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CONTENTS

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Co-ordination of Government Grants for Research and Development

THE War brought about a recognition of the value and application of research in solving the many problems which arose during the continuance of the struggle. As is well known, Germany, both in government and commercial circles, had recognised the value of research work before the dawn of the present century. The years following the Armistice have furnished evidence that if the British Empire is to keep pace with its competitors it must make the fullest use of the scientific worker in dealing with the complicated questions of administration and development which confront it. It is of good augury that this fact is now appreciated both by the Government of Great Britain and those responsible for the Empire overseas, the subject having been discussed at the Conferences of Prime Ministers which have been held in London.

Omitting for the moment the wider issues of this matter, a brief survey may be made of the developments which have taken place in Great Britain. As a forerunner of newer bodies at present in existence here, the Development Fund was inaugurated in 1910. The objects of this fund were to provide assistance, after due inquiry, to agriculture, fisheries, forestry, and so forth, in the form of grants for education, research, and other development work. After the War other interests arose, some of them conflicting, though this was not appreciated at the time. Bodies such as the Empire Marketing Board, the Colonial Development Fund, and the Colonial and Middle Eastern Services were formed, whilst increased grants for various new purposes were made to the Ministry of Agriculture and to the University Grants Committee.

These newer bodies and the increased activities of the older Development Fund grew up piecemeal, with little co-ordination and in the absence of any carefully thought-out or balanced scheme. To such an extent has this proved the case that many scientific workers themselves have found it difficult to ascertain the proper body to consult in connexion with a piece of work they may have had in hand ; whilst to the layman the multiplicity of bodies making grants and the trouble of discovering to which to apply has furnished proof, if proof were wanting, of the inadequacy of the methods in force. Attention was directed to this state of affairs in these columns so long ago as July 26, 1930.

Owing to the lack of unified control over the allocation of grants by the various bodies in existence, it became apparent that Parliament had very little voice in the matter. It was being asked by different bodies to make provision for carrying out objects which were seemingly substantially the same, though this was not evident in the Estimates presented to the House of Commons; nor was it easy to appreciate the position after a close study. For these reasons the matter has been investigated by the Estimates Committee of the House, of which Sir Vivian Henderson is chairman. The first report of this Committee has now been presented to Parliament, and was referred to in NATURE of April 16, p. 572. The Committee has confined itself to an examination of the estimates of the above-mentioned funds and services. The report is timely and will prove illuminating to the public, though it may present few surprises to those conversant with the position.

It has been difficult for research workers and others to discover in how far the various bodies receiving grants from Government have been cognisant with the work being undertaken by their confrères, but the Committee does not suggest that the bodies and departments allotting grants are in ignorance of the position. Nevertheless, the Committee has discovered that grants are being made by the Empire Marketing Board for many purposes which are also assisted by the Department of Scientific and Industrial Research, the Ministry of Agriculture, the Development Fund, and the Forestry Commission. Many institutions are receiving grants from the State through one or more, or even up to five or more, different sources. It is also apparent that grants are being made from the Colonial Development Fund for ordinary purposes of government in Colonies which are at the same time in receipt of a grant-in-aid from the Colonial Office. It has thus become apparent (1) that Parliament is not in a position to ascertain with ease the total assistance it is granting to one institution; (2) that the multiplicity of grants obtained by one institution from several different bodies results in a greater total being given than would be the case if the total sum were voted by Parliament itself in a single grant.

The Committee directs attention to the long-established canon of sound finance by which all government aid for any one purpose or any one body should be provided in a single grant. It is recognised that this ideal may often be unattainable; but the Committee considers that it is essential, before this principle is departed from in any one case, to make sure that there are adequate grounds for so doing.

The Committee is therefore of opinion that, even if bodies and departments have extant elaborate arrangements for maintaining the essential co-ordination, the necessity for such arrangements appears to challenge the efficiency of the present system and to constitute a strong case for reviewing it. It therefore recommends that the Estimates should be so framed in future that the total State grant allocated to any institution should be readily ascertainable.

The authors of the report have expressed no opinion on the policy of assisting the various objects for which grants are made, but they are of opinion that they may properly review the very complicated machinery by which that policy is being carried into effect. Various political and Empire questions, including the adoption of a general tariff and the approaching Ottawa Conference, which need not be entered into here, have come to the front to make the moment opportune for this review. The tariff and Empire preferences, for example, alter the basis upon which the Empire Marketing Board was formed in 1926; and the working of the Colonial Development Fund can now be reviewed in the light of experience which has been gained.

The Committee directs attention to the threefold organisation for medical, agricultural, and industrial research, under the Lord President of the Council, now taking shape in Great Britain; its suggestion that these bodies should gradually become the controlling departments in their respective spheres will be welcomed.

In the event of effect being given to the Committee's suggestions, the new Advisory Council for Agricultural Research could take over portions of the work of the Development Fund, whilst certain of the work of the Empire Marketing Board might be absorbed by the relevant trade intelligence service. The grants from the Colonial Development Fund should be restricted, as was originally intended, to works of a capital nature, and grants such as have been recently sanctioned for ordinary government administrative purposes should be discontinued.

As regards the inter-relation and co-ordination of grants by the different Empire administrations, the Committee's report should enable this important side of the problem to be discussed with an added insight at the Ottawa Conference to be held in July.

The Mind Judicial

(1) *The Life and Letters of Sir Edmund Gosse.* By the Hon. Evan Charteris. Pp. ix + 525 + 18 plates. (London: William Heinemann, Ltd., 1931.) 25*s.* net.

(2) *The Religion of Man: being the Hibbert Lectures for 1930.* By Rabindranath Tagore. Pp. 239. (London: George Allen and Unwin, Ltd., 1931.) 7*s.* 6*d.* net.

"*Let it be granted:—That a controversy may be raised about any question and at any distance from that question.*"—LEWIS CARROLL.

"*The human mind has compressed ages into a few years for the acquisition of steel-made claws. . . . The new organs that to-day are being added as a supplement to Man's vital stock are too quick and too numerous for his inner nature to develop its own simultaneous concordance with them and thus we see everywhere innumerable schoolboys in human society playing pranks with their own and other people's lives and welfare, by means of newly acquired pen-knives which have not had time to become humanized.*"
—RABINDRANATH TAGORE.

WE of the body scientific are seeking to impose ourselves mentally upon the world—to rival the word painters—having long done so in ways mechanical and succeeded: with terrible effect in part yet with much benefit in some fields. The money-changers have recognised our value by supplying us with capital but we have in no way learnt to curb the control they exercise upon society. To-day, apparently they hold us at ransom. We have the temerity to believe that the public health cannot be sound unless we intervene in its protection and even direct the lines of action. What then is our medical value, primarily, to society, our qualification to advise? To answer the question, we need to hold up the mirror very closely to ourselves—to ask what we see in ourselves that is special; what we ought to ask for; what we should find. To see more than darkly is very difficult—as years go by the field of view is ever widening, the need of grasping the whole field more obvious, the vision more and more clouded, less easy to interpret. We can but compare—nothing is absolute—through biography especially: not necessarily through study of special books but constantly of thumb-nail sketches to be made here and there, indeed everywhere.

I have long advisedly watched the game we play and often asked myself what its meaning was, how it might be directed and brought under rule, so as to be of more avail than it is. No general answer is forthcoming. I entered upon my career as a student thirsting for knowledge of method. My first books—"Pepper's Playbook of Science" in particular—had told me of much that was interesting but nothing of the process by which the knowledge had been gained. How could one learn to do such things? I found the teaching dogmatic—Huxley's especially—but much of it was practical and went home. Gradually, in Germany particularly, the method in the background began to leak through, so that I was able to build outlines of a system.

When I began to teach, in 1870, I already had a conscious purpose and desire—to aid in introducing what Charles Kingsley had so aptly termed the method of sound scientific thought. We were then at the Darwin-Colenso stage—faith was giving way to fact. We began by fighting down the cramping system of payment by results administered by Matthew Arnold and others; more freedom of thought seemed to prevail but only during a brief interval. In stealthy ways, first through the inspector, the examiners have not only recovered their position but also have raised their dread power to that of inquisitioners. We are fallen back into the paths of primitive religion: unquestioning faith, not eternal doubt, is the demand now made upon the student. Theirs not to reason why, theirs but to do and die. Were it not for a few pathfinders, our so-called science would be entirely romanised in its methods—this is why it is proving to be of so little public worth in lifting the masses into intelligence. The sale of moral filth is being consistently cheapened: no considered effort is being made, from our side, to meet what desire there may be for healthy knowledge. A transcendent future and the in'ards of atoms are held out for popular consumption; the present doings of the hordes of earthly molecules remain unnoticed. We make no attempt to get down to any understanding of life as it is: the talk is all of the past—which we study but do not heed. Whence springs the new discipline of science? What is there in ourselves from which it is bred? It is in some way a natural product but of rare occurrence. Is this accident or inevitable?

