capture by boron to be inversely proportional to the neutron velocity, we wish to communicate some of our results.

We found that, within the whole range from neutrons of thermal velocity up to the resonance level of Br (18 min.), the cross-section for neutron capture by boron decreases with increasing energy of the neutrons. Though we can give no proof that the cross-section is really proportional to $1/v$ (v being the velocity of the neutrons), our experiments show at least that no discontinuities occur in this range of velocity. The absorption of neutrons by boron can therefore certainly be used to determine qualitatively their energy.

Frisch and Placzek assumed an especially simple cross-section function for boron in consequence of the character of neutron capture followed by disintegration into two charged particles. A similar process is that of neutron capture by ${}^6\text{Li}$. We therefore thought that, if this reasoning was correct, the cross-section for neutron capture ought also to depend in the same way on the velocity, for lithium as for boron. In this case the ratio of those two cross-sections would be independent on the velocity.

The results of some measurements with absorbers of lithium and boron are given in the accompanying table; μ_{Li} and μ_{B} indicate the massive absorption coefficients of lithium and boron for neutrons. Assuming the $1/v$ law for the absorption by boron we obtain the energies indicated in the last column. The experiments have been carried out in the usual way: cadmium was used to separate the neutrons of thermal energy from those, belonging to the different resonance levels, which were selected by using the respective elements as indicators.

Energy of neutrons	μ_{B}	μ_{Li}	$\mu_{\text{B}}/\mu_{\text{Li}}$	Volts
Resonance level of				
Br (18 min.)	0.8	0.2	4.0 ± 1	56
I	1.5	0.4	3.8 ± 0.6	16
Ag (22 sec.)	3.4	0.3	11.3 ± 1.5	3
Rh (45 sec.)	6.3	0.8	8.0 ± 1.5	1
Thermal energy	30	3.0	10.0 ± 1.5	0.04

These results seem to show that for energies above the resonance level of Ag (22 sec.) the cross-section functions for capture by lithium and boron behave differently. But this deviation seems due to scattering of neutrons by the lithium absorber.

A series of experiments showed that the cross-section for back diffusion of neutrons by carbon was constant within the whole range between the resonance level of Br (18 min.) and thermal energy. (This result agrees with the results of Pontecorvo and Wick³.)

A sheet of cadmium (0.5 gm./cm.^2) absorbed 95 per cent of the artificial radioactivity created by slow neutrons in dysprosium⁴. This indicates that dysprosium has either no resonance level for the capture of slow neutrons, or a resonance level the energy of which is lower than the upper limit for strong absorption by cadmium. Experiments with cadmium absorbers and boron absorbers of different thicknesses seem to prove the latter alternative; these experiments are being continued.

We found in general that the cross-sections for resonance neutron capture and for capture of thermal neutrons are largest for those nuclei the resonance levels of which have the lowest energy.

Added in proof: Determination of the breadth of the level for Ag (22 sec.). A solution of AgNO_3 and an equivalent solution of HNO_3 were used alternatively for the slowing down of neutrons in a vessel, the dimensions of which were large, compared with the mean free path of neutrons belonging to the level of Ag (22 sec.). Comparing the intensities of silver and of rhodium resonance neutrons in these two cases, we observed that AgNO_3 (1.0 gm./cm.³) reduced the intensity of the neutrons belonging to the level Ag (22 sec.) to 46 per cent, those belonging to the level Rh (45 sec.) only to 84 per cent of the intensity obtained in HNO_3 . Since the neutrons of the rhodium level are slower, this shows that only every fourth neutron becomes a silver neutron whilst being slowed down. The neutrons are not slowed down continuously, they lose on the average half their energy at every shock with a free proton. A resonance level is therefore only passed by all neutrons when its breadth is at least half its energy. Our result shows that three quarters of the neutrons jump over the silver level. Its breadth must therefore be 1/8 of its energy or 0.4 volt. Of course 0.4 volt is at the same time the maximum breadth of the γ -ray of some millions of volts which is emitted when the neutron is captured.

We wish to thank Mr. P. Savitch for his efficient help and for interesting discussions.

HANS VON HALBAN, jun.
PETER PREISWERK.

Institut du Radium,
Laboratoire Curie,
Paris.
April 3.

¹ P. Preiswerk and H. von Halban, jun., *C.R.*, **202**, 840 (1936).

² O. R. Frisch and G. Placzek, *NATURE*, **137**, 357 (1936).

³ Pontecorvo and Wick, *La Ricerca Scientifica* **ii**, **2**, n.3-4.

⁴ G. v. Hevesy and H. Levi, *NATURE*, **136**, 103 (1936).

Structure of Neutrons and β -Disintegration

It seems that an electron does not exist as a separate dynamical entity in a neutron. We assume, accordingly, that when a neutron is formed from a proton and an electron, the excess of energy of the particles is transformed into rest mass, energy and momentum being conserved.

If u , V , V' are the velocities of an electron, proton and neutron, and m , M , M' their respective masses, then

$$\frac{m u}{\sqrt{(1-u^2/c^2)}} + \frac{M V}{\sqrt{(1-V^2/c^2)}} = \frac{M' V'}{\sqrt{(1-V'^2/c^2)}} + 2mc,$$

$$\frac{m}{\sqrt{(1-u^2/c^2)}} + \frac{M}{\sqrt{(1-V^2/c^2)}} = \frac{M'}{\sqrt{(1-V'^2/c^2)}} + 2m;$$

where $2mc^2$ is the binding energy.

Neglecting V , we find:

$$M' \approx M - m + \left[\frac{m}{\sqrt{(1-u^2/c^2)}} - m \right];$$

the term in square brackets would correspond to the neutrino.

It would seem that the kinetic energy of β -rays, emitted at disintegration, is acquired at the expense of the rest mass of a neutron; the difference between the masses of neutrons should, accordingly, be of the order of magnitude of the energy of β -rays.

Several values have been found for the mass of a neutron. For example, Chadwick and Curie-Joliot obtained 1.0067 and 1.010 respectively (difference

about $6mc^2$ or 3×10^6 volts). If the difference between the masses is genuine, and not due merely to experimental errors, it could be explained by the structure of neutrons suggested. It is not necessary to assume that the electron spin is destroyed at the formation of a neutron; it might remain unobservable.

A classical picture of a neutron would be a rotating 'sphere' smoothly connected with a 'gyroscope' so that the spin of the latter remains uninfluenced by the external field.

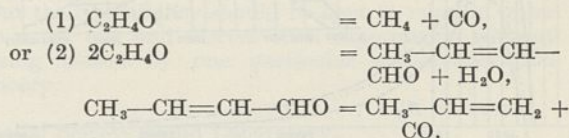
D. MEKSYN.

Department of Mathematics,
Imperial College of Science,
S.W.7.

Thermal Decomposition of Acetaldehyde and Ethylene Oxides: Existence of Short-Lived Intermediates

THE writer of the section of the Annual Reports of the Chemical Society, which has just been published, tells us that the results of the investigations of Hinshelwood and his co-workers on one hand, and of myself and my co-workers on the other, lead to the conclusion that the decomposition of acetaldehyde is influenced by chain mechanism at low temperatures but not at high temperatures. Whether the conclusion could justly be drawn from the published information available to the writer of the section of the Report is a matter of opinion; but it appears to be negated by the results of more recent work.

Our work shows that, considered from the point of view of organic chemistry, when acetaldehyde is heated to temperatures between 360° and 500° , and over a wide range of concentrations, decomposition follows two alternative courses, represented by the equations:



The former process is dominant in an unpacked tube, though some propylene is always formed; but the second process is dominant in a packed tube. It may be added that the propylene always undergoes some condensation, with the result that some 6-carbon hydrocarbon is produced, together with more complex products.

Now it would appear at first sight that we are dealing with two quite independent processes, one taking place on the surface, and the other in the gas phase; and as the volume change accompanying the second set of changes is relatively only a little less than that accompanying the simpler process represented by the first equation, the extent to which each of the processes takes place cannot be determined from the results of pressure measurements. Detailed analytical methods do, however, enable us to follow the processes exactly, and when this method is adopted we arrive at a very interesting conclusion.

While packing a reaction tube results in the slowing down of the first process and accelerating the second, it is found that the total rate of decomposition of the acetaldehyde is altogether independent of the nature or dimensions of the reaction tube. One must conclude therefore that the first stage in the process of decomposition, over the range of temperature

referred to, involves the formation of one single type of primary nucleus. The simplest explanation of the result which we have arrived at involves the assumption of the existence of a short-lived intermediate, the transition process involving the passage over a potential barrier, such that the change,

primary nucleus \rightarrow short-lived intermediate,

is practically irreversible. The short-lived intermediate may then either undergo change in the gas phase within average time Δt , when the result is represented by equation (1), unless within this period it strikes a surface, when it undergoes, or takes part in, the changes represented by the second set of equations.

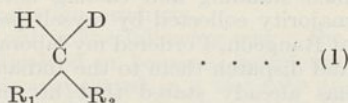
We find that at all concentrations, and at all temperatures at which we have carried out experiments, the rates of decomposition both of acetaldehyde and of ethylene oxide are accelerated initially, the acceleration being more marked in the case of ethylene oxide, which exhibits an induction period. From the consideration of thermodynamic data, one would have anticipated that such a relationship would exist. However, the phenomenon of acceleration is so marked in the case of both compounds, and the primary energy changes are relatively so small, that one cannot escape the conclusion that the processes involved in the thermal decomposition of these compounds are very much more complex than has been suggested, and must be bound up with secondary changes, such as that involved in the formation of a short-lived intermediate, the existence of which is indicated by the results of our investigation. We specifically avoid the use of the term free radical in reference to these phenomena.

MORRIS W. TRAVERS.
R. V. SEDDON.

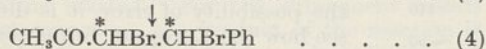
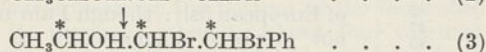
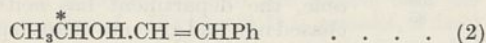
Chemistry Department,
University, Bristol.
May 6.

Reduction of γ -Phenyl- α -Methylallyl Alcohol with Deuterium

AN attempt to prepare a compound containing an asymmetric carbon atom of the form



in an optically active state has been based upon the experiment of Kenyon and Partridge previously published¹, in which an asymmetric synthesis is achieved by means of the following series of reactions:



d - γ -phenyl- α -methylallyl alcohol [α]₅₈₉₃^{18°} = +22.0, $c = 5$, $l = 2$, in carbon disulphide² on reduction with hydrogen at two atmospheres in the presence of a platinum oxide catalyst prepared according to the method of Adams, Voorhees and Shreiner³ in ether solution gave methyl- β -phenylethylcarbinol (α ₅₈₉₃^{18°} - 3.32; α ₅₇₈₀^{18°} - 3.56; α ₅₄₆₁^{18°} - 4.01; α ₄₃₅₈^{18°} - 6.48; ($l = 0.25$); b.p. 127° C./18 mm.;

$\mu_D^{20} = 1.5167$); while fully active methyl- β -phenylethylcarbinol prepared by direct resolution⁴ has (α ₅₈₉₃^{18°} - 3.43, α ₅₄₆₁^{18°} - 4.10, α ₄₃₅₈^{18°} - 6.85; ($l = 0.25$); $\mu_D^{20} = 1.5168$).