The point of view from which I would consider the biography of Sir Edmund Gosse will be apparent from these remarks. He died in May 1928. A critic and literary publicist of some distinction, much given to the study of current French literature, librarian to the House of Lords, 1904–14: he was best known in his last years on account of the felicitous weekly literary article which he contributed to the *Sunday Times*, after he left the

Lords. The one work which won him distinction was his "Father and Son" (1907)—an intimate account of his most remarkable father and mother and of his own early upbringing under their affectionate but severe guidance. As a biography the book now ranks as a classic, of great historical and psychological value. I read it with intense interest when it was first published. Although issued anonymously, it was easy to guess who father and son were—"'Goose and Gosling', you mean", at once said the late Israel Zangwill, when asked if he had read the book.

The father—Philip Henry Gosse (1810–87)—was a zoologist of repute, a fellow of the Royal Society, to which he contributed no less than sixty-two descriptive papers. Brought up in a severely puritan atmosphere, he early developed great natural aptitude as botanist and zoologist; at the same time he became intensely religious and eventually a member of the Plymouth Brotherhood, a sect closely akin to the Sandemanians, to which Faraday belonged. He wrote a number of popular natural history books, which he himself illustrated. His father, although a painter, was an indefatigable writer. Philip Gosse married Emily Bowles, who was of New England descent; she was a successful writer of tracts: in her son's opinion, she had in her the making of a novelist but advisedly abstained from writing, being naturally of a very devout and pious turn of mind. She had formed a definite conception of the absolute, unmodified and historical veracity, in its direct and obvious sense, of every statement contained within the covers of the Bible.

Edmund Gosse, therefore, had a strong infusion of literary blood in him, hence we can understand how it was that he became a victim of what his grandmother called—that cursed writin'.

The turning point in Philip Gosse's career came when Darwin's "Origin of Species" divided the ranks of naturalists. Gosse appears to have been privately advised of the theory in advance by Hooker, Darwin and Lyell, with the view of joining in its support. As a naturalist he was at first inclined to favour it but soon reverted to the first chapter of Genesis—he forthwith wrote, as a challenge, in advance, his celebrated "*Omphalos* (1857)—an attempt to untie the geological knot"! He argued, quite logically, that an all-important factor had been left out of account—'the Law of Prochronism in creation'. He contended that when the catastrophic act took place, the world presented instantaneously the appearance of a planet on which life had long existed, fossils included—made to order with all other things. Such was faith—such the power of the Bible in days before Darwin.

We may think him narrow but taking the state of opinion into account, Gosse's mental attitude, I venture to think, was in no whit different from that prevailing to-day among students in nearly all branches of science. 'And Arrhenius said—Let there be ions and there were ions', is as firmly believed in by the majority as any fiat in the first chapter of Genesis was by Gosse. Our general mental reactions are the same as they were—we still worship authority, only some have changed their book and have new gods. The point is—Gosse had a closed mind: so have most of us: Darwin still has few supporters, prepared not merely to face the facts but demanding suspension of judgment until the case be complete.

The young Huxley scoffed at Gosse's book and Charles Kingsley gave him no support. He became a mental wreck through disappointment and was no more seen at the Royal Society. To the last, he remained in expectation of the personal coming of the Lord. His son's biographer writes—"his faith, being cast in bronze and unassailable, did not suffer but his dogmatism grew less vociferous, a new gentleness tempered his outlook towards the opinions of others and blent with his affection for his son".

How is such a man to be classed? Not among scientific thinkers. He was contemporary with Carlyle, Charles Kingsley and Ruskin. These men were all literary and greatly devoted to the Bible, all greatly influenced by its teachings but without Gosse's bigotry. Ruskin was the most fully imbued with its spirit and saturated with its language; he was also a naturalist, a geologist of no mean order; as an art worker he was exceptionally exact and scientific, yet a rhapsodist and unscientific in general outlook. Carlyle was the rigid scholar in outlook but dour in spirit and interests. Kingsley was the hearty, sporting country clergyman, supercharged with energy, a good pen and imbued with a clear conception of scientific method. At one time he was overcome by doubts; even Ruskin confessed, in late life, to the feeling that he might have been led to change his views had he dared to reconsider their validity.

Edmund Gosse was not only different from his father but seems also to have been little influenced mentally by his severe training at the hands of his parents. He did not even assimilate biblical English. He early became emancipated in a re-

markable way. When about six years old, he lost his belief in his father's omniscience by discovering that his statements about things in general could not be implicitly accepted. Then he began to question the efficacy of prayer, to which absolute value was attached by his parents, when told that he must not pray for things, although the view held by the household was that if anything were desired you should not lose any time in seeking for it but ask God to guide you to it.

Finally, when idolatry was severely condemned at mission meetings, particularly bowing down before wood and stone, he decided to make an experiment: hoisting a small chair on to the table close to the window, he said his daily prayer in a loud voice, substituting the address "O Chair" for the usual one. He expected that God would certainly exhibit his anger and chastise his impious and wilful action. Nothing happened. His conclusion was that his father was not really acquainted with the divine practice in cases of idolatry. What might have happened had such a thinking child been taught properly to experiment and reason? I commend the problem to the attention of Dr. Lyttelton.

His father trained Edmund Gosse so thoroughly as an observer and collector of marine organisms that, before he was five years old, the boy discovered 'a tiny atom', which he carried to his father as a form 'with which he was unacquainted', since figured on lists of sea-anemones as *Phellia microcinela* or the walled corklet. The training, however, had no effect in leading him to take up such study. One lesson he had from his father, in about his fourth year, is worthy of notice; we may even say, 'Teachers, please copy':

"In particular, he had a scheme for rationalising geography, which I think was admirable. I was to climb upon a chair, while, standing at my side, with a pencil and a sheet of paper, he was to draw a chart of the markings on the carpet. Then, when I understood the system, another chart on a smaller scale of the furniture in the room, then of a floor of the house, then of the back-garden, then of a section of the street. The result of this was that geography came to me of itself, as a perfectly natural miniature arrangement of objects and, to this day, has always been the science which gives me least difficulty."

Edmund Gosse became emancipated when he came to London at the age of seventeen. Through the influence of Charles Kingsley, he found an opening at the British Museum in the cataloguing section. Thereafter he reverted to his type and became a mere man of words, showing no particular interests outside humanistic literature. The "Life and Letters" contains many of his letters but there is little in these of interest or in any special way informative: that a father and mother of ultra-rigid outlook should give rise to a son, if not of loose opinions, of no opinion in particular about any subject yet with some gift of words, is very remarkable. The story is of value in connexion with the present attempt to produce biologists—can men worth their salt be nursed into being by any education? I doubt it.

Man to the chemist is a composite structure of organic compounds—life the interaction of molecular forces. Outside this definition we cannot go—nor do we see how those who cannot think in terms of chemistry have the right to go further either in assertion or denial. In the laboratory the possibilities are infinite, in ourselves they are limited—we are built, it seems, to pattern, of selected oriented materials; our operations are as strictly controlled as if we ran upon roads and rails. Nature, the dear old nurse, has so taken us by the hand that she regulates our actions by drugs—nerves seem to be only of secondary value, conductors of impulses and orders. We are bedrugged not only from within but also from without—by an astounding set of 'factors' which are gradually being dragged into the open, as definite crystalline substances. The outlook grows more and more 'mechanised' every day.

"That which merely gives us information can be explained in terms of measurement but that which gives us joy cannot be explained by the facts of a mere grouping of atoms and molecules", says the poet Rabindranath Tagore. What of the "joy" that is to be obtained by merely pricking a little morphine into the blood stream? I would range all the controlling agents under the name advitants—endogenous or exogenous. They are all carbon compounds, some of simple, some of complex structure. Whatever their mode of action, it certainly is the outcome of peculiarities in their structure. From this point of view, the various types of mentality are due to variations in the structure of our own composite mechanism.

One type is necessarily dominant—the literary. So soon as man rose in numbers, words gained control and the wordy perpetuated their kind, the while doing the minimum of manual work. To write is but to talk upon paper. To maintain society subservience became necessary. The able came together but kept themselves under, through jealousy: the adventurous naturally often fell victims. Only the few could be allowed to think.

To-day we are advisedly limiting their number by declining to breed them. Hence the present state of society—and it may become far worse.

The industrial element has been gradually developed through the rise of intelligent men from the working masses. This class alone has encouraged invention and experimental inquiry. The literary class has parasitically enjoyed the fruits of the work of the industrial class, without ever entering into its methods. At all times, the commercial instinct must have been more or less developed in all men, as man is necessarily individual. No communistic experiment such as the Russians are seeking to make has hitherto been successful. It is easy to see how a merchant class is arisen and, with its power of the purse, has assumed control in modern industry without sufficiently understanding what it controls.

It is clear that, in the future, divided control—involving the inclusion of all necessary elements—can alone give what is needed: the German industrialists have already proved this to demonstration: they have also already found that it is easy to go too far. Recent events also show how, in matters of government, it is being recognised that expert aid is essential to success. We are on the way to recognise that the introduction of scientific method into our affairs cannot much longer be avoided. The attitude of ultra-conservatives like Lord Snowden and Sir Herbert Samuel is of extraordinary interest, showing their complete inability to interpret the changes introduced into the world at the hands of workers in natural science, as distinct from humanistic science. The Realists must have it in the end. It is no longer a question what the masses do: the problem is what the few can and must do to provide occupation, food and lodging for the masses.

"To-day more than ever before in our history, the aid of spiritual power is needed . . . its sources will surely be discovered in the hidden depths of our being. Pioneers will come to take up this adventure and suffer and through suffering open out a path to that higher elevation of life in which lies our safety.

"The vastness of the race problem with which we are faced to-day will either compel us to train ourselves to moral fitness in the place of merely external efficiency or the complication arising out of it will fetter all our movements and drive us to our death."

The poet has vision where the scientific worker is unseeing. He preaches a true religion of man—something above research as this is now understood.

HENRY E. ARMSTRONG.

Teaching of Mathematics

(1) *The Teaching of Arithmetic in Schools: a Report prepared for the Mathematical Association.* Pp. 82. (London: G. Bell and Sons, Ltd., 1932.) 2*s*. net.

(2) *The Teaching of Elementary Algebra.* By Clement V. Durell. Pp. viii + 136. (London: G. Bell and Sons, Ltd., 1931.) 3*s*. 6*d*. net.

NOT only is the science of mathematics constantly pushing forward its boundaries, but the old territory is also being examined afresh, and new methods of approach are being suggested and tried. Of this latter fact the two little books under review afford clear evidence.

(1) The first, which deals with the teaching of fundamentals, is issued by the Mathematical Association; and it is difficult to overrate the influence exerted by this Association on the teaching in secondary schools. It has already introduced reforms, notably in subtraction and multiplication, which, though they may seem trifling when viewed by themselves, profoundly affect the work in the more advanced stages. This new Report suggests no startling innovations, but it stands as a compendium of the most enlightened methods practised in our schools to-day. It advocates uniformity of method, so far as that is practicable, within the same school; but it gives a number of different methods without dogmatising about their relative values. It is quite definite, however, in its recommendations; and it shows commendable courage in modifying its previous recommendations where they have not stood the test of practical experience in the classroom.

(2) Mr. Durell's book, representing as it does the opinions of one man, belongs to a different category. Its teachings are more open to controversy. It expounds with great lucidity the views of the modern school, views which the present reviewer regards as essentially sound. In the days of his youth, Todhunter and Colenso wrote the authoritative textbooks in algebra. They set a fashion, or rather perpetuated a fashion, which is largely followed up to the present day. The defects of the tradition are many. One is that it introduces algebra as a new subject, and not as a natural development of the science of number which the pupils have previously been studying. Another is that it attaches undue importance to the manipulation of symbols as distinct from an understanding of their significance. A third is that it ignores the fundamental distinction between directed and non-directed numbers, a distinction which was first brought out prominently in England in Sir Percy

Nunn's epoch-making book. The intelligent student of the olden days used to feel vaguely that the signs + and − were used ambiguously: that they were sometimes used as verbs and meant *add* or *subtract*, and sometimes as adjectives, and defined the number that followed as *positive* or *negative*. But the distinction was never brought out clearly in the text-books.

The new school of algebra teachers, of whom Mr. Durell is a good representative, has changed all that. It has made the clear comprehension of what directed numbers mean one of the essential aims in the teaching of algebra; and it has so devised the approach to the study of algebra that the gulf between it and arithmetic should disappear. There is a difference of opinion whether that approach should be via the equation, or via the formulæ that are used in mensuration and in science. Mr. Durell favours the latter, and gives very cogent arguments for his preference. He writes well, seasons his theories with an abundance of common sense, and presents the reader with valuable hints on teaching which are based on a wide personal experience. P. B. BALLARD.

Systematic Zoology

Klassen und Ordnungen des Tierreichs, wissenschaftlich dargestellt in Wort und Bild. Von Dr. H. G. Bronn. (1) Band 3, Abteilung 3: *Bivalvia* (*Muscheln*). Bearbeitet von Dr. F. Haas. Lief. 1. Pp. 176. 19·50 gold marks. Lief. 2: *Schriftenverzeichnis*. Pp. 292. 38 gold marks. Lief. 3. Pp. 177-384. 28·80 gold marks. (2) Band 4: *Vermes*. Abteilung 2: *Aschelminthen*. Buch 1: *Rotatorien, Gastrotrichen und Kinorhynchen*. Bearbeitet von A. Remane. Lief. 1: *Rotatorien*. Pp. 160. 20 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929–1931.)

(1) OF the three parts of this new account of the bivalve molluscs, one (the second section) is entirely occupied by an alphabetical list of almost 7000 titles of books and papers on the class published up to the end of 1928. The author promises a further list of more recent works when the text is finally completed. This account of the bivalves is planned on a liberal scale, for the two parts of the text before us, altogether 384 pages, carry the description only so far as the shell and the cognate subject of pearls. The characters and classification of the Bivalvia are briefly set forth; three main orders are recognised—Anisomyaria, Taxodontia, and Eulamellibranchiata, the last divided into five sub-orders. A short account of the form, relations, and positions of the organs prefaces the detailed consideration of the shell, which begins with the description of the varied external features and the mathematics of the curvature of the shell-valves.

The author has given very adequate attention to the sculpture and colouring of the shell surface, the structure and chemical composition of the component layers of the shell, the interlocking mechanisms and the ligament, and the sexual dimorphism exhibited by the shells of a number of species which have been described under different names for the two sexes. The last eighty pages, devoted to a description of the different kinds of pearls and their modes of formation, form a useful summary of present knowledge of this subject. The text is illustrated by 200 clearly drawn figures. We look forward to an equally adequate account of the soft parts.

(2) The Rotifers are usually regarded as 'a small group', but the number of species known is stated to be more than 900, and the number of species living is probably not less than 1500. The literature is extensive—the author states that a list of the published papers will occupy almost 100 pages—and is widely scattered, and therefore a new account of the group by an author so competent will be welcomed by professional and by amateur workers. Both of these will regret some of the changes in nomenclature, for example, *Epiphanes* instead of *Hydatina*, *Floscularia* for *Melicerta*, which appear to be necessary if the double nomenclature employed for certain genera since 1913 is to be avoided. A statement of the characters of the Rotifera is accompanied by six useful original drawings showing the anatomical features as seen from dorsal, ventral, and lateral aspects. This is followed by an excellent account of the history of our knowledge of the Rotifera which, apart from a note by John Harris (1696), begins with Leeuwenhoek's descriptions of some of these animals, among which the well-known *Melicerta ringens* (or, as it is to be called, *Floscularia ringens*) is clearly recognisable.

The historical section is divided into four periods—the first from 1696; the second from 1838, when Ehrenberg's well-known work on Infusoria appeared; the third from the time of publication of Hudson and Gosse's monograph in 1886; and the fourth from Beauchamp's memoir in 1909. In a brief statement on the size of Rotifers, the author remarks that the smallest, *Ascomorpha minima*, which is about 0·04 mm. long and 0·03 mm. broad,

is the smallest known metazoan. The different forms of the body of Rotifers, the jointing of the body, the head and its corona and processes, the appendages of the trunk, and the foot are considered. The ciliation of the trochal region is traced from the primitive type, most closely approximated in *Notommata*, through the varying forms represented by *Pedalia*, *Floscularia* (*Melicerta*), *Philodina*, *Epiphanes* (*Hydatina*), and *Brachionus*, and a description is added of the wheel-organs of each family.

A clear account is given of the glands, including the retrocerebral organ, the different grades of development of the lorica, and the three kinds of envelope—the gelatinous, as in certain Flosculariacea; the secreted case of firmer consistency, as in the Bdelloid genus *Habrotrocha*; and the envelope formed of foreign particles, as in *Floscularia ringens*. The illustrations, 153 in number, are well chosen and clearly reproduced.

Short Reviews

Das Tierreich: eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Gegründet von der Deutschen Zoologischen Gesellschaft. Im Auftrage der Preussischen Akademie der Wissenschaften zu Berlin. Herausgegeben von F. E. Schulze and W. Kükenthal.

(1) Lief. 54: *Myriapoda.* 2: *Scolopendromorpha.* Bearbeitet von Dr. Graf Attems. Pp. xix + 308. 50 gold marks.

(2) Lief. 55: *Amphibia. Anura III., Polypedatidæ.* Bearbeitet von Dr. E. Ahl. Pp. xvi + 477. 77·50 gold marks.

(3) Lief. 56: *Acarina; Bdellidæ, Nicoletiellidæ, Cryptognathidæ.* Bearbeitet von Dr. Sig. Thor. Pp. xiii + 87. n.p. (Berlin und Leipzig: Walter de Gruyter und Co., 1931.)

(1) Dr. Graf Attems gives a brief account (16 pp.) of the external morphology of the Scolopendromorpha and defines the two families, Scolopendridæ and Cryptopidæ, which constitute the order. In the first of these families are 16 genera with 238 recognised species, besides a further 44 species of uncertain position; in the second family are 12 genera with 106 species, with a score which are incompletely described. The discrimination of genera and species is made as straightforward as possible by the provision of excellent keys and of clearly drawn illustrations, 387 in number.