Reduction of the same batch of alcohol with deuterium prepared from 99 per cent heavy water by decomposition over iron⁵ at 600° C. is complete within one hour and results in a saturated alcohol: α ₅₈₉₃^{18°} - 3.44, α ₅₇₈₀^{18°} - 3.65, α ₅₄₆₁^{18°} - 4.11, α ₄₃₅₈^{18°} - 6.74 ($l = 0.25$); b.p. = 127° C./18 mm.; $\mu_D^{20} = 1.5168$. This on oxidation with chromic acid in acetic acid at 75°-80° C. gave methyl- $\alpha\beta$ -dideutero- β -phenylethyl ketone, which after purification by preparation of the crystalline bisulphite compound, and subsequent decomposition with sodium carbonate solution, had: $\alpha = \pm 0$; b.p. 232° C. (Beilstein 235°-236° C.); Found C = 80.3 per cent, H = 8.84 per cent; C₁₀(H₁₀D₂)O requires C = 80.0 per cent; H = 9.33 per cent.

This result appears to show that if the addition of deuterium to (2) takes place unsymmetrically as in the case of bromine addition, an asymmetric system of the type (1) has no optical rotatory power. If optical activity is associated with some form of unsymmetrical electrical distribution around the asymmetric atom, then it would appear that the fields associated with light and heavy hydrogen in combination with carbon are approximately equivalent.

The boiling point and refractive index appear to undergo no change when hydrogen is replaced by deuterium in these compounds.

In view of the fact that the absorption of deuterium was half completed in ten minutes, it is unlikely that any exchange reaction in the presence of the catalyst would materially affect the result.

We wish to thank Dr. J. Kenyon for his kind interest in this work.

J. B. M. COPPOCK.
S. M. PARTRIDGE.

Battersea Polytechnic,
S.W.11.
March 27.

¹ Kenyon and Partridge, *Chem. and Ind.*, 55, 81 (1936).

² Kenyon, Partridge and Phillips, *J. Chem. Soc.*, 85 (1936).

³ Pickard and Kenyon, *J. Chem. Soc.*, 105, 1125 (1914).

⁴ Adams, Voorhees and Shreiner, "Organic Syntheses", 8, 92.

⁵ Coppock, *Trans. Faraday Soc.*, 31, 913 (1935).

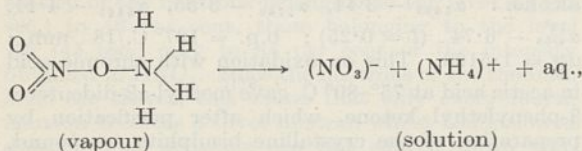
Absorption Spectra and Linkage of Inorganic Salts in the Vapour State

IN continuation of earlier work¹ we have investigated the absorption spectrum of inorganic sulphates and of ammonium nitrate in the vapour state. The same method was employed, but that the SO₂ bands were used as indicator of decomposition of the sulphates. The observed maxima of selective absorption are as follows (in $\mu\mu$): H₂SO₄ 262, K₂SO₄ 258, Ag₂SO₄ 265, and ZnSO₄ 269. The red wave limits are 285, 293, 300 and 294 $\mu\mu$ respectively.

The free sulphate ion absorbs only below 220 $\mu\mu$, while dimethyl and diethyl sulphate possess a maximum of selective absorption at about 270 $\mu\mu$ in the liquid state². The red wave limits observed in the vapour state agree fairly well with the energy of the dissociation process SO₃ = SO₂ + O(³P), and that observed in dilute aqueous solutions of alkali sulphates with that of the process SO₄²⁻ = SO₃²⁻ + O(³P). It

is concluded that inorganic sulphates are covalently bound in the vapour state.

Special interest is attached to the spectrum of ammonium nitrate in the vapour state. It exhibits a diffuse maximum at 262 μ , with a long wave limit at 299 μ , and hence appears to be bound covalently in the vapour state, as are all the other inorganic nitrates investigated earlier. This indicates a structural formula such as



with five covalent bonds in the vapour state, in contradiction to the covalency maximum of four, introduced by Sidgwick on the basis of the octet theory.

A detailed report will be published in the *Proceedings of the Indian Academy of Sciences* (Bangalore).

M. ISRARUL HAQ.
R. SAMUEL.

Department of Physics,
Muslim University,
Aligarh.

¹ NATURE, 137, 496 (1936).

² S. M. Karim and R. Samuel, *Proc. Ind. Acad. Sci.* (Bangalore), 1, 398 (1934).

Isotope Displacement in the Arc Spectrum of Platinum

We have been engaged for some time upon the study of the fine structures of thirty-three lines of the arc spectrum of platinum in the region $\lambda\lambda$ 6800–4320. We find that the odd isotope, 195, has a nuclear spin of $\frac{1}{2}$, and that all the terms observed by us exhibit regular even isotope displacement, the lightest isotope lying deepest. The approximate abundance ratios of the four observed isotopes, 198, 196, 195, 194, are 1 : 4 : 4 : 5. Jaeckel and Kopfermann¹ have just recently published fine structure measurements of 46 Pt I lines in the region $\lambda\lambda$ 5900–2350. They also find that the spin of 195 is $\frac{1}{2}$ and report the values of the even isotope displacements in 27 terms. Eight of the lines measured by J. and K. are amongst those studied by us and both sets of measurements are in good agreement.

EVEN ISOTOPE DISPLACEMENTS IN THE PT I SPECTRUM

Term	Authors	J. and K.	Term	Authors	J. and K.		
$5d^9 6s^2$	2F_2	199	205	$5d^9 6s6p$	3D_1	~76	110
	2F_1	200	200		3G_1	~107	109
	4G_1	93			3D_2	~45	85
$5d^9 6s$	1D_2	116	123	3G_2	107		
	2P_1	35	37	$D_1 (X_1)$	83	85	
$5d^9 6p$	2F_2	57	55	$D_2 (Y_1)$	50	47	
	2F_1	~15	~40	$D_3 (Z_2)$	~13	45	
$5d^9 7s$	3D_1	~23	15	2F_2	109	116	
	3D_2	2	12	2F_1	107		
	E_1	~0		2D_1	~25	~50	
$5d^9 6s7s$	M_3	107		$D_1 (13_1)$	107		
	2F_3	107	~100	$D_3 (17_1)$	107		
	2F_4	107	~100				

The terms observed by J. and K. belong to the $5d^9 6s$, $5d^9 6s^2$, $5d^9 6s6p$, $5d^9 7s$, $5d^9 6p$, $5d^9 6s7s$ and $5d^{10}$ electron configurations, and from already established data on even isotope displacement they justifiably assume the displacement in $5d^{10}$ to be approximately

zero. This enables absolute displacements to be determined.

We have measured even isotope displacement in 25 terms and obtained relative values based upon the assumption that the displacement in $5d^9 7s^2 D_2$ was zero. The measurements of J. and K. show that a slight adjustment is necessary for they give $12 \text{ cm.}^{-1} \times 10^{-3}$ as the absolute displacement for this term. This absolute value is adopted by us and we find that our displacements are in very good general agreement with those of J. and K. The important confirmatory fact that there is agreement between both sets of relative displacements is, of course, independent of the slight adjustment.

The accompanying table gives a comparison of our values with those of J. and K. Displacements are given in $\text{cm.}^{-1} \times 10^{-3}$, and in all cases the three even isotopes are approximately equidistant, 194 being deepest.

Attention may be directed to the fact that Pt 195 (spin $\frac{1}{2}$) is an atom with an odd nuclear neutron, and, as has been shown by one of us², the spin value of $\frac{1}{2}$ occurs more frequently in this type than any other spin value. Further evidence on this point is being published in another note.

We shall shortly publish elsewhere a fuller discussion together with an analysis of the fine structure interval factors in the terms of the 195 isotope.

S. TOLANSKY.
E. LEE.

Physics Department,
University of Manchester.
April 15.

¹ B. Jaeckel and H. Kopfermann, *Z. Phys.*, 99 (1936).

² S. Tolansky, NATURE, 135, 620 (1935).

Reported Occurrence of European Fishes on the Tavoy Coast, Burma

My attention has been directed to the letter of Mr. J. R. Norman in NATURE of February 22: as the collector of the material in question, I feel it desirable to recapitulate the facts.

At Maungmagan in 1933, I made an extensive collection of fish, some being purchased from the boats before the cargo was landed, some from fishermen standing and casting nets in the waves, the majority collected by myself personally. On arrival at Rangoon, I ordered my laboratory steward to pack and dispatch them to the Indian Museum. Dr. Hora has already stated that his museum possesses no material of European origin; any interpolation of strange fish must therefore have occurred in my department.

To the best of my belief, and after consultation of such records as are available, the department has neither purchased nor had given to it any specimens of European fish: though I am naturally not prepared dogmatically to exclude the possibility of error, it is difficult to see how the European forms could have intruded. I believe I can recollect the collection of a *Cottus* and a *Blennius*, but again memory, after the lapse of a year, is liable to be untrustworthy. If

circumstances permit, at the same time at the same place this year I will make a further collection which may finally settle the dispute.

In conclusion, facts—or the sincere belief of the observer, whichever may be preferred—cannot be

dismissed by the statement that they are "so widely opposed to geographical distribution as scarcely to merit serious consideration". The history of zoology is full of inconvenient records and, although I am fully prepared to admit the improbability of the present ones, I also hold that they cannot simply be ignored as contrary to theory.

F. J. MEGGITT.

University College,
Rangoon.

Darwin's *Cavernularia*

SOME years ago, I discovered in the cellars of the Cambridge Museum of Zoology a specimen of the sea-pen *Cavernularia* with the label "Voyage of the *Beagle*. C. Darwin. Galapagos Is." I described¹ it briefly under the name *Cavernularia darwinii*.

A point of special interest about this specimen is that there was no record, at that time, of any species of *Cavernularia* or of the closely related genus *Veretillum* found on the eastern side of the Pacific Ocean.

Quite recently, Miss Elisabeth Deichmann² has described a species under the name *Veretillum binghami* from the Gulf of Lower California, which I feel sure is identical with the *Cavernularia darwinii* of the Galapagos Islands. It may be sufficiently distinct to be called a variety of that species (such as *Cavernularia darwinii* var. *binghami*), but the essential point is that it is now known that these Pennatulids do occur, and apparently in large numbers, on the coast of Lower California.

SYDNEY J. HICKSON.

¹ *Proc. Camb. Phil. Soc.*, 20, 3 (1921).

² *Bull. Bingham Oceanogr. Coll.*, Yale, 5, 3 (1936).

A Colour Reaction for the Detection and Determination of Vitamin D

OUR endeavour to find a chemical method for determining vitamin D in the presence of ergosterol and other sterols led to a colour reaction specific for vitamin D—in so far as this reaction is not given by ergosterol and its irradiation products.

The test is carried out in the following way: the solution of sterols (dissolved in benzene, petroleum ether or chloroform) is evaporated in a test-tube to about one quarter of a cubic centimetre and 5–10 drops of a 0.1 per cent solution of pyrogallol in absolute alcohol are added. After heating on a water bath, 2–4 drops of a freshly prepared 10 per cent solution of dry aluminium chloride (sublimed, "pro synthesis") in absolute alcohol are added and the heating is continued. If vitamin D is present, a deep violet colour appears at the bottom of the test-tube, reaching its maximal intensity about four minutes after heating started. For the subsequent colorimetric determination, the product of the reaction is immediately dissolved in absolute alcohol (lilac-red coloured solution), and a current of dry carbon dioxide is blown over the surface in order to prevent further oxidation; the test-tube is then closed with a rubber stopper.

Under these conditions, cholesterol, ergosterol, lumisterol give no colour reaction; suprasterol II (A. Windaus), however, in the same concentration as vitamin D, gives a fainter tint¹. Fatty or oily solutions of vitamin D must first be carefully saponi-

fied; the solvent is then evaporated *in vacuo* and the reaction can be carried out with the petroleum ether extract. This extract must be absolutely dry (use anhydrous sodium sulphate) and free from any fatty substances. Solvents other than petroleum ether, benzene, chloroform or absolute alcohol must be eliminated by distillation before starting the reaction. Since prolonged heating of a solution of pyrogallol and aluminium chloride in absolute alcohol gives rise to a faint pink colour, the addition of alcohol must be avoided before the reaction has taken place.

The quantitative determination can be easily carried out by means of an ordinary colorimeter¹ or a Zeiss-Pulfrich-Stufenphotometer. The reading can be made within an hour after the test. During this time the colour does not change markedly provided the above-mentioned procedure is followed carefully. So far we have analysed three specimens of pure vitamin D (calciferol) and obtained uniform results. Commercial samples of vitamin D in natural oils, as well as solutions of weighed amounts of calciferol in olive oil, have also been tested: the results were in accordance with the indicated strengths and the theoretical values, respectively. The smallest detectable amount is about 0.002 mgm. of vitamin D. The optimal quantity for the colorimetric determination has been found to be within the limits of 0.01–0.1 mgm. The detection of vitamin D in mixtures containing vitamin A and related products (for example, cod liver oil) can only be carried out after removal of all other substances which give a colour reaction with the above mentioned reagents².

We are greatly indebted to Sir Henry Dale for the interest which he has taken in our work and for providing us with a sample of calciferol. We should like also to express our sincere gratitude for the help given us by the Glaxo Laboratories Ltd., which furnished us with samples of calciferol and lumisterol.

WILHELM HALDEN.

HARIKLIA TZONI.

Medizinisch-chemisches Institut,
Universität, Graz.

¹ A communication on the colorimetric method will be published in a separate paper by Mrs. Hariklia Tzoni.

² The results of our work on this subject will be published later in a separate paper.

X-Ray Study of Myosin

In a recent paper¹ the following passages occur: "Astbury finds that certain changes occur when wool is treated with steam. When myosin is exposed to steam similar changes are detected (*sic*). Astbury and Dickinson suggest that the myosin in muscle undergoes this change in the course of muscular activity": and "The change in myosin known to occur when muscle becomes active is therefore distinctly different from the change that Astbury and Dickinson suppose takes place".

We should like to point out that we have never expressed such an opinion, as readers of NATURE may readily verify for themselves by referring to our communication². At the moment, we are concerned in trying to establish what appears to be a remarkably close analogy between the X-ray and elastic properties of myosin and the supercontracting form of keratin; but as for what chemical changes are involved in muscle itself in bringing about the

postulated elastic changes in the configuration of the myosin chain-molecules, we have never expressed any views on the matter, since our experiments on living muscle are still incomplete.

Such unjustified statements as those here mentioned cannot but be damaging to the much-desired co-operation between physics and biology, and we feel that they should not be allowed to pass unchallenged.

W. T. ASTBURY.
SYLVIA DICKINSON.

Textile Physics Laboratory,
University, Leeds.
May 8.

¹ A. E. Mirsky, *J. Gen. Physiol.*, **19**, 571 (1936).

² W. T. Astbury and Sylvia Dickinson, *NATURE*, **135**, 95 (1935).

Ascorbic Acid in Paroxysmal Hæmoglobinuria

IN examining C hypovitaminosis we found a patient, suffering from paroxysmal (cold) hæmoglobinuria, highly deficient in ascorbic acid. The patient was treated with ascorbic acid, 300 mgm.

being given intravenously for several days. The hæmoglobinuria, easily elicited before, disappeared. Though the treatment was stopped more than six weeks ago, no paroxysm can now be stimulated. The protective action of ascorbic acid on red blood corpuscles could also be demonstrated *in vitro*. We think this experience justifies a trial with ascorbic acid in blackwater fever.

L. ARMENTANO.

Medical Clinic,
Szeged.
March 12.

Origin of the Word 'Monolayer'

I SHOULD be very much obliged if any reader of *NATURE* could say who first coined the convenient word 'monolayer' (or 'monofilm'), as an abbreviation of the rather cumbersome expression "monomolecular (or unimolecular) layer".

F. G. DONNAN.

Department of Chemistry,
University College,
London, W.C.1.

Points from Foregoing Letters

PROF. H. MUNRO FOX shows that the oxygen consumption of English marine invertebrates is greater than that of northern species, each at the temperature of their habitat, and, since their activities are the same, he postulates a greater non-locomotory metabolism. Ciliary activity is parallel to oxygen consumption, but respiratory movements of the warmer-water Crustacea are no faster than those of colder-water species, and thus correspond to the similar oxygen consumptions postulated for locomotion.

Dr. R. Peierls points out that Shankland's experiment is compatible with the assumption that, in the Compton effect, a recoil electron and a secondary photon are emitted simultaneously, although not in the relative directions current theory would require. This assumption would also be compatible with the positive result of the Bothe-Geiger experiment.

Accepting Milne's theory, according to which the multitude of distant galaxies form a continuous luminous background for the night sky, M. Leontovski calculates the spectrum of this background. He concludes that more than half the radiation with which the universe is filled is infra-red, and that to a very sensitive eye the colour of the night sky would appear dark red.

Drs. H. von Halban, jun. and P. Preiswerk confirm Frisch and Placzek's assumption that the ability of boron to capture neutrons decreases with the velocity of the neutron; there is as yet no definite proof that the capture cross-section is proportional to $1/v$. The authors describe results of various experiments on neutrons captured by lithium, dysprosium, silver and rhodium.

Dr. D. Meksyn suggests that a neutron is formed from a proton and an electron with conservation of energy and momentum, the excess energy of the particles being transformed into rest mass. A neutron has no definite mass; the kinetic energy of β -rays at disintegration is acquired at the expense of the rest mass of a neutron.

Further study of the decomposition of acetaldehyde (between 360° and 500°) in 'packed' and unpacked

tubes, leads Prof. M. W. Travers and R. V. Seddon to the conclusion that the process is more complex than has been suggested hitherto. They believe that a short-lived intermediate compound is formed, which may either give rise to methane or, if it strikes a surface during a given short period, may lead to the formation of propylene. Hence the latter is preferentially formed in 'packed' tubes.

J. B. M. Coppock and S. M. Partridge find there is no change in optical rotatory power and other physical constants in the reduction products of γ -phenyl- α -methylallyl alcohol with light and heavy hydrogen.

The absorption of light by sulphuric acid, potassium, silver and zinc sulphates and by ammonium nitrate, in the vapour state, has been determined by M. Israrul Haq and Prof. R. Samuel. The authors point out the bearing which their results have on the energy of dissociation of SO_3 and SO_4^{--} and upon the constitution of ammonium nitrate.

A table giving the displacement in the fine structure of certain lines in the arc spectrum of platinum (connected with the presence of the four isotopes 198, 196, 195 and 194) is given by Dr. S. Tolansky and E. Lee. Their measurements are in good agreement with those of Jaeckel and Kopfermann, and indicate that the isotopic displacements of the three even isotopes are equidistant, the lightest isotope, 194, lying deepest.

A colour reaction specific for vitamin D—in so far as it is not given by ergosterol and its irradiation products—is described by Dr. W. Halden and Mrs. H. Tzoni. It depends on the appearance of a deep violet colour on the addition of pyrogallol and aluminium chloride (in alcoholic solutions) to a suitably prepared sample. Vitamin A and related products must be removed.

ERRATUM. Referring to the note in this column (May 16) on apatite in the enamel of teeth, J. Thewlis points out that apatite is represented by the general formula $3(\text{Ca}_3\text{P}_2\text{O}_8)_m\text{CaX}$, in which X can represent O, $(\text{OH})_2$, CO_3 , F_2 and Cl_2 ; the particular form of apatite present in teeth has not been determined, but it is known that practically no fluorine is present.

Research Items

Honey-Hunters of Tanganyika

AN isolated group of Wangindo in the north-eastern foothills of the Mahenge massif, Tanganyika Territory, live the life of their forefathers, for geographical reasons little influenced by the outside world. There are only a few hundreds of them, their more numerous kinsmen living a long distance off across the Liwale District border. They have no stock, but disliking the settled life of agriculture, hunt game with poisoned arrows, and above all like to wander off, sometimes for weeks, in search of honey. In an account of these people by the Rev. A. T. Culwick in *Man of May*, it is said that honey is the keystone of their economy. The Mgingo thinks in terms of honey, his house smells of it, his children are smeared with it, and his conversation invariably turns to "that hollow tree two days walk away where the bees are". The honey bird is his greatest friend and he will follow its call for days. When the tree with the honey is found, he cuts it down, taking the honey, but never failing to leave some of the grubs for the bird. The Wangindo make beehives, but do not hang them near their villages. They place them far away in inaccessible parts of the forest, finding them unerringly without blazing. The beehives are cylinders made of strips of bark of the *miombo* tree. One end of the cylinder is closed by a flap of bark bent over and held in place with a piece of string passed through holes. It is placed in a tree with the open end rather lower, to prevent the rain from getting in. Occasionally, but not universally, aromatic herbs are put in to attract the bees. When the honey is ready, the bees are driven out by smoke from a grass torch. The honey is placed in a bowl of hartbeeste skin and lowered to the ground by a rope attached to tongues of skin left for the purpose. The honey is squeezed from the comb by hand and eaten uncleaned. The wax is boiled, filtered, and then remelted into lumps for sale to traders. Though many Wangindo are travelled and even have been in Government service, they always return to their wild life.

Undescribed Pebble Industry from Natal

A HITHERTO undescribed flaked pebble industry was first observed by Mr. J. F. Schofield and Mr. J. G. Cramb on coastal sites in the neighbourhood of Durban so long ago as 1929, but it was not possible to decide on its exact horizon until a more definite stratigraphy was established. This was afforded by the Tangaat River site, discovered in December 1935, in which the pebbles were not only found in large quantities, but were also closely associated with implements of which the antecedents were more fully known. In a description of the industry by Mr. Schofield (*Ann. Durban Museum*, 3, 5; 1936), the lydianite pebbles, from which the implements are made, are said all to be small, the largest being less than two inches in diameter, and nearly all were very thin, not more than 5-6 mm. in thickness, differing in this from all pebble industries previously described. The implements were made from both pebble flakes and pebbles. The types of implements are end-

scrapers, hollow end-scrapers, bevelled end-scrapers, points, crescents and gravettes. Three degrees of patination have been noted. The implements have been found in association with Bantu pottery, Asturian core implements, implements of Wilton and Smithfield types, Still Bay implements and Glen Grey type implements. Their position in the time-scale is, however, indicated by the stratification at the Tangaat site, on which a layer of sterile sand, six feet thick, separates the industry from the Bantu deposits; and although the pebbles are associated in a few instances with Late Middle Stone Age material, they evidently belong to the Later Stone Age cultures of the Natal coast. They form a link between the Late Stone Age industries which succeeded each other amongst the prehistoric inhabitants, who nevertheless remained ethnically constant. This is consistent with the view of L. H. Wells that the Bush-Boskop hybrid race remained constant along the south-eastern seaboard, until it was further hybridised by Bantu-Bush hybrids.