(2) A brief description of the salient biological and structural features of these tree frogs precedes the systematic account of the twelve genera and 527 species—found in the African and Indo-Malayan region—which are included in the family Polypedatidæ. Noteworthy are the keys devised for the separation of the large genera *Rhacophorus* and *Hyperolius*, each of which contains nearly two hundred species. The systematic characters are set forth clearly, and for many of the species in considerable detail, and there are 320 figures, mostly in half-tone, representing usually the dorsal aspect of the frogs.

(3) The systematic treatment of the Bdellidæ or snouted mites is prefaced by a useful account of their external features, internal anatomy, life history, and biology. For the less-known Nicoletiellidæ a briefer description suffices, and for the very small Cryptognathidæ, with only one genus and two species, the general account is restricted to the external features, as the development, internal anatomy, and the nature of the food of these mites are unknown. The keys, systematic descriptions, and illustrations have been carefully prepared by Dr. Sig. Thor, to afford the maximum of help in the difficult task of determining these mites.

Each volume has a systematic index and "nomenclator generum et subgenerum". The three parts before us worthily maintain the high traditions of the series to which they belong.

Electrical Insulating Materials: an Engineering Treatise on the Production, Characteristics and Uses of Electrical Insulating Materials. By H. Warren. Pp. 516. (London: Ernest Benn, Ltd., 1931.) 42*s.* net.

The insulating materials from which the designer has to choose cover a very wide range of natural and artificial substances. They vary from rocky deposits, like slate and marble, to highly complicated synthetic resins. The engineering expert has to familiarise himself with all of them, and choose for his special purposes those with suitable characteristics. Mica is the most important mineral material for insulating work. Its excellent electrical properties, great mechanical strength, ease of cleavage into continuous laminæ, purity, chemical inertness, and resistance to high temperature put it into a class by itself. It is used in natural plates for condensers, certain heating devices, and small commutators. It is also used for non-electrical purposes, such as sound producing diaphragms, and to build up composite materials.

On the other hand, materials like casein, the albuminoid which is the basis of cheese, is sometimes used for switch covers, lampholders, etc., especially abroad. The manufacturer has to consider ease of working and the degree of polish possible, as well as the electrical and mechanical properties of the materials. He will find this book most useful for reference, and parts of it suggestive and instructive.

Manx Algæ: an Algal Survey of the South End of the Isle of Man. By Dr. Margery Knight and Mary W. Parke. (L.M.B.C. Memoirs on Typical British Marine Plants and Animals, 30.) Pp. vii + 155 + 19 plates. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1931.) 10*s.* 6*d.*

British workers in the field of marine algology have been seriously hampered for many years by the paucity of literature. The present memoir is

a welcome addition, being the result of some years of work at the Isle of Man research station. It includes the Chlorophyceæ, Phæophyceæ, and Rhodophyceæ, and embodies the results of a systematic survey of the south-east corner of the island.

The first part of the book gives an account of the way in which the marine algæ perennate, and separates them into perennials, pseudo-perennials, and annuals, basing the categories on the extent of thallus destruction in the autumn and the extent of the growing period. An interesting account is also given of the algal migrations in the littoral zone, careful observation having revealed the fact that the algæ move up and down the shore with a seasonal periodicity that can possibly be correlated with changes in external factors, such as light and temperature. In all cases the onset of unfavourable conditions appears to be heralded by copious reproduction. So little work of this kind has been published that this section of the book will be especially welcomed by algologists.

In addition to this, the authors have compiled a list of algæ for the area concerned, with their precise localities and time of reproduction. They have also constructed a key for the identification of these same genera.

The plates and maps are a useful asset, those of the former, showing the algæ *in situ*, being a particularly pleasing addition to the volume.

L. N.

Vergleichende Stammesgeschichte: Grundlagen, Methoden, Probleme unter besonderer Berücksichtigung der höheren Krebse. Von K. Beurlen. (Fortschritte der Geologie und Paläontologie, herausgegeben von Prof. Dr. W. Soergel, Band 8, Heft 26.) Pp. viii + 317-586. (Berlin: Gebrüder Borntraeger, 1930.) 30 gold marks.

PALÆONTOLOGY, compared with zoology and botany, suffers many disabilities, but these are in part outweighed by one advantage which the sciences concerned with living organisms cannot possess—the time factor. This advantage is particularly evident in studies dealing with the broader aspects of phylogeny. In this present work is given a detailed examination of the phylogeny of the higher Crustacea. Two main periods of development are suggested, outside which no new types have arisen. At these times development was explosive, many new types arising between which no transitional forms are found. The course of development in the many other animal groups briefly analysed by the author appears to be parallel to that given for the Decapoda: each developmental cycle is characterised by two stages, the first in which new types suddenly appear, and the second in which these types undergo continuous modification.

The work concludes with a discussion of many problems and theories of evolution, such as orthogenesis, adaptation, and function and form—"Die Funktion folgt aus der Form". Although the subject matter of the book is thus mainly biological, yet it appears likely that many of the suggestions contained in it must eventually be approached from the geological side.

Tara: a Pagan Sanctuary of Ancient Ireland. By Prof. R. A. S. Macalister. Pp. vi + 208 + 10 plates. (London: Charles Scribner's Sons, 1931.) 10*s.* 6*d.* net.

PROF. MACALISTER'S "Tara" is a study in archæology and traditional history combined such as would be possible nowhere but in Ireland. He takes his readers over the ground of this famous centre of Ireland's history with the "Dindshenchas" in his hand. Point by point the account of Tara given in this 'guide-book' of the ninth century is compared with the site, and it is shown how far the structures mentioned may be identified, or with what degree of certainty the position of others may be conjectured. Prof. Macalister's plea for a scientific investigation of the site is justified repeatedly. It is a work which might well be regarded as a national duty.

Prof. Macalister is on less solid ground when he turns to the unravelling of the traditions connected with Tara. He puts forward the extremely interesting suggestion that it was the centre of a 'Twin' cult, and the sanctuary of a priest king like the Grove of Nemi, the Irish king being exposed to the same fate of slaughter by a stronger rival as the Italian ministrant of the sacred grove. Prof. Macalister's theories offer material of much interest for discussion, but without much hope of arriving at any certain conclusion on the evidence as it stands at present.

The Psychology of Children's Drawings: from the First Stroke to the Coloured Drawing. By Helga Eng. Translated by H. Stafford Hatfield. (International Library of Psychology, Philosophy and Scientific Method.) Pp. viii + 223 + 8 plates. (London: Kegan Paul and Co., Ltd., 1931.) 12*s.* 6*d.* net.

THE subject of this book is a very fascinating one and deals with the development of children's drawings from the first ill-defined scribbling of the infant through the formalised drawings of older children. The author points out that small children draw not so much what they see as what they know. In the final chapter, there is provided a comparison of children's drawing and the art of primitive man. It is emphasised that so many of the drawings found on cave walls, etc., and attributed to primitive man, are works of art, and could not be produced by any present-day child or adult of average ability. They are the work of the artists of the day. The drawings of children always show a formalism, stiffness, and want of expression seldom seen in the work of primitive man. There is in the work of the ancient artists a representation of expression, of movement, of reality which is not seen in the drawings of children. There is still room for a vast amount of work to be done on the development of children's drawings, their relation to eidetic imagery, to mental development, and the phantasy life of the child.

The Uncertainty Principle in Modern Physics

SOMEWHERE in the literature of the theory of relativity occurs the statement: "The theory of relativity is physics, and we render it no good service by too hastily attributing to it a philosophical or indeed a speculative metaphysical meaning". Prof. C. G. Darwin, in his Friday evening discourse before the Royal Institution on Feb. 26, did not quite make the same statement about the uncertainty principle, but he stressed its physical side and had only a word or two to say on its other aspects. Prof. Darwin believes that the question of human free will is not touched by recent developments in physics. It is doubtful if any of the old deterministic descriptions of Nature were antagonistic to the doctrine of human free will, for it is a presumption to suppose that the organic world is controlled only by the laws of physics and chemistry. Since the Heisenberg uncertainty relations are also laws of the inorganic world, it is again a presumption to suppose that they control those activities in which human beings feel that they have freedom of choice. What the new principle does is point out to the 'die-hard' determinist that there is nothing in physics which makes the idea of free will absurd.

Prof. Darwin's lecture was a very clear exposition of the principle, and those who were not present to hear it will profit by reading the printed version. He gives an excellent illustration of the completely wave-like character of particles. If electrons are shot through two small holes situated close together in a screen, they produce an interference pattern on a photographic plate placed to receive them on the other side. If one hole is covered so that a pin-hole camera results, the electrons passing through the remaining hole produce general fogging of the plate. This is an experiment which can be performed in thought only; it is given as a type and contains the essential point of other practical experiments. It brings out the fact that these showers of particles have more than a particle aspect; they are also waves.