Biological Control of the Sugar Cane Hopper in Hawaii

ACCOUNTS of the lengthy campaign for the biological control of the sugar cane leaf-hopper (*Perkinsiella saccharicida*) in Hawaii have been published from time to time by the Hawaiian Sugar Planters' Association. The insect was first observed in Hawaii by Dr. R. C. L. Perkins in 1900. How, or exactly when, it reached Hawaii can only be conjectured. It seems, however, very evident that it came with imported cuttings of cane for planting, and it was ultimately determined to be an undescribed species from Queensland. This fact, coupled with the circumstance that it did no noticeable damage in Australia, led to the conclusion that it was probably held in check by natural enemies. A plan was formulated for the control of the leaf-hopper by biological means, since the creature had attained a status of a major pest of cane in Hawaii. The immediate outcome was the organisation, in 1904, of a Division of Entomology at the Experiment Station of the H.S.P.A. The next step was the journey to Australia made by Mr. A. Koebele and Dr. R. C. L. Perkins with the object of studying leaf-hopper parasites. A number of parasites were discovered and ultimately established in Hawaii, but the final subjugation of the pest came later. This was only achieved when the predaceous plant-bug *Cyrtorhinus mundulus*, discovered in 1920 by the late Dr. F. Muir in Queensland, was introduced and established. In 1923 the biological control of the leaf-hopper was considered to be complete, and it has remained in a state of repression ever since. A connected account of the history of the pest, along with its biological control, is given by Mr. O. H. Swezy in Bulletin 21, Entomological Series, of the H.S.P.A. Experiment Station, Honolulu (Jan. 1935).

Asexual and Sexual Development in Ascidiaceans

IN an interesting paper comparing sexual and asexual development, Dr. N. J. Berrill (*J. Morph.*, 57, 353) has brought out many sharp contrasts

between the development of eggs and of buds in Ascidians. From a review of the literature concerning mitosis, tissue culture, regeneration and differentiation, it is concluded that cells cannot maintain structural differentiation during mitosis, and such cells are therefore unable to divide, or may divide amitotically, or may dedifferentiate before division. Cells which have dedifferentiated can only redifferentiate along the original line. In bud development, the cell sizes are minimal, polarity and bilaterality are present before development begins, and gross differentiation of form becomes apparent from the beginning. The initial bud masses contain only 40 cells in *Distaplia* but 1,000 or more in *Ecteinascidia*, and these cells undergo eight to ten cleavages. Cytological or cellular differentiation apparently begins only when cell divisions have ended. When there is no nutritive limitation, cell division continues until there are sufficient cells for the expression of all the characters, and the course of development is direct. If there is nutritive limitation, the number of cells is less and some characters may not be expressed until later. The large size of egg cells is due to an inhibition of cell division, a physiological condition which in some respects resembles anaesthesia. In sexual development, cleavage and differentiation are fundamentally dissociable processes, the rate of cleavage finally diminishing as a state of equilibrium is approached, represented by the attainment of minimal cell size for the species.

Some New British Copepods

It is not often that copepods new to science are recorded from Britain, but in his recent paper, "Copepods from the Interstitial Fauna of a Sandy Beach" (*J. Mar. Biol. Ass. United Kingdom*, 20, No. 2; 1935), Dr. A. G. Nicholls describes several new species and three new genera from Kames Bay, Millport. The copepods, in contrast to true sand-burrowing animals, do not displace the particles of sand through which they move but crawl over the surface of the grains. Wilson (1932) first directed attention to the abundant copepod fauna of such regions, describing his method of collecting, and introducing a number of new genera and species. The same method is followed by Dr. Nicholls, and the number of new forms described is interesting and surprising. All are feeble swimmers and move with an incessant wriggling worm-like motion; they are all minute, and, although belonging to different families, have many features in common, being elongate and cylindrical, with scarcely any demarcation between metasome and urosome, and in some cases with peculiarly modified spear-shaped setae on the swimming legs which are found in no other habitat. The different species show an almost specific distribution from low water to the highest part of the beach, which is submerged only by the highest tides and may receive large quantities of fresh-water from rain directly or by drainage. In some cases specific vertical distribution is shown, certain species being restricted to the top two or three centimetres of sand, while others are found only below this, at least during the period of tidal exposure. Those which inhabit the superficial parts of the beach may be subject to considerable changes of salinity. All the species appear to breed continuously, though they are more numerous in spring and summer than later in the year.

Polarity Phenomena in Cambial Activity

RECENT experiments with the aspen poplar (*Populus tremuloides*, Michx.) by A. B. Brown have produced results which lead the author to suggest that cambial activity is not rigidly polar in its development in the root. In the present contribution (*Canad. J. Res.*, 14, Feb., 1936), he describes experiments which involved ringing the roots which attach sucker shoots to the parent plant, the rings being made so that cambial activity was interrupted in one or more places at once. It was found that a much greater cambial activity in the morphologically upward direction took place than has hitherto been observed. On the other hand, similar experiments in stems produced very little cambial activity in the acropetal direction, and where a vigorous burst of activity was noticed the gradient of tissue production fell very rapidly. In the face of the results obtained from roots, the author suggests that cambial activity may not be inherently polar in its development, but that it shows a tendency to development in a morphologically downward direction rather than in a morphologically upward one.

White Rot of Lime Trees

THE common timber-rotting fungi do not usually attack lime trees, but the 'pitch-crust' fungus, *Ustilina vulgaris*, has the notoriety of being able to do so. Mr. W. H. Wilkins has made a study of the disease (*Trans. Brit. Mycol. Soc.*, 20, Pt. 2, 133-156, January 1936). The causal organism was isolated, and its pathogenicity established by re-infection. A lengthy report of the distribution of diseased and discoloured wood appears in the paper. Microscopic examination showed that the fungus attacked the cell-walls of the tracheids, but made its way along the woody tissue by way of the pits. The vessels, rays and parenchyma were practically unaffected. A barrier of discoloured wood marked the advance of the fungus up the trunk, and also into the roots. The disease is not widely distributed; but it rapidly destroys the commercial value of an infected tree.

The Diamond Pipes of South Africa

THE helium-ratios of a series of rocks and minerals from the kimberlite pipes of South Africa have been determined by A. Holmes and F. A. Paneth (*Proc. Roy. Soc., A*, 154, 385-413; 1936). The helium-ratio of kimberlite, corresponding to an age of fifty-eight million years, is consistent with the late-Cretaceous age assigned to the diamond pipes. It is found that amphibolite xenoliths, known to represent Pre-Cambrian rocks, give 'ages' much higher than that of kimberlite. Three eclogite nodules have similar high helium-ratios and are thus proved to be accidental xenoliths representing pre-existing crustal rocks of much greater age than kimberlite. Holmes points out that this result shows that his hypothesis for the origin of potash-rich ultrabasic rocks has become untenable, since it was based on the assumption that kimberlite was a residual magma generated from peridotite magma by early crystallisation of eclogite and dunite. Xenoliths of the peridotite-pyroxenite suite from kimberlite, including zircons, are all found to have 'low' helium-ratios. Such low results are ambiguous, since they might indicate either (a) that the xenoliths were cognate with kimberlite, or (b) that the xenoliths represent old crustal rocks which lost their helium

at the time of their incorporation in the original magma of kimberlite. The second alternative is favoured by the fact that zircons from kimberlite investigated by Lord Rayleigh in 1909 proved to have a high helium-ratio, pointing to a Pre-Cambrian age for the zircon-pyroxenites to which Williams has traced the zircons. It is concluded that at least some of the members of the peridotite suite represent a deep-seated crustal layer of ultra-basic rocks.

The Gulf Stream and Agulhas Current

OBSERVATIONS of salinity, temperature and dissolved oxygen of the water, taken by the research vessels *Atlantis* and *Discovery II* on lines of stations across the Gulf Stream between Chesapeake Bay and Bermuda and across the Agulhas Current southward from Port Elizabeth, have recently been compared ("Aufblau und Bewegung von Golfstrom und Agulhasstrom", G. Dietrich, *Naturwiss.*, April 10, 1936). In both instances the least oxygenated layer lies at a depth of roughly 1,000 metres, rising to lesser depths on approaching the American coast. On the assumption that the current has the least and negligible velocity in this layer, the relative velocities in the other layers have been calculated by means of Bjerknes's theory. Force due to the earth's rotation causes a 'piling up' of the water, which can be calculated. The observed differences in mean sea-level along the United States coast are considered.

A New Densimeter

WHEN the density of a liquid is to be determined by using density bulbs, it seldom happens that any of the bulbs has exactly the right density. In a communication to the Editor, Dr. K. Kuhlmann, of the Institute of Fisheries, Moscow, states that by making a portion of the wall of a bulb flexible and subjecting the liquid under test to a measured pressure, the volume of the bulb can be so adjusted that its density is that of the liquid. From the pressure applied, the density may be calculated if the temperature is also known. The device is an application of the principle of the well-known hydrostatic toy, the 'diver'.

Magnetic Energy Spectrum of Cosmic Rays

P. M. S. BLACKETT has described (*Proc. Roy. Soc.*, A, May 1) a large electromagnet constructed to deflect cosmic ray tracks in a cloud chamber, and its use to obtain the energy distribution of cosmic rays. Unlike the solenoids used by some other workers, the magnet can be run with a rather low power consumption; 25 kw. allows tracks 17 cm. long to be photographed in a field of 14,000 gauss. The magnet has a 8,000 kgm. iron circuit and 3,000 kgm. copper windings. An innovation is the use of an air blast for cooling instead of water or oil. The technique of obtaining and measuring the cloud-chamber tracks has been elaborately worked out. The distortions introduced by unsymmetrical expansion in the chamber and by the photographic lens were eliminated by comparison with a set of tracks taken with no magnetic field. It was found possible to estimate particle energies up to about 2×10^{10} e.v., and an energy spectrum was obtained based on observation of 188 particles. The frequency of the tracks falls off with increasing energy roughly according to $1/E^2$, and positively and negatively charged particles occur in about equal numbers. The paper

contains incidentally some interesting observations on the image curvatures introduced by high aperture photographic lenses (see also *NATURE*, May 16, p. 838).

Cosmic Ray Showers

E. C. STEVENSON and J. C. Street have recently described experiments on the production of 'showers' by cosmic rays (*Phys. Rev.*, March 15). Photographs were taken with a large metal-lined wooden cloud chamber controlled by a coincidence arrangement of three Geiger-Müller counters. One counter was placed above and two below the chamber, and a lead plate was placed in the middle of the chamber. A number of complicated showers were observed, but the most striking observation was the frequent appearance of a divergent shower below the plate, apparently produced by a single electron incident from above. The counter arrangement is, of course, adapted to select this phenomenon. The most generally accepted view of shower formation has been the conversion of a photon, and a number of the observed showers were apparently produced in this way. The production of showers by single electrons is new and rather unexpected.

Maximum Vehicle Capacity of a Highway

It is stated in *Roads and Streets* of April that a very extensive survey of highway accidents in the United States was concluded in 1934 under the supervision of the Massachusetts Institute of Technology, the Federal Government providing £100,000 towards the expenses. More than two and a half million cars were studied when running on the road, and statistics of accidents were obtained from 200 towns and cities. One section of the report deals with the mathematical analysis of accident situations, and is instructive. Various formulæ have been suggested for the safe distance to be maintained between two vehicles following one another at the same speeds. The distance between the centres of the vehicles is equated to the sum of three terms, one a constant, another proportional to the velocity and the last proportional to the square of the velocity. It is necessary to assume that the coefficient of friction is constant at all speeds. Philadelphia and New York adopt formulæ of this type, the deceleration in the former formula being taken as 19 feet per sec. per sec. and in the latter 15 feet per sec. per sec. A reaction time of half a second is allowed in both cases. It would seem that some additional allowance should be made for a possible superiority in the braking power of the leading car. The Massachusetts Registry of Motor Vehicles tested on the road 687 pleasure vehicles with four-wheel brakes. Seventy-six per cent of these could be stopped from 20 m.p.h. in the standard distance of 30 feet or less. But only about 4 per cent could be stopped in less than 20 feet. An interesting corollary to the mathematical analysis of highway capacity is the case where a two-lane road is reduced at some point to one lane. Taking the curve giving the maximum capacity of a two-lane road in cars per hour, it is shown that the maximum number of cars per hour is 1,800. Each lane of the two-lane section must therefore discharge cars at a rate not exceeding 900 cars per hour. But this is accomplished at a speed of about 5 m.p.h. Hence no matter how full the single lane may be in time of congestion, traffic cannot pass along the two-lane road faster than 5 m.p.h. This explains the extremely slow speeds often experienced in congested highways.

Use of Electricity in Agriculture

CONFERENCES on the immediate problems of crop production are held periodically at the Rothamsted Experimental Station. The twenty-first report* is on the use of electricity in agriculture. The completion of the Grid system and its subsidiary lines in Great Britain is bringing many rural areas within reach of a supply of electricity. While generally admitting its convenience, farmers require more information about costs as compared with internal combustion engines.

There is also some confusion in the minds of consumers as to the reasons which lead the companies to ask for guarantees, minimum charges, two part tariffs, etc. Mr. M. M. Harvey, in a paper on the best way to use electric power, gives explanations which appeal to the agriculturist. Discussing the extra cost of rural distribution over town distribution, he explains that if a farmer retails a 100 gallons of milk daily from vans in a few streets, two or three vans can deal with this retailing, and the delivery costs per gallon are low. It is obvious that if he has to retail to the same number of consumers the same number of gallons over the whole of his county, the distribution costs per gallon would be many times his town delivery costs, and he would have to obtain a higher price per gallon to cover this. Similarly, farmers ask why they are having to pay at a higher rate for having a large transformer than for having a small one; apparently they are being penalised for occasionally making a larger demand on the supply system. The explanation given is that if a purchaser take 50 gallons of milk daily as a maximum, then they could budget for sufficient cows to give

this supply. But supposing the purchaser said he required 200 gallons on one day of the year, then the farmer would have to keep a larger herd simply to supply this one day's demand. He would therefore be justified in charging extra for the availability of a larger supply of milk occasionally.

Everyone admits the great convenience of electricity for light and power. It saves a great deal of labour when a piece of work can be started and finished simply by pressing a button. Modern electric motors are so good, and their moving parts so well enclosed, that a breakdown is a very rare occurrence. The supply companies are willing to test them periodically. A farmer who contemplates installing electricity will find in Mr. Harvey's paper data about farms of all kinds, some of which will doubtless be like his own.

In a foreword by Sir John Russell, it is pointed out that the experiments made at Rothamsted show that for the same grinding rate and fineness of grinding, 4.6 units of electricity per hour were equivalent to 2.3 pints of Diesel oil per hour. At the price paid (1.42*d.* per unit), electric power came out a little more expensive than paraffin, when overhead costs were neglected. When such costs were taken into account, however, electric power was cheaper than paraffin, although a little more expensive than Diesel oil. Electric power in its ease of application and cleanliness possesses many advantages. No attempt to estimate the value of these advantages has been made.

In the present report nothing is said about electrical ploughing or electrical discharges over crops. The latter is now believed to have little, if any, value. The Conference discussed only the practical applications of electricity. In future conferences, horticultural possibilities such as obtaining early crops by heating the soil will doubtless be discussed.

* Rothamsted Conferences, 21: The Use of Electricity in Agriculture; being a Report of a Conference held at Rothamsted on January 29th, 1936, under the Chairmanship of Sir Bernard E. Greenwell. Contributions by Sir E. J. Russell, M. M. Harvey, B. A. Keen and G. H. Cashen, F. E. Rowland, C. A. Cameron Brown and others. Pp. 77. (Harpending: Rothamsted Experimental Station, 1936.) 2s.

Organisation of Plant Cytoplasm

A VERY valuable summary of modern views on this difficult subject will be found in two little monographs* by Prof. A. Guilliermond of the Sorbonne, dealing respectively with the 'chondriome' and 'vacuome'. These two names are given by the author to two distinct types of morphological unit which can be found in varying form in the cytoplasm throughout the life of the cell. The cytoplasm itself is regarded as an optically empty colloidal solution of long colloidal thread molecules (proteins, etc.), which have imbibed so much water that their refractive index approximates to their aqueous medium.

They thus give the properties of a viscous sol to the cytoplasm, but the thread molecules link up at any surface to form an elastic solid plasma membrane.

The vacuome and chondriome systems can be distinguished by their behaviour to vital stains. The vacuome system stains heavily when the living cell is in dilute solutions of neutral red. In the meristem cell the vacuome system thus revealed is a concentrated colloidal solution dispersed in small drops or threads amongst the cytoplasm, but cell expansion is largely determined by the entry of water into this system, which then coalesces in stages into the well-known 'vacuole', in which the colloidal substances are dispersed in dilute solution and precipitate as red-staining granules in the presence of neutral red.

The chondriome system does not stain *in vitam*, but subvitality will take up Janus green; thus

* Exposé de biologie (embryologie et histogenèse). Par Prof. A. Guilliermond. 2: Les constituants morphologiques du cytoplasme; le chondriome. Pp. 128. 20 francs. 3: Les constituants morphologiques du cytoplasme; le système vacuolaire ou vacuome. Pp. 108. 18 francs. (Actualités scientifiques et industrielles, 170, 171.) (Paris: Hermann et Cie, 1934.)

simultaneous demonstrations of the two systems is temporarily possible with neutral red and Janus green.

The lipin nature of the chondriome makes it disappear in acetic acid or alcohol fixatives unless unsaturated fatty acids are first oxidised to hydroxy acids, less soluble in alcohol and xylol, as by treatment with chromic acid or osmic acid, etc. The

vexed questions of the relation of the chondriome system to the plastids; of the methods of multiplication in embryonic cells of both vacuome and chondriome, and of the relation of the vacuome system to the Golgi network or the Holmgren canals are discussed very concisely and with a full citation of the work upon animal cytology which will be very valuable to the botanist.

Zooplankton of the Great Barrier Reef*

FOLLOWING the general report on the zooplankton of the Great Barrier Reef (noticed in NATURE of August 3, 1935) more detailed work on the different groups is now in progress. The pelagic animals belonging to the Tunicata, Mollusca and Siphonophora are here discussed. Comparison with other expeditions is emphasised, particularly the *Siboga* Expedition, but in this year's work on the Barrier Reef a continuous series of samples is available, giving valuable information as to seasonal distribution and life-histories which has never before been obtained to such an extent. Identification of species has already been made by Miss A. B. Hastings (Tunicata), Mr. A. K. Totton (Siphonophora) and Miss Anne L. Massy (Pteropoda), whilst Prof. Paul Pelseneer has looked through the larval gastropods. Identification was not possible in the last group and in the larval lamellibranchs, but reports on the Tunicata and Siphonophora have already been published (in Vol. 4 of these reports).

The larger tunicates were abundant in the stramin net, but among the great numbers of small animals retained by the silk net they were less important. On the average, the tunicates formed one half of the total number of animals caught in the stramin net, while in the coarse and fine nets, oblique hauls, these proportions were only 5.7 per cent and 2.7 per cent respectively. The total collections comprised three species of Doliolids, six species of Salps and eight species of Appendicularians; but the only species which played an important part in the composition of the plankton at the weekly stations were *Salpa democratica*, *Oikopleura rufescens* and *O. longicauda*. On the average for the year, the Thaliacea far outnumbered the Appendicularians in the stramin catches; but there were violent fluctuations in the composition of the Tunicata due to swarming of certain species, especially *Salpa democratica* and *Megalocercus huxleyi*. In the coarse silk net small appendicularians preponderated, except in months when swarms of salps were met with. In both nets the Doliolids were on the whole of small significance.

Easily the most abundant salp was *Salpa democratica*, with two maxima—September–January, and April–May; during the remaining months it was almost completely absent. On only a few days really large catches were made when the salps were often to be seen in the sea in enormous numbers. The spring increases occurred at full moon, the later increases at or after new moon. The authors are of opinion, however, that the salp increases do not really indicate a lunar periodicity in breeding, but that they indicate successive outbursts of reproduction in the

waters round Low Island, the sudden peaks being due to swarms drifting up the Barrier Reef Lagoon. The chief increases occur when the temperature is between 24° and 28° C. It is probable that salinity has no effect on their presence, whilst temperature is important. The comparatively few salps in the collection may indicate that those caught are the better able to live in shallow coastal water, and the same may hold good for appendicularians, or it may be that in some years other species will be found which, owing to sparse distribution, were not brought near the coast in this one year.

Of the Appendicularians treated as a whole, *Oikopleura rufescens* and *O. longicauda* are the most abundant, the maximum occurring in January and February, coinciding with the highest temperature and decreasing salinity. The Barrier Reef collections are so far the only records giving a full picture of a year's course in a region in the Pacific where warm tropical water conditions exist throughout the year. The absence of *Oikopleura dioica* is striking. Of the Mollusca, the pteropods are much the most important, although there were numbers of larval gastropods and lamellibranchs at times. Here again the pteropod records contain the first contribution towards their seasonal study in the tropics. Only three are important in the coastal waters of the Barrier Reef, *Creseis acicula*, *C. virgula* and *Cavolinia longirostris*, agreeing with the results of the *Siboga* Expedition. The creseids extend normally nearer the coast than the other genera.