The Heisenberg uncertainty principle is the expression of our inability to locate a particle, for example, an electron, and to measure its momentum accurately at the same time. Heisenberg appears to take the view that processes in Nature are discontinuous. Other exponents of the theory assume that the laws of Nature are average or probability laws. They go so far as to say that the principle of causality no longer holds in the old sense in which that principle was applied.

Another possible conclusion is that the new principle is a consequence of our predilection for the description of phenomena in space-time, and that a wider background than that provided by the four variables x, y, z, and t would make the principle unnecessary. This question and the attempt to discover a unitary method of description in physics are closely associated.

The theory of relativity stresses the lack of union between gravitational and electromagnetic phenomena, and since its advent several attempts have been made to unite these two domains. Weyl, Eddington, and Einstein have all succeeded in doing so; but quantum phenomena stand aside from their theories in the same way that electromagnetism stood aside from Einstein's theory of gravitation.

Dirac's equations, especially in Darwin's form, point to a remarkable analogy between the quantum and electromagnetic theories, and it has been shown that these fundamental equations of the new quantum theory are expressible in the form of a vanishing divergence, when the geometrical background is that afforded by the use of five variables. This at once suggests the possibility of union of all the three domains, and the theory has been successfully developed.

We are here concerned with one result arising from this unitary theory, namely, the fundamental importance of the length h/m_0c, associated with any particle of mass m_0.

The theory shows that Planck's assumption of the existence of a quantum of action and the Wilson-Sommerfeld relations both lead to the result that no length less than h/m_0c is detectable in association with the particle.

The principle, stated in a slightly different form, has been called the principle of 'minimum proper time'. The length in this case is measured along the track of the particle in space-time. When interpreted in terms of ordinary space and time, it means that in the case of a particle moving with velocity v, the smallest detectable length is:

$$\Delta l = \frac{h}{m_0 c} \frac{\beta}{\sqrt{1-\beta^2}} \text{ where } \beta = v/c ;$$

and the smallest detectable interval of time is:

$$\Delta t = \frac{h}{m_0 c} \cdot \frac{1}{\sqrt{1-\beta^2}}.$$

This means that there is always an uncertainty in the position of the particle of amount Δl. The amount increases with the velocity, and if the velocity of light could be attained, it would be impossible to locate it at all. Like a monochromatic wave, it might be said to occupy all space. This principle of uncertainty was also discovered by Ruark in 1928 in a different form and by a different method, but his statement of it is evidently the expression of the same principle. Since that time it has been frequently rediscovered and discussed.

In spite of the fundamental difference between this principle and that of Heisenberg, it can be shown that it leads to his relations when the distances concerned are small. A very interesting result follows from an application to atomic orbits. No atomic orbit can be shorter than Δl, otherwise we could detect its existence through the spectrum of the atom in which it occurs. It follows from this that there is a maximum atomic number, and calculation shows the number to be 97. The prin-

ciple admits the possible existence of heavier nuclei, but declares that it is impossible for atoms of higher number, built on the Rutherford model, to exist with their full complement of electrons. If the laws we discover in physics hold in all parts of the universe, we deduce that there is this definite limit to the number of elements existing. This is an interesting conclusion, and it is remarkable that the number falls so close to the number of elements at present known, namely, 92. The principle behaves here as a condition of stability, and it may be that elements of higher number than 92 are extremely unstable, and now remain only in minute quantities.

This question of the maximum number of elements possible has been discussed by V. V. Narliker in NATURE for March 12, p. 402; 1932. The notation and method of Sir Arthur Eddington have been applied, and from considerations of invariance the maximum number obtained is 92.

The unitary theory and uncertainty principle deduced from it indicate that observers in space and time will discover both space and time are discontinuous, for their measurements of intervals of length and time will always be in integral multiples of Δl and Δt. The method of arriving at this conclusion indicates that this discontinuity underlies the old quantum theory. H. T. FLINT.

Sir Charles Parsons and his Work

"SAVERY, Newcomen, Smeaton, the famous Watt, Woolf, Trevithick, and some other English engineers were the veritable creators of the steam engine," said Sadi Carnot in his essay of 1824, while a year ago the *Engineer*, on the occasion of the death of Sir Charles Parsons, remarked that "to Great Britain belongs the credit for the origination of nearly all the fundamental inventions for the production and industrial utilisation of heat energy".

Although during the nineteenth century many improvements in heat engines, more especially in internal combustion engines, were made abroad, it remains true that it is in the records of the British Patent Office that most of the outstanding inventions made in connexion with steam engines and steam turbines are to be found. With the steam turbine will ever be associated the name of Sir Charles Parsons, who, as Sir Alfred Ewing said when lecturing on the work of Parsons at the Royal Institution last November, "was incomparably the most illustrious and most revolutionary engineer of his time". In view of the long and close friendship of Sir Alfred with Parsons, it was almost inevitable that on the occasion of this lecture, an account of which has recently been published, he should pay a tribute to him not only as an engineer but also as a friend. He therefore addressed his remarks not so much to those familiar with the steam turbine and its development, as to those who wished to know more of what Parsons did and how he did it, and what manner of man he was that he should be ranked so confidently among famous men.

Allowing for differences in time and circumstances, there is a remarkable similarity between the work done by Watt and by Parsons, and what the latter said of his great forerunner might well be applied to himself. When delivering the second Joule memorial lecture to the Manchester Literary and Philosophical Society in 1922, Parsons said: "James Watt's conclusions appear to have been the result of close and patient reasoning of a mind endowed with extraordinary powers of insight into physical questions, and of drawing sound practical conclusions from numerous experiments devised to throw light on the subject under consideration".

In his early surroundings, Parsons was even more fortunate than Watt, and his boyhood was spent in an atmosphere calculated to stimulate to the highest degree his interest in science and the mechanical arts. His father, by his construction of the famous reflecting telescope, had made Birr Castle the 'Mecca' of astronomers all over the world, while his mother possessed manipulative skill of no mean order. His tutors, too, were men of the highest calibre. In its influence on its various members, the home at Birr may well be compared to that of the Darwins at Downe. From it, Parsons emerged one of the most industrious of men, but also one of the shyest, and the effects of his unconventional boyhood remained stamped on him for life. It was his natural reserve and modesty—characteristics possessed by few inventors—which puzzled strangers. "His hesitating, fragmentary speech, his passive hand-shake, his somewhat shrinking manner," said Sir Alfred, "gave at first an impression of ineffectiveness which completely belied the latent force, the precision of purpose, the resolution that treated obstacles only as incentives to further effort, the fertility of invention that never accepted defeat."

Of Parsons' invention and development of the steam turbine, it may be said it was a piece of creative work comparable to that of a great writer or artist. Moreover, it was one for which the time was ripe, and which immediately and successfully fulfilled its purpose. The slow-speed reciprocating engines developed from the original inventions of Newcomen and Watt were ill adapted for driving the electric generators which were just coming into use when Parsons started work, and he was but one of many who attacked the problem of high speed. De Laval solved it one way and Parsons another. Thanks to the authorities at the Science Museum, Sir Alfred was able to exhibit at his lecture the historic turbo-generator Parsons made in 1884 and exhibited in the Inventions Exhibition of 1885. Running at the extraordinary speed of 18,000 revolutions a minute, the turbine drove an armature of only $2\frac{5}{8}$ in. diameter, the construction of which displayed as much ingenuity as the turbine itself. It was not mentioned by Sir Alfred, and it is little known, that among the important novelties in this machine was a system of forced lubrication.

At first the Parsons turbine was used without a condenser and was "a notorious steam eater". How Parsons brought in the compound turbine, the condensing turbine, the marine turbine, and the geared turbine, and how he successfully attacked the many problems which arose as the turbine gradually superseded steam engines in power-houses and ships, Sir Alfred made clear with the help of lantern slides, but unfortunately the report of his lecture has no illustrations.

It was once said that the work of Parsons had halved the cost of generating electricity. That is probably well within the mark. The relative importance of turbine plant to-day is shown by the official statistics quoted by Sir Alfred. "British power-stations in 1930", he said, "show that steam turbines provided more than $5\frac{1}{2}$ million kilowatts, while all the other types of heat engines accounted for less than a quarter of a million." But neither the generation of power nor the propulsion of ships monopolised the activities of Parsons. He spent much time and money in the attempt to produce artificial diamonds, worked out a scheme for boring a shaft in the earth's crust 12 miles deep, studied the casting of large steel ingots, and in his later years turned to the subjects which had engrossed his father and became a maker of optical glass and a constructor of large telescopes. No one to-day doubts that he was the most illustrious engineer of his time, and a biography of him should prove of the greatest value to students of both science and engineering.

The Great Barrier and the Formation of Coral Reefs

DR. YONGE divided the plan of operations of the Great Barrier Reef Expedition into four sections: (1) the detailed study of the feeding of corals; (2) the plankton and sea-water; (3) an ecological study of corals and associated organisms; and (4) the examination of the bottom flora and fauna, with the determination of the zoning of life at increasing depths (NATURE, **121**, 213; 1928). The British Museum (Natural History) has now commenced to publish the results in these four sections. Dr. Yonge's own work is mainly included in vol. 1 and has been already sufficiently summarised in NATURE, **127**, 309; 1931. It is a very remarkable study of the feeding of corals, from which he concludes that symbiotic algæ are "an indispensable factor in the necessarily exceptional powers of growth and repair possessed by the marine communities known as coral reefs". This is as much as concerns the student of the formation of coral reefs.

The methods for the collecting of zooplankton, designed mainly by F. S. Russell, require careful study, but comment is deferred until some quantitative and qualitative results are published. There were 189 hauls of the nets at 68 stations, together with a series of reef-flat plankton collections. For comparative purposes it would be useful if future marine expeditions adopted similar methods. The number of new species of animals obtained in the plankton may be small, the geographical region being the tropics, but the wealth of the collections is indicated in Mr. Barnard's "Amphipoda", more than a thousand specimens (23 species) of Hyperiidea having been submitted to him for examination.

Vol. 3 contains papers relating to the structure and ecology of reefs. J. A. Steers's geographical introduction is intended for biologists who deal "with definite facts" while geographers "deal with theory". He might have added that biologists on this expedition set out to obtain and test their facts largely by experiment, thus differentiating this from all previous expeditions. Mr. Steers's main work is published in the *Geographical Journal*, wherein he considers the formation of the Great Barrier Reef. He accepts the view that there was a post-glacial rise of sea-level, the coast platform having been formed largely by low-level Pleistocene abrasion, this following on down-faulting of a peneplain, composed of Pre-Tertiary rocks.

Dr. Stephenson contributes a happy report containing the outlines of the "Development and the Formation of Colonies in *Pocillopora* and *Porites*". He also, assisted by some members of his party, writes a long account of Low Isles and other lagoon reefs, and of one piece of the Barrier Reef. According to Miss Marshall and Dr. Orr's borings, Low Isles reef is a mere veneer of corals and other organisms covering a mud bank (NATURE, **129**, 141; 1932). It has a very different foundation from any coral reef visualised by Darwin or any other student of the formation of coral reefs. Dr. Stephenson states that the organisms are extending the surface of the reef outwards, presumably debris being laid down in the waters around in such a way that this outgrowth is assisted. The reef itself was formed as one or more reef patches of a type described as "made of dead boulders and masses of coral with sand between and the surface . . . very irregular and full of complex holes and crevices". The slope to the barrier lagoon is "covered by fixed blocks of dead coral of varying shape" and is illustrated by useful sections. "As the depths of the water increases they tend to become higher, and many of them form very large mounds", the tops often exposed at low water. Their sides are 20 ft. or more deep, and corals grow "on top of them and a little below the top". Nearer the shore they give place to a rugged area "covered by fixed blocks of dead coral". These perpendicular mounds seem to resemble those in the "zone of coral heads" on the lagoon side of Yonge Reef in the barrier series and formerly described in similar places by Surgeon Paradice, who is not referred to. Where I have seen similar structures they were in decay or stationary, and I await further evidence that they have been built

up by corals and are being added to the reef; in particular, I would learn of the destructive as well as of the constructive organisms and processes in and around Low Isles reef.

Dr. Stephenson should give his reference where he objects to the words "a typical coral reef" as "improper". Surely it is as improper to apply the names he has invented for parts of Low Isles Reef to Yonge Reef of the outer barrier, which appears to have been largely mortared and built by calcareous algæ not present in the former. Yonge Reef has no land and, except boulders, no part projecting above ordinary low tide level, whereas these inner reefs of the lagoon have an elaborate arrangement of cays, ramparts, and rocks above the level at which the building corals can live. Does our author reject the idea that there has been a lowering of sea-level in these regions in very recent times? There is "a general consensus of opinion amongst those who know" as to this (Steers), but in the summary of this report it is not even referred to. Were the superficial structures of Low Isles examined with this recent negative displacement of sea-level in view? If not, they require re-examination. In particular, the rocks shown in Plate V., Figs. 3 and 4, might just as well be parts of a formerly continuous reef which is slowly washing away as boulders; if so, many of their building organisms should be in the position in which they grew.

Yonge Reef "was chosen for careful examination" so that a full account will doubtless follow. It is of infinitely greater importance to the student of coral reef questions than all these lagoon reefs. A reef against the open ocean in such a position has usually an outer narrow ridge a few yards behind the breakers broken by trenches, a reef flat at about low tide level, often in places a little lower, a boulder zone, and a lagoon flat. Yonge Reef is described as having the same outer ridge, inside which is a depression (outer moat) up to 5 ft. deep and 100 yards broad. Then comes the "reef crest . . . a pavement of solid coral rock, swept clear of debris . . . 160 yards in breadth", more or less exposed at low water, and this is succeeded by an ill-defined depression (inner moat) 50 yards broad, up to 18 in. deep, rising into the boulder zone. The crest and inner moat seem to us to be comparable with the inner half of what is termed the reef-flat and to carry the same organisms, but the outer depression, up to 5 ft. deep, is a most unusual feature that merits full description. We presume that it was found at Ribbon, Ruby, and Escape Reefs, justifying the statement that Yonge Reef is typical. It would help us to understand this reef had there been any mention of the genera of building algæ in the list of its fauna and flora and referred to as a "heavy incrustation of nullipores". In any event, Yonge Reef should never have been blended in this report with a series of lagoon reefs many miles away from the open ocean, for it will throw those who have not made personal examinations of coral reefs into inextricable confusion.

The systematic work of the bottom fauna is published in vol. 4, which at present contains nine reports. It commences with that of the Annelida by Mr. C. C. A. Monro, but was it worth his time to examine a collection of 46 species of Chætopoda, of which more than half are represented only by single specimens? Clearly this class of animal, so important on shallow reefs, was never collected, and subsequent reports lead us to believe that only the obvious forms of life in such positions were collected. Enteropneusts suggest a similar story, only 2 species with 12 species of larvæ being described by E. Trewavas. Low island reefs should be almost ideal for the adults, and yet there are recorded only 21 specimens of *Ptychodera flava* and 8 "fragments" of *Balanoglossus carnosus*, which is described as "common on most sandy places". If only Mr. Monro, who has the specialist's knowledge, could be sent out to collect such groups of animals, on a tropical coral reef coast, what information we would have! He would settle his species on the spot, and in a second year his report would be completed! It would be of more value to science than twenty years in a museum working on collections such as this. Neither he nor Mr. Lyman Clark, who had more than five hundred specimens of Echinoderma other than Asteroidea, 117 species in 66 genera, thinks it worth while to consider geographical distribution. There are very few field notes, and the reader will inevitably conclude that the expedition did little collecting work. This is unfortunate, as a knowledge of the whole fauna and flora of the region is essential to an ecological study of any part.

Another report in this series is Prof. S. J. Hickson's revision of the genera and species of the Xeniidæ. It is of high scientific importance and of great educational value to future taxonomic workers on sedentary animals. The desirability of field observations is clear, Dr. Manton's note, "not the same species as on Escape Reef", leading to the discovery of a new species. It is also pleasing to see that the British Museum has a good taxonomist to deal with Tunicates in the person of A. B. Hastings, who appears temporarily to have deserted Polyzoa. G. P. Whitley, ichthyologist to the Australian Museum, collected most of the three hundred and fifty specimens of fish, which he assigned to a hundred species, and his field notes are fuller than usual. He remarks that the region is not sufficiently analysed for a synthesis of the geographical distribution of fish. A. A. Livingstone, of the same museum, has 33 species in 20 genera of Asteroidea, but by a slip New Ireland is placed in the Maldives. We would also refer to an excellent study of *Trochus* by the Australian naturalist, F. W. Moorhouse (vol. 3). It feeds on algæ, which it rasps off the rocks, and its optimal area appears to be on the relatively bare weather sides of reefs between tide marks, where the water is well aerated and every bare surface is covered by such algæ. Tables of size frequencies and of monthly rates of growth are given. Breeding takes place after two years, the *Trochus* being then about 5·5 cm. in diameter, the full size being about 9 cm.

J. STANLEY GARDINER.

Obituary

PROF. WILHELM OSTWALD

WILHELM (FRIEDRICH) OSTWALD, whose death took place on April 4, was the most notable and widely known figure in the history of physical chemistry during the quarter of a century which preceded his retirement from active academic work in 1905. Of this branch of science, in fact, he may quite properly be called the founder.

Born at Riga on Sept. 2, 1853, and educated at the recently established *Realgymnasium* in his native town, Ostwald entered the University of Dorpat in January 1872. In 1877 he became magister and privatdozent, and in 1878 he obtained the degree of doctor. Three years later, he accepted a call to the chair of chemistry in the Polytechnic at Riga, where he remained until 1887. It was at Riga that Ostwald's amazing powers as an organiser, thinker, investigator, and teacher had, for the first time, free opportunity to unfold themselves and to grow in strength. There he organised his teaching on a physico-chemical basis, and his aim was to train his students to be scientific thinkers. It was to Ostwald's laboratory at Riga that Arrhenius came in 1885, seeking help and sympathetic understanding of his work.