Siphonophores were much more abundant than medusae and only a few coral planulae were caught. Of the thirty-two species of Siphonophores, twenty from the Barrier Reef Lagoon, two species predominated, *Lensia subtiloides* and *Diphyes chamissonis*, and these were responsible for the main fluctuations in abundance during the year. Many species were absent because of low salinity during the heavy rains, but they were probably present outside the reef. That the three species *Diphyes chamissonis*, *Lensia subtiloides* and *Enneagonum hyalinus* were present in the lagoon during the period of low salinity points to the possibility that these species are specially adapted to life in shallow coastal waters. This seems to be the first time that any siphonophores have been definitely recognised as coastal species in a predominantly oceanic group.

* British Museum (Natural History). Great Barrier Reef Expedition, 1928–29. Scientific Reports. Vol. 2, No. 7: The Zooplankton. 4: The Occurrence and Seasonal Distribution of the Tunicata, Mollusca and Coelenterata (Siphonophora). By F. S. Russell and J. S. Colman. Pp. 203–276. (London: British Museum (Natural History), 1935.) 5s.

Metallurgical Research at the National Physical Laboratory

VOL. 25 of the "Collected Researches of the National Physical Laboratory" (London: H.M. Stationery Office, 1935. 25s. net) contains some of the more important of the publications which have emanated from the Metallurgical Department during the last ten or twelve years. This volume of 432 pages shows how profound has been the influence that this Department has exercised, particularly perhaps in setting a standard for other workers to emulate. It is not too much to say that every one of the twenty-three papers now collected together is of real importance.

The work is concerned in the first place with the alloys of iron, not the least important of the contributions being those devoted to the preparation of the pure elements chromium, manganese and silicon. The essential part played by refractory materials in such research needs no stressing, and the paper on special refractories for this purpose contains information which will be of the greatest value to all workers in the higher temperature range.

Passing on to the consideration of the work on non-ferrous materials, three papers dealing with the silver-tin alloys and amalgams, which represent work carried out for the Dental Investigation Committee of the Department of Scientific and Industrial Research, lay down for the first time scientific foundations for the study of dental amalgam fillings. Although this work is at the present time in a rela-

tively elementary stage, and far more intense research is required before many of the intriguing problems connected with these materials are solved, a most important commencement has been made.

Other papers are concerned with the transformations in the copper-gold alloys, the constitution and the physical properties of the alloys of cadmium and zinc, the properties of metallic cadmium, the crystal structures of α - and β -manganese, a new form of dilatometer and the surface tension of liquid metals. Particular attention may perhaps be directed to the last of these, since in addition to the measurement of the surface tension for a number of liquid metals and lead-tin alloys, the work has resulted in evidence to show that bismuth, cadmium and antimony may be highly associated in the liquid state. Anything which increases our knowledge, at the present time almost infinitesimal, of the condition of metals and alloys when molten, is most heartily to be welcomed.

Practically the whole of this work was carried out under the supervision of the late Dr. W. Rosenhain, and published whilst he was superintendent of the Department concerned, or soon after his retirement. Although his name occurs once only in this list of papers, and that in the introduction to the researches on the alloys of iron, the volume represents a lasting memorial to the influence which he exercised on research in his own Department, and through it, in most parts of the world.

F. C. T.

Lunar Effects on Atmospheric Pressure

UNDER the heading "Effect of the Moon on Barometric Pressure" a summary appeared in NATURE of November 16, 1935, p. 800 of a paper by R. A. Robb and T. R. Tannahill¹ entitled "The Lunar Atmospheric Pressure Inequalities at Glasgow". A remarkable feature of their results, to which attention was directed, was the relatively large magnitude of the diurnal amplitude compared with that of the semi-diurnal amplitude, the two being in the ratio of more than four to one.

It now appears from a paper by Prof. S. Chapman² that this result was due to the presence of a systematic source of error, arising from the plan that had been followed of rejecting all days from the analysis on which the difference of pressure between successive upper transits of the moon exceeded 0.1 inches of mercury. This plan resulted in the appearance of an effect known as the 'convex effect' to which Bartels directed attention in 1927. Such days of small pressure change occur more frequently when the barometer is above than below its normal level, and at such times the pressure curve is near a maximum value and tends to be convex; it follows that in the long run a spurious maximum will be found near the middle of the lunar day, which in this case was reckoned to begin at the lunar upper transit, and that the spurious term will therefore have a phase angle somewhere near 270°.

Chapman points out that the first three harmonic components found by Robb and Tannahill, for which the amplitudes were 64, 15.6 and 8.9 microbars, had phase angles of 267°, 285° and 292° respectively, which illustrate the 'convex effect', and that the results obtained were substantially not of lunar origin. He states, however, that an earlier and hitherto unpublished analysis of the Glasgow data by Robb in 1926, made in such a way that the 'convex effect' was not present, showed correctly that the lunar atmospheric tide at Glasgow is, for the latitude, very small—of amplitude 4 or 5 microbars, that is, about a third of the amplitude at Greenwich and Aberdeen, as had been found by Chapman in the cases of Victoria and Vancouver.

Prof. Chapman has also recently discussed the lunar atmospheric tide in the Azores³, using unpublished data for Ponta Delgada (38° N., 26° W.) and Santa Cruz (39° N., 31° W.). Bi-hourly barometric data were employed, obtained in each case by interpolation from pressure read at 6, 10, 11, 16 and 21 hours from a Tonnelot compensated barometer with the aid of the continuous record of a Richard barograph, the analysis being made with the aid of Hollerith sorting and tabulating machines lent by the British Tabulating Machine Co. Ltd.

The results are shown by the values obtained for

the semi-amplitude C_2 and the phase angle θ_2 of the lunar semi-diurnal variation of the barometric pressure expressed by the formula $C_2 \sin(2t + \theta_2)$, t being lunar time reckoned from the local hour of lunar transit, 360° being a lunar day, while C_2 is in microbars. The observational material was divided into seasons (May–August, March–April–September and October, and November–February), and into groups of a decade or rather less. The mean results were $22 \sin(2t + 55^\circ)$ for Ponta Delgada (39 years' observations) and $18 \sin(2t + 58^\circ)$ for Santa Cruz (twenty-six years' observations). These phase angles of 55° and 58° correspond to an unusually long lag of high tide (high barometric pressure) after lunar transit, amounting to 72 minutes of solar time at Ponta Delgada and 65 minutes at Santa Cruz. Other places with similar phase angle are Madras (56°), Samoa (59°) and Hongkong (60°). As at most stations, the tide is later near the December solstice than at other seasons; it is common to find also the minimum amplitude at that time, but this was not found at the Azores in as many as half the groups, though the length of time covered by the observations is too small and the probable errors of C_2 consequently too large, to make it certain that this tendency is not present. At both stations C_2 was substantially smaller in the period 1924–32 than during the earlier periods.

¹ *Proc. Roy. Soc. Edin.*, 4, Part 1, No. 9.

² *Proc. Roy. Soc. Edin.*, 56, Part 1, No. 1.

³ *Quart. J. Met. Soc.*, 62, No. 263, 41 (January 1936).

Educational Topics and Events

CAMBRIDGE.—F. W. Shotton, of Sidney Sussex College, has been appointed University lecturer in the Department of Geology, and Dr. N. Feather, of Trinity College, University lecturer in the Department of Physics.

The Frank Smart studentship in botany is vacant. Applications should be made to Prof. A. C. Seward at the Botany School on or before June 4.

Candidates for the Michael Foster studentship in physiology are requested to send their applications with a statement of the course of research they propose to undertake to Sir Joseph Barcroft, Physiological Laboratory, by July 7.

At Jesus College, A. E. Green, Smith's prizeman in 1936, has been elected to a research fellowship.

GLASGOW.—The construction of a new Chemistry Institute, the erection and equipment of which will cost approximately £200,000, is to begin almost immediately. Towards the cost of this Institute, the Carnegie Trust for the Universities of Scotland has contributed £118,000, and it is hoped that further assistance will be forthcoming from private sources, as the cost of erecting these new buildings will impose a serious burden on the University. Prof. T. Harold Hughes has been appointed architect of the new Institute.

Prof. R. Stockman is retiring from the chair of materia medica at the end of the current session.

LIVERPOOL.—Mr. Reginald George Batson has been appointed to the chair of civil engineering. Mr. Batson was from 1908 until 1933 principal assistant in the Engineering Department of the National Physical Laboratory, and from then to the present

time principal scientific officer in charge of the Road Research Laboratory of the Department of Scientific and Industrial Research, and secretary to the Road Research Board.

LONDON.—The following appointments have recently been made: Dr. Arthur Wormall, senior lecturer in biochemistry, University of Leeds, to the University chair of biochemistry tenable at St. Bartholomew's Hospital Medical College; Dr. W. F. Harper, lecturer in anatomy, University of Aberdeen, to the University readership in anatomy tenable at London Hospital Medical College.

The degree of D.Sc. has been conferred on: M. Mitra (Royal College of Science); E. J. B. Willey (University College); W. G. Penney (Royal College of Science); I. E. White (external student); D. F. Martyn (external student); and the degree of D.Sc. (Engineering) on Prof. Leonard Bairstow, University professor at the Imperial College (Royal College of Science).

The Dunn exhibitions in anatomy and physiology for 1936 have been awarded to R. S. Murley (of St. Bartholomew's Hospital Medical College) and Ernest Petrie (of University College) respectively.

Mr. H. J. Collins has been appointed as from October 1 to the Chadwick chair of engineering tenable at University College. Since 1929 he has been assistant professor in civil and municipal engineering at the College.

H.M. Queen Mary has been pleased to become patron of Queen Mary College, University of London, of which his late Majesty was patron.

DR. ALEXANDER M. SMITH has been appointed lecturer in agricultural chemistry in the Edinburgh and East of Scotland College of Agriculture in succession to Dr. A. Lauder, who retires in September.

DR. L. C. MARTIN, assistant-professor of technical optics in the Imperial College of Science and Technology, has been invited to spend a year in the Institute of Applied Optics, University of Rochester, U.S.A., exchanging with associate-professor Rudolph Kingslake, of Rochester, for the session 1936–37, to whom a reciprocal invitation has been extended by the Imperial College.

PROF. J. G. FITZGERALD, dean of the Faculty of Medicine and director of the School of Hygiene and of the Connaught Laboratories, University of Toronto, has been invited by the Rockefeller Foundation to make a study of the methods at present employed in the teaching of preventive medicine to undergraduates in medical schools. It is anticipated that the study will occupy a period of one year commencing September 15. Dr. Charles Edward Smith of the Stanford University Medical School, San Francisco, will assist in the undertaking. University medical schools in the United States and Canada, the British Isles and in European countries will be visited in the course of the survey. Prof. FitzGerald is to resign as dean of the Faculty of Medicine, University of Toronto, on June 30. He will be given leave of absence by the governors of the University for the necessary period and will, it is expected, return to the University of Toronto in September 1937 as director of the School of Hygiene and of the Connaught Laboratories.

Science News a Century Ago

A Surrey Museum

ON May 30, 1836, *The Times* said: "A very interesting museum on a small scale has just been opened in the neighbourhood of the Surrey Zoological Gardens. The principal object of this establishment is professed to be the exhibition of a genuine, rare and nearly complete collection of the birds of the British Isles, and the profession is not belied by what is actually to be seen in the collection. It contains nearly 300 specimens of the feathered tribe of Great Britain, from the gigantic eagle to the diminutive wren. These specimens are many of them remarkably brilliant in plumage, and of beautiful diversities of colours. . . . They are arranged and classified according to the ornithological systems of Selby, Montague and Bewick, and the Linnaean names, as well as those by which they are generally and provincially known to the natives of England, are attached to the cases in which they are contained. There are also some North American specimens, which though in some degree different to the feathered species of our woods and fields, are in many respects extremely similar."

Sir Francis Pettit Smith's Screw Propeller Patent

OF the many promoters of screw propulsion, the most important was Francis Pettit Smith, the Hendon farmer, whose first patent was taken out on May 31, 1836. Born on February 9, 1808, at 31 High Street, Hythe, Smith was educated at Ashford, and began life as a grazing farmer on Romney Marsh, whence he removed to Middlesex. He was always fond of making models, and early in 1836 he drove a model boat by means of a screw on his pond at Hendon, and at about the same time he exhibited a screw-driven model boat at the Adelaide Gallery. With the assistance of Wright, a banker, and Thomas Pilgrim, a practical engineer, in the summer of 1836 he constructed a boat of ten tons having an engine of six horse-power and a single-threaded wooden screw with two complete turns. From these experiments sprang the developments which led to the building of the *Archimedes*, the *Novelty* and *H.M.S. Rattler*, and the introduction of the screw into both warships and merchant ships. Twenty-two years after he took out his patent, Smith was presented with a testimonial at a public dinner in St. James's Hall, Robert Stephenson being in the chair. The testimonial took the form of a fine silver salver and silver claret jug which Smith bequeathed to the Science Museum. He died in South Kensington on February 12, 1874, and was buried in Brompton Cemetery.

Temperature of Underground Springs

WRITING to Prof. Jameson on June 1, 1836, J. D. Forbes said: "On occasion of a late visit to the district of Lead Hills I suggested to my friend and former pupil, Mr. Irving of Newton, the importance of determining the temperature of the springs in the bottom of the Lead Hill Mines at this particular epoch. The working having been discontinued since the end of March, any supposed influence of animal heat and light is avoided, and yet the pumping of the water has been regularly carried on. Mr. Irving immediately and zealously undertook the inquiry; and descended to the deepest part of the mine on the 16th of May and found the temperature of the

water in the bottom to be 49°. This was at depth of 95 fathoms below the entrance to the Susanna Vein. . . ."

Visitation of the Royal Observatory, Greenwich

IN his autobiographical notes for 1836, Airy records: "On June 4th the Annual Visitation of the Observatory was held, Mr. F. Baily in the chair. I presented a written Report on the Observatory (a custom which I had introduced at Cambridge) in which I did not suppress the expression of my feelings about chronometer business. The Hydrographer, Captain Beaufort, who was one of the Official Visitors, was irritated; and by his influence the Report was not printed. I kept it and succeeding Reports safe for three years, and then the Board of Visitors agreed to print them; and four Reports were printed together, and bound up with the Greenwich Observations of 1838."

Societies and Academies

LONDON

Royal Society, May 21. SIR PATRICK LAIDLAW and W. J. ELFORD: A new group of filterable organisms. A group of filterable saprophytic organisms has been discovered in sewage. In the normal course of their development, they have small forms of about the size of vaccinia virus (0.125-0.175 μ), though larger forms also occur (0.5 μ or more). Cultures are readily obtained by filtering mixtures of sewage and Fildes's broth through membrane filters of appropriate porosity, and incubating the filtrates at 30° C. They can be maintained in subculture in indefinite series. Three strains have been isolated which differ in their cultural characters and also serologically, though morphologically they appear the same, and they all show the same end-point in filterability. These organisms are of interest in view of the small forms, which although comparable in size with some of the viruses, can nevertheless lead an independent existence. It is, as yet, uncertain how the organisms should be classified. MARION A. WATSON (HAMILTON): Factors affecting the amount of infection obtained by aphid transmission of the virus Hy. III. Experiments have been carried out in order to show the effect of various factors on the percentage of infection obtained with the virus Hy. III in tobacco, using its insect vector *Myzus persicae*. A maximum percentage infection was obtained during the winter months and a minimum during the summer months. The percentage infection increases with the number of aphids used per plant, and the relation between the numbers of infection obtained for each aphid number shows that the infections are local and independent. The percentage infection increases with increased feeding time on the healthy plant, but there is no indication of a preliminary time period in which no infection is obtained. The percentage infection decreases very rapidly with increasing time on the infected plant from 2 minutes to 1 hour. After 1 hour it increases slightly with further increase of the feeding periods. R. RUGGLES GATES: Genetical and taxonomic investigations in the genus *Oenothera*. This paper presents the results of a three years' genetical survey of the genus *Oenothera* in eastern Canada and adjacent areas. By combining genetical with taxonomic methods, a fuller knowledge is attained of the wild

populations in a particular area than has been possible in any case hitherto. Thirty-two new species and varieties are described, as well as many smaller variations, and much light is thrown on the geographical distribution of these and other forms, as well as their relationships. There are indications of movements from south to north in several different lines of descent, and also of a coastal series of forms with strongly bent stems. Six of these new species have produced trisomic mutations, most of them directly from wild seeds, and one a triploid mutation, which shows that the mutation phenomena are not the result of cultivation. The catenation in all the species examined is a ring of 14 chromosomes. Certain prairie species show marked alteration of habit when grown in England, and a new category of *evanescent characters* is made for differential characters which appear only at certain stages of development.

PARIS

Academy of Sciences, April 20 (*C.R.*, 202, 1353-1388). ERNEST ESCLANGON: The equations of dynamics deduced from the principle of limited relativity. SERGE BERNSTEIN: The domain of convergence of the polynomials $B_n f(x) = \sum_0^m f(m/n) C_n^m x^m (1-x)^{n-m}$. MARCEL GODCHOT and PIERRE VIÈLES: Active methylglycolic acid and its derivatives. I. VINOGRADOV: Some new inequalities in the theory of numbers. ROBERT FORTET: Probabilities in chain. PAUL REGNAULD: The encounter of two material bodies. ALEXANDRA PROCA: The theory of the positron. ANDRÉ THURET: The calculation of the specific heats of the mineral oxides vitreous silica, lime, alumina as a function of the temperature. Formulæ expressing the specific heats as a function of the temperature are given for these three substances, and the corresponding curves shown with the experimental values observed by various authors. STÉFAN PROCOPIU: The electromotive force of movement of metals in water and their electro-kinetic potential. ROBERT GUILLIEN: The intensity and form of the absorption bands of liquid oxygen. CHARLES MAUGUIN: The theory of the reflection of the X-rays by crystals. DANIEL SCHNÉEGANS: The stratigraphy of the Lias of the Ubaye sheet in the Morgon massif (Basse-Alpes). JACQUES BONDON and BRANKO YOVANOVITCH: The ante-Carboniferous strata of western Morocco. MLE. BERTHE DELAPORTE: New researches on the cytology of bacteria. MAURICE DOLADILHE: Contribution to the study of one of the constituents of the acidoglobulins: protein C.

CAPE TOWN

Royal Society of South Africa, March 18. A. W. ROGERS: The superficial deposits of the Kalahari. (presidential address). H. E. MORRISON and J. T. MORRISON: The relationship between winter rainfall and barometric pressure, barometric tendency and wind direction at Cape Town. A. F. SPILHAUS: A study of the aspiration psychrometer. T. F. DREYER: (1) The archaeology of the Florisbad deposits. Evidence indicates that the local development of the fluted flake is older than the coastal development, and that it was here synchronous with the development of the Stellenbosch elsewhere. The evidence is based upon the absence of bone tools, the presence of numerous extinct mammalian fossils, and the dis-

tribution of implement types. (2) The archaeological succession of the natural deposits at Plettenberg Bay and Mossel Bay. It is deduced that there are a black surface layer, a layer of red sand, and an intercalated reddish yellow layer. This latter contains implements of late Stellenbosch type. At Plettenberg Bay this series overlies a white sand (karringmelk grond) which yields Stellenbosch types. It is presumed that the pre-Red Sand deposits are synchronous at the two places. If this is so, the implements of the lime talus at Mossel Bay would be older than those in the white sands at Plettenberg Bay, which is further indicated by typology. M. H. GIFFEN: The chromosome numbers in the genus *Berberis*. A. C. LEEMANN: Contribution to the study of *Dichapetalum cymosum* and the ecology of the Transvaal veld. P. W. LAIDLER: South African native ceramics.

Moscow

Academy of Sciences, *C.R.*, 4, No. 8-9, 1935. J. NATANSON: The representation of functions by formulæ analogous to the Fourier formula. B. VULICH: Metric spaces of a certain type. N. GUNTHER: Spectral function of certain integral equations. G. GAMBURCEV: Establishment of electro-mechanical equivalents. D. D. SARATOVKIN: Distribution of admixtures at crystallisation. P. N. ULJANOV: Drying and sterilising wood and other structural materials with infra-red rays. R. R. CHUGAIEV: Stability of earth slopes subjected to the action of ground water flow. J. A. ARBUZOV and B. M. MICHAÏLOV: Thermal disintegration of dimethylcyclohexane. B. A. RUBIN and L. I. NAUMOVA: Problem of biochemical characteristics of varieties in vegetables. V. S. BUTKEVICH and L. K. OSNICKAJA: Consumption of succinic acid by fungus films as affected by acetate. A. P. VINOGRADOV and G. G. BERGMAN: Vanadium in the petroleum and bitumens of the U.S.S.R. A. H. ANDRES and J. VOGEL: Karyological investigation of the embryonal oogenesis in man. G. E. BYKOV: On the age and the conditions of formation of brown coals in the upper Zeya plain. J. V. RAKITIN: Hastening the ripening of melons. S. N. JAGUZINSKIY: Observations on the variability of *Scenedesmus* Meyen in pure cultures. A. M. POPOV: Fauna of the Avacha Bay and its distribution into communities. A. I. KURENOV: Zoogeographical conclusions from an expedition to the middle Sikhote-Alin range.

ROME

Royal National Academy of the Lincei (*Atti*, 22, 551-608; 1935). F. SACCO: Transversal tectonic lines of the Appenine (2). A. PELLOUX: Scheelite from the Gerrei mines in Sardinia. G. LAMPARIELLO: Behaviour at infinity of the usual functions of a point. F. TRICOMI: (1) Transformation and reciprocity theorem of Hankel. (2) A theorem of Abel for Hankel's transformation and some new applications of a formula on Bessel functions. L. SONA: Transloculatory current which invests a bilateral lamina (6). G. SUPINO: Plane elastic problem and its interpretation in space (2). S. FRANCHETTI: Liquid state and interatomic forces (2). M. AIROLDI: Case of accelerated erosion in the Valle d'Urba. G. BRUNELLI and G. CANNICCI: Preliminary notice of the chemical and biological characteristics of the Lake of Massaciuccoli. S. RANZI: Researches on the absorption of mineral substances by the embryo of *Sepia officinalis*.

Forthcoming Events

Tuesday, June 2

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Prof. G. C. Turner: "Some Problems of Clinical Research in Surgery".

RESEARCH CO-ORDINATION COMMITTEE (in co-ordination with the Engineers' Study Group), at 7.30.—(at the Guildhouse, Eccleston Square, Victoria, S.W.1).—Dr. Enid Charles: "Population Trends in Relation to the Housing Problem".