In 1887, Ostwald was invited to fill the chair of physical chemistry at Leipzig in succession to G. Wiedemann, and it was in Leipzig, first in the buildings of the Agricultural Institute and then, from 1897 onwards, in the new Physical Chemistry Institute in the Linnéstrasse, that Ostwald's greatest work as a teacher, writer, investigator, and inspirer of research was carried out; and it was during his Leipzig period that his intellectual and creative powers attained their zenith.

Ostwald retired from his chair at Leipzig in 1905 and, in the same year, he was nominated by the German Emperor as first exchange professor to America. In 1909 he was awarded the Nobel prize in chemistry.

In a short notice it is not possible to give more than an indication of some of Ostwald's scientific and literary achievements. In his work as an investigator, Ostwald, by his own hands or with the help of a large number of students who flocked from all parts of the world to his laboratory, laid the foundations of large sections of physical chemistry. Problems of chemical affinity, strength of acids as determined by density measurements, distribution between bases, effect on hydrolysis of methyl acetate, etc., were the subjects which first attracted his attention; and he discovered, independently of Arrhenius, that the conductivity and chemical activity of acids run parallel. Then came the development of electrochemical studies—electrical conductivity and electromotive force measurements as methods of studying chemical activity, solubilities, etc.—and out of these studies came the dilution law and Ostwald's devotion to energetics. Lastly, in the laboratories at Leipzig, the foundations of the study of catalysis were well and truly laid. By no other leader in chemical science has such a wide range and variety of scientific interests been manifested.

Great, however, as were Ostwald's experimental contributions to physical chemistry, his work as teacher and as champion of what might then be called the new learning (van't Hoff's theory of solutions, Arrhenius's theory of electrolytic dissociation, etc.) was perhaps of still greater value for the advance of science. An enthusiastic lover of his subject, Ostwald was possessed by the spirit of the missionary and the teacher. To the joy of creating and acquiring knowledge was added the equally great joy of passing on his knowledge and mental outlook to others. Ostwald was a master both of the spoken and of the written word, and once his orderly and clear-thinking brain had arranged his ideas, he could give rapid and unhesitating expression to them in clear and smooth-flowing language. His extraordinary memory, moreover, never failed to supply him with apt illustrations with which to adorn an argument.

In the early days at Riga, Ostwald collected together all that was known in the department of physical chemistry, and so gave to all serious students his "Lehrbuch der allgemeinen Chemie" (1885–1887); and in order to promote the study of physical chemistry and to provide an organ for its expression, he founded, in collaboration with van't Hoff, the *Zeitschrift für physikalische Chemie*. From that time, book after book—his "Grundriss", his "Elektrochemie", his "Hand- und Hilfsbuch", his "Grundlinien der anorganischen Chemie", his "Schule der Chemie", etc.—poured from his pen. To the all-compelling power of Ostwald's personality, to his burning enthusiasm, and to the freshness, breadth, and inspiration of his personal teaching and of his writings, physical chemistry owes a very special debt.

By the end of last century, Ostwald's interest in a specialised branch of science had developed, quite naturally as he felt, into an interest in generalised knowledge or philosophy; and, in 1902, he published his "Vorlesungen über Naturphilosophie", which attracted much attention at the time and received the warm appreciation of William James. As was natural with Ostwald, there followed on the publication of his "Vorlesungen" the founding of the periodical, *Annalen der Naturphilosophie*. So Ostwald, the apostle of physical chemistry, became the apostle of the doctrine of energy as the fundamental basis of reality.

Although Ostwald had never been much interested in industrial chemistry, he felt it to be his patriotic duty to make his country independent of others for the supply of the nitric acid necessary for the manufacture of explosives, and he turned his attention, therefore, to the production of nitric acid by the catalytic oxidation of ammonia. The process which he developed was the main source of Germany's supply of nitric acid during the War.

Ostwald was a man of large mind and large heart;

he spoke his mind freely and always put forward his views with enthusiasm and conviction, but he neither scorned nor regarded lightly the honestly held views of others. His honesty of purpose, his enthusiasms, his freshness of mind, and the variety of his interests gave to all intercourse with him a charm which impressed all those who had the privilege to partake of it. To his purely scientific interests he added an intense interest in music and painting, and the exercise of these two arts was the means whereby a tired and sometimes overwrought brain became rested and refreshed. To his interest in painting is no doubt due the interest which, during the later years of his life, he took in the theory of colour, his views regarding which he has expounded in his book, "Physikalische Farbenlehre", and in other books and memoirs.

ALEX. FINDLAY.

DR. H. T. FERRAR

THE death of Hartley Travers Ferrar at the comparatively early age of about fifty-two years was announced in London on April 19. Leaving Oundle in 1898, he entered Sidney Sussex College, Cambridge, and took a second class in the Natural Science Tripos in 1901. Besides being captain of his College boat club he rowed in the University trials, and it was when stepping out of an eight at Henley that he was offered a place as geologist to Capt. Scott's First Expedition to the Antarctic. The chief scenes of his labours on the expedition were in South Victoria Land, where the great Ferrar Glacier was named after him.

On his return to Cambridge in 1904, Ferrar was elected a fellow of the Geological Society and spent several months in writing up his observations. Living beneath the same roof with him at this time, and discussing almost daily his many problems, I learned to appreciate—possibly as few could who had not accompanied Scott—those sterling qualities that had enabled him to accomplish so much, and won him so many lifelong friends.

In the autumn of 1905, Ferrar joined the Egyptian Survey, and before Christmas had made a long camel trip into the Eastern Desert beyond Edfu. By April 1906 he was in the Western Desert (Sellima Oasis) beginning to interest himself in water-supply. In late 1907 he commenced field-work in Upper Egypt on the movements of subsoil waters, with particular reference to their effects upon cotton and other crops; and this study was extended to Lower Egypt in subsequent years. Results were published as a Survey Department paper in 1911. During 1910–11 he made a series of experiments, in association with the Department of Agriculture, on the effects of movements of the water-table on the cultivation of cotton in the Delta, in the course of which he set out many lines of tube wells and recorded thousands of observations. The experiments proved that there was (up to a limit) a steady increase in the crop yield with increase in the thickness of soil above the water-table. The findings were issued as a Survey Department paper in 1912. During this period also he visited the oil-fields.

Somewhere about 1912, Ferrar retired from the Egyptian Survey and proceeded to New Zealand, his wife's home country. The outbreak of war saw him in Egypt again, with the New Zealand Forces, and later he became an efficient map-officer attached to the Australian Flying Contingent in Palestine.

In 1919, Ferrar was appointed geologist to the New Zealand Survey (Department of Scientific and Industrial Research) in which he had risen to the position of assistant director at the time of his death. Amongst other publications, an important *Bulletin* (No. 27, New Series, 1925), written mostly by himself, "On the Geology of the Whangarei-Bay of Islands Subdivision, Kaipara Division", describes the results of the survey of 1905 square miles in North Auckland and deals largely with mineral deposits. In his latest outstanding work (*Bull.* No. 33, New Series, 1929), "On the Soils of Irrigation Areas in Otago Central", his Egyptian experiences were invaluable, as shown by his discussion of the irrigation problems. His soils are classified into series, classes and types, and such subjects as climate, drainage, soil-profile, youthful and mature soils are considered.

It was largely on the strength of this last publication that, in February last, Ferrar was awarded the degree of D.Sc. (Diploma) by the University of New Zealand. Besides his official publications, some thirty papers on different subjects were contributed to scientific journals in Great Britain, Egypt, and New Zealand.

In May 1931 old memories were revived when the *Discovery* called in at Wellington on its way to southern latitudes.

BERNARD SMITH.

WE regret to announce the following deaths:

Dr. Albert P. Brigham, professor emeritus of geology at Colgate University, president in 1918–19 of the American National Council of Geography Teachers, on April 1, aged seventy-six years.

Mr. Donald R. Dickey, a research associate of the California Institute of Technology, who was an authority on the birds and mammals of North and Central America, on April 16, aged forty-five years.

Dr. B. K. Emerson, for forty-seven years professor of geology at Amherst College, and president in 1899 of the Geological Society of America, on April 7, aged eighty-eight years.

Prof. C. S. Hastings, professor and emeritus professor of physics at Yale University since 1884 and a member of the U.S. National Academy of Sciences, a well-known designer of astronomical telescope objectives, aged eighty-three years.

Sir Thomas Legge, C.B.E., for nearly thirty years senior medical officer of factories at the Home Office and afterwards medical adviser to the social insurance section of the Trades Union Congress, who took a leading part in the promotion of industrial health in Great Britain, on May 7, aged seventy years.

The Hon. Dr. William Pember Reeves, formerly Agent-General and afterwards High Commissioner for New Zealand, who was director in 1908–19 of the London School of Economics, on May 15, aged seventy-five years.