TEXTILE INSTITUTE, JUNE 3-6.—Annual Conference and Exhibition to be held at the Hotel Victoria, Northumberland Avenue, London, S.W.1.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records, No. 8 (Timber Mechanics Series, No. 2): Strength Tests of Structural Timbers. Part 2: General Procedure of Selecting and Testing Joists, with Data on British Columbian Douglas Fir, *Pseudotsuga Douglasii* Carr. By C. J. Chaplin and E. H. Nevard. Pp. 10. (London: H.M. Stationery Office.) 6d. net. [224]

Acoustics of Telephony. By Dr. E. G. Richardson. (Post Office Green Papers, No. 25.) Pp. 18+4 plates. (London: General Post Office.) Free. [234]

City and County of Bristol: Bristol Museum and Art Gallery. Report of the Committee for the Year ended 31 December 1935. Pp. 28+4 plates. (Bristol: Bristol Museum and Art Gallery.) [294]

Report by the Hydrographer of the Navy on the Services carried out by H.M. Naval Surveying Service and on the Work of the Hydrographic Department for the Year 1935. Pp. viii. (London: Admiralty.) [304]

Saorstát Éireann: Roinn Talmhaíochta (Department of Agriculture): Brainse Iascaigh (Fisheries Branch). Report on the Sea and Inland Fisheries for the Year 1934. Pp. 34. (Dublin: Government Publications Sale Office.) 9d. [15]

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge during the Academic Year 1934-1935. Pp. 106. (Cambridge: Printed at the University Press.) [15]

The National Physical Laboratory. Report for the Year 1935. Pp. iv+249+12 plates. (London: H.M. Stationery Office.) 12s. net. [45]

Ollscoil na h-Eireann (The National University of Ireland). Calendar for the Year 1935. Pp. viii+306+536+333. (Dublin: National University of Ireland.) [45]

Ministry of Agriculture and Fisheries. Bulletin No. 99: Report on Insect Pests of Crops in England and Wales, 1932-1934. Pp. vi+50. (London: H.M. Stationery Office.) 1s. net. [75]

University of Oxford: Committee for Advanced Studies. Abstracts of Dissertations for the Degree of Doctor of Philosophy. Vol. 8 (Dissertations accepted during 1935). Pp. iv+181. (Oxford: Clarendon Press; London: Oxford University Press.) 3s. net. [75]

Patents, Designs and Trade Marks: Fifty-third Report of the Comptroller-General of Patents, Designs and Trade Marks, with Appendices, for the Year 1935. Pp. 22. (London: H.M. Stationery Office.) 4d. net. [85]

Policing the Saar. (Series A, No. 8.) Pp. 32. (London: The New Commonwealth.) 3d. [85]

Other Countries

Meddelande från Lunds Astronomiska Observatorium. Ser. 1, Nr. 140: Critical Remarks on G. Strömberg's Paper "The Formation of Galaxies, Stars and Planets". By Torsten Gustafson and Helge Nordström. Pp. 6. Ser. 1, Nr. 142: On the Correlation between Absolute and Apparent Magnitudes. By W. Gyllenberg. Pp. 9. Ser. 1, Nr. 143: A Method of Analyzing the Distribution of the Stars' Absolute Magnitudes. By W. Gyllenberg. Pp. 10. Ser. 1, Nr. 144: Notes on a Method to determine the Cosmic Absorption. By W. Gyllenberg. Pp. 9. Ser. 2, Nr. 79: A Study of Stellar Motions based on Radial Velocities. By Helge Nordström. Pp. 196. Ser. 2, Nr. 180 (Historical Notes and Papers, Nr. 5): On the Orientation of the Egyptian Pyramids. By Björn Svanonius. Pp. 9. (Lund: Astronomiska Observatorium.) [45]

Inigo Jones Seasonal Weather Forecasting Trust: Crophurst Observatory. Observatory Paper No. 2: The Elements of Crophurst, 1892-1935. Pp. 17. Observatory Paper No. 3: Observations of Deep Earth Temperatures at the Botanic Gardens, Brisbane, 1928-1935, and at Crophurst Observatory, 1935 from 1st June; also The Sea Surface Temperatures at the Pile Lighthouse, Moreton Bay; and The Solar Constant of Radiation at Montezuma, Chile, and at Table Mountain. Compiled by Inigo Jones. Pp. 14. (Beerwah, Qd.: Crophurst Observatory.) [45]

Česká Akademie Věd a Umění (Académie Tchèque des Sciences et des Arts). Trída 2: Anthropologica. Homo předměstenski fosilni člověk z předmostí na Moravě. 1: Lebky. (L'Homme fossile de Předmostí en Moravie, 1: Les Crânes.) By Prof. Dr. J. Matiegka. Pp. 145+16 plates. (Prague: Česká Akademie Věd a Umění.) [65]

Handelingen van het Zevende Nederlandsch-Indisch Natuurwetenschappelijk Congres gehouden te Batavia van 23-26 October 1935. Pp. 771+25 plates. (Batavia: G. Kolff and Co.) [75]

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des réunions. Vol. 97: The Interpretation of the Zones on Scales of Salmon, Sea Trout and Brown Trout. By T. H. Järvi and W. J. M. Menzies. Pp. 63. (Copenhagen: Andr. Fred. Høst et fils.) 4.00 kr. [75]

Carnegie Institution of Washington. Year Book No. 34, July 1, 1934—June 30, 1935; with Administrative Reports through December 13, 1935. Pp. xxxii+414. (Washington, D.C.: Carnegie Institution.) [85]

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 16: 1933-1934. Pp. 223+vi. (Rochester, N.Y.: Eastman Kodak Co.) [85]

India Meteorological Department. Scientific Notes, Vol. 6, No. 67: Measurement of Vertical Currents in the Atmosphere, mainly of Thermal Origin, with Pilot Balloons. By K. R. Ramanathan and K. P. Ramakrishnan. Pp. 213-222+2 plates. (Delhi: Manager of Publications.) 14 annas; 1s. 6d. [85]

State of Illinois: Illinois Natural History Survey. Manual 1: Fieldbook of Illinois Wild Flowers. Pp. x+406. (Urbana, Ill.: Illinois State Natural History Survey.) [85]

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 17: Education for Democracy; Public Affairs Forums. By J. W. Studebaker and C. S. Williams. Pp. 74. (Washington, D.C.: Government Printing Office.) 10 cents. [85]

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1935. (Publication 3382.) Pp. iv+80. (Washington, D.C.: Smithsonian Institution.) [85]

Smithsonian Miscellaneous Collections. Vol. 95, No. 8: Thomas Walter, Botanist. By William R. Maxon. (Publication 3388.) Pp. 6. (Washington, D.C.: Smithsonian Institution.) [85]

Chinese Medical Journal. Supplement No. 1: Pathology and Microbiology; being mainly Proceedings of the Chinese Society of Pathology and Microbiology held in Canton, November 5-8, 1935. Pp. iv+518+80 plates. (Peiping: Peiping Union Medical College.) 2.50 U.S. dollars. [115]

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Deuxième Série, Fasc. 3: Mélanges Paul Pelseuer. Pp. ii+1206. (Bruxelles: Musée Royal d'Histoire Naturelle de Belgique.) [115]

U.S. Department of Commerce: National Bureau of Standards. National Bureau of Standards Miscellaneous Publication M122: Weights and Measures in Congress; Historical Summary covering the Period of the Continental Congress to and including the adoption of the Joint Resolutions of 1836 and 1838. By Sarah Ann Jones. Pp. 19. (Washington, D.C.: Government Printing Office.) 5 cents. [115]

Year Book, American Amaryllis Society, 1935. Vol. 2, dedicated to Theodore L. Mead. Edited by Dr. Hamilton P. Traub. Pp. 162. (Orlando, Fla.: Dr. Hamilton P. Traub, Mira Flores.) [115]

Koninklijke Vereeniging "Koloniaal Instituut", Amsterdam. Vijf en twintigste Jaarverslag, 1935. Pp. 125. (Amsterdam: Koloniaal Instituut.) [115]

Dominion of Canada. Eighteenth Annual Report of the National Research Council, containing the Report of the President and Financial Statement, 1934-1935. Pp. 158. (Ottawa: National Research Council.) [115]

Osiris: Studies on the History and Philosophy of Science, and on the History of Learning and Culture. Vol. 2, Part 3: Sir Thomas Browne, True Scientist. By Gordon Keith Chalmers. Pp. 28-79. (Bruges: The Saint Catherine Press, Ltd.) [115]

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Vincent, for the Year 1934. Pp. v+51. (Kingstown, St. Vincent: Government Printer.) 6d. [115]

Tanganyika Territory: Department of Lands and Mines: Geological Division. Bulletin No. 6: Provisional Geological Map of Tanganyika with Explanatory Notes on the Geological Formations and Mineral Occurrences and a Chronological Table (provisional) of the Former. By Dr. E. O. Teale. Revised edition. Pp. iii+50. (Dar es Salaam: Government Printer.) 4s. [115]

Koninklijk Nederlandsch Meteorologisch Instituut. No. 102, Mededeelingen en Verhandelingen, 37: De frequentie van halo-waarnemingen bij de zon in Nederland, voornamelijk van 1914-1931. By C. Visser. Pp. v+95. ('s-Gravenhage: Rijksuitgeverij.) 1.00 f. [115]

Bergens Museum. Årsberetning 1934-35. Pp. 100. (Bergen: A/S John Griegs Boktrykkeri.) [125]

Rules for the Grading of Teak Squares. Prepared by L. N. Seaman and V. D. Lemaye. Pp. iii+19. (Delhi: Manager of Publications.) 6 annas; 8d. [125]

The Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 8: Selected Clinical Articles. 1: An Interesting Outbreak of Variola vaccinia in Milch Cattle at Lahore, by G. K. Sharma; 2: An Unusual Case of Navicular Disease, by R. L. Kaura; 3: Supernumerary Teats in Buffalo-Cows, by G. K. Sharma. Pp. iii+11+3 plates. (Delhi: Manager of Publications.) 8 annas; 10d. [125]

Field Museum of Natural History. Botanical Series, Vol. 12: The Forests and Flora of British Honduras. By Paul C. Standley and Prof. Samuel J. Record. (Publication 350.) Pp. 432+16 plates. (Chicago: Field Museum of Natural History.) [145]

Albert Nodon, in Memoriam. Pp. 28. (Bordeaux: Société Astronomique.) [155]

Catalogues

The Spekker Photoelectric Absorptiometer: an Objective 'Colorimeter' for use in Chemical Analysis. Pp. 5. (London: Adam Hilger, Ltd.)

Acridiflavine 'B.D.' (Intravenous). Pp. 4. (London: The British Drug Houses, Ltd.)

Books Old and Modern, including a number on the following Subjects: Botany, English Literature and Poetry, Entomology, and Music. (Catalogue No. 245.) Pp. 20. (London: Dulau and Co., Ltd.)

Vertebrata Recentia—Fossilia zum Teil aus der Bibliothek des Herrn Baron Franz von Nopcea, Budapest. (Antiquariats-Katalog Nr. 694.) Pp. 130. (Leipzig: Gustav Fock, G.m.b.H.)