News and Views

Christopher Borrus

IT is a tradition of the Society of Jesus that St. Ignatius, its founder, was wont to watch the heavens in order that his heart might be inflamed with the love of God from the consideration of the wonders of His work; and from almost its earliest days the Society has included men who have devoted themselves to astronomy and other sciences. Clavius, Scheiner, Grimaldi, Hell, Mayer, Boscovich, Secchi, and Perry are but a few of the men of science who have belonged to the Society. One of the first, however, was Christopher Borrus, who was born in Milan in 1583, joined the Society in 1601, and died on May 24, 1632, three hundred years ago. Like Fathers Trigault, Rhò, and Schall, he was sent as a missionary to the Far East, and wrote a valuable account of Cochin China. He made observations on the variation of the compass, and, according to Kircher, drew up the first charts of the Atlantic and Indian Oceans, showing the spots where the magnetic needle makes the same angles with the meridian. He was thus a forerunner of Halley. His explanation of the chart is contained in a manuscript which belongs to the Royal Academy of Lisbon. He also made suggestions as to a new method for determining longitude at sea. After some years spent in the East, he returned to Europe, and taught mathematics at Coimbra. His death took place at Rome shortly after he had entered the order of Cistercians.

The Varley Brothers

IN an interesting address on the brothers Varley, who did much valuable pioneering work in telegraphy and electrical engineering, Col. Lee, of the Post Office, in a lecture on May 5 to the Institution of Electrical Engineers, pointed out that the whole progress of telegraphy during the constructive period up to the laying of the Atlantic cable was largely the history of Cromwell and Samuel Alfred Varley. This year is the hundredth anniversary of the birth of S. A. Varley. Cornelius Varley, the father of the two brothers, was a well-known scientific worker, and delivered the fourth Friday evening discourse at the Royal Institution. He was a descendant of Oliver Cromwell. The first attempts to lay an Atlantic cable having failed, Cromwell Varley served on a committee appointed by the cable company which issued a most valuable report. Later on, Cromwell Varley and Sir William Thomson (Lord Kelvin) entered into partnership as consulting engineers, being joined later by Fleming Jenkin. Cromwell Varley wrote many scientific papers, one of them published by the Royal Society describing experiments on luminous phenomena which came very near to discovering the electron. Samuel Alfred Varley did much valuable work in telegraphy. During the Crimean War, he laid the first field telegraph in 1854. His greatest invention was the self-exciting dynamo, on which he had been experimenting since he was seventeen years of age. On technical grounds the priority of this invention is generally attributed to others. At the International Inventions Exhibition in 1885, he was awarded a gold medal for inventing a self-exciting dynamo. He championed the cause of the electrical industry against the Brush patent for the compound wound dynamo. Varley's precedence in the invention was upheld after an appeal to the House of Lords and the Brush patent was declared invalid. Both the brothers Varley and the late Earl of Crawford played a leading part in founding the Institution of Electrical Engineers. Among the seventy-one founder members were four of the Varley family.

Life and Work of Dr. James Murie

DR. JAMES MURIE, well known for his work on the Thames fisheries, was born on March 30, 1832, and he died in 1925. To commemorate the centenary, Mr. A. Lawrence Wells gives an interesting account of his life and work in the *Southend Standard* of March 31 last. Murie is chiefly remembered for his later work at Leigh, where he lived and did valuable service in connexion with the local fisheries, but his early career was full of adventure. Educated for the medical profession at the University of Glasgow and specialising in zoology, he first worked at the Royal Infirmary, Glasgow, proceeding to the Royal College of Surgeons in London as assistant in the Museum, where, under Prof. J. E. Queckett, he worked at comparative anatomy, especially aquatic mammals. After two years at the Museum, he travelled through Europe and made several voyages as ship's surgeon, finally joining the expedition to the White Nile under John Petherick, who was meeting Capts. Speke and Grant for exploration of the western tributaries of the White Nile. The expedition, disastrous as it proved to be as regards Petherick's party, was yet productive of much valuable zoological material, and the fish collection was declared by Dr. Gunther to be the finest ever received from that part of Africa.

ON his return to England, Murie again worked at the Royal College of Surgeons, arranging and cataloguing the collection of slides left by Prof. Queckett; then becoming prosector for the Zoological Society, and later sub-editor of the Linnean Society's publications. It was whilst working for the Linnean Society that he rented a cottage at Leigh and so began his interest in the Thames fisheries. These various employments no doubt helped in his later work, which he made peculiarly his own. Besides his practical help and constant sea-going with the fishermen, he reported on the fisheries for the Kent and Essex Sea Fisheries Committee, which required much original research. The first part of this valuable report on the Fisheries of the Thames Estuary has been published, the second part, as has been already noticed in NATURE (May 14, 1927, March 5, 1932), is partly in proof and partly in manuscript, and the whole is now in the Southend Library.

New Foreign Members of the Linnean Society

AT the meeting of the Linnean Society of London on May 12, the following were elected foreign members :—Prof. Klas Robert Fries, director of the Botanic Garden, Stockholm, who has made very important contributions to our knowledge of the flora of South America, chiefly of the Argentine, Bolivia, and Brazil. His work on the tropical American *Anonaceæ*, *Amarantaceæ*, and *Colamniferæ* (Malvales) and his monographs of *Wissadula* and *Petunia* are especially noteworthy. He has also done valuable work on the flora of Rhodesia, the Congo, etc., and has made contributions to mycology. Prof. Eduard Fischer, professor of botany at the University and director of the Botanical Institute, Bern, distinguished for his works on a wide range of mycological subjects since 1883. He has devoted especial attention to the Gasteromycetes, on which he contributed the section in Engler and Prantl's "Pflanzenfamilien". He has produced monographic studies of the Rusts of Switzerland, and carried out extensive studies of the biology of heterœcious rusts. He collaborated with E. Gaümann in the most complete work on the biology of parasitic fungi that has yet been published. Prof. Ludwig Jost, director of the Botanical Institute and Gardens, University of Heidelberg, known for his work as a teacher of plant physiology and his influence on the development of his subject. Prof. Émile Topsent, professor of zoology and comparative anatomy, University of Strasbourg, the leading authority in the world on sponges. His first paper was published in 1887, since when he has published a number of papers and several important books, including reports for the Prince of Monaco. His large quarto volume—"Campagnes . . .", Monaco, 1928—is the most up-to-date monograph on sponges.

U.S. National Academy of Sciences

IT is announced by Science Service that the following have been elected foreign associates of the U.S. National Academy of Sciences: Marchese Guglielmo Marconi; Prof. Karl von Goebel, Munich; Prof. H. Wieland, Munich; Prof. Fritz Haber, Berlin. Fifteen new members were elected: Dr. R. T. Birge, University of California, physics; Dr. E. G. Boring, Harvard University, psychology; Dr. S. R. Detwiler, Columbia University, anatomy; Dr. W. A. Jacobs, Rockefeller Institute for Medical Research, New York City, chemotherapy; Dr. D. W. Johnson, Columbia University, geology; Dr. L. O. Kunkel, Boyce Thompson Institute, Yonkers, N.Y., plant physiology; Dr. K. Landsteiner, Rockefeller Institute for Medical Research, New York City, immunology and pathology; Dr. W. C. Mendenhall, U.S. Geological Survey, geology; Dr. Marston Morse, Harvard University, mathematics; Dr. F. K. Richtmyer, Cornell University, physics; Dr. J. C. Slater, Massachusetts Institute of Technology, Cambridge, Mass., physics; J. R. Swanton, Bureau of American Ethnology, Washington, D.C., anthropology; Dr. R. J. Trumpler, Lick Observatory, Mt. Hamilton, Calif., astronomy; Dr. E. W. Washburn, U.S. Bureau of Standards, and editor-in-chief of International Critical Tables, chemistry; Dr. J. B. Whitehead, the Johns Hopkins University, mathematics and philosophy.

Jericho

RECENT correspondence in the daily Press on the Exodus and its relation to the fall of Jericho was no doubt to some extent responsible for the interest taken in the account of the third season's excavations on the site of that city given by Prof. John Garstang before the Royal Asiatic Society on May 12. Although two seasons' work had produced no certain evidence of dating, Prof. Garstang on opening his third season had arrived at an opinion, based on the evidence of stratification as well as the absence of any sign of Mycenæan contact, that the conflagration which destroyed the city, and of which there is abundant evidence, had taken place during the late Bronze Age, probably somewhere about 1400 B.C. With the view of obtaining datable objects which might or might not confirm this view, the Bronze Age cemetery some four hundred yards west of the city mound was attacked and twenty-five tombs were opened and cleared. Objects numbering eighteen hundred, the great majority pottery, were obtained covering the history of the site throughout the Bronze Age. Most significant of all, however, were ninety-four royal Egyptian scarabs, which have been examined by Prof. Newberry and pronounced by him to range from the Hyksos period to the reign of Amnhotep III. Egyptian influence first appears about 1500 B.C.; but nothing of the Tel el-Amarna period and the age of Akhenaton has been found. It is, therefore, concluded that the city was destroyed at some date between 1411 B.C. and 1375 B.C. Evidence of reoccupation appears in the Iron Age; but the walls were not rebuilt until about 900 B.C.

Excavation in Southern Palestine

SIR FLINDERS PETRIE briefly summarises the results obtained by the British School of Archæology in Egypt at Tel Ajjul up to the close of the past season's excavations, in the *Times* of May 13. The results fully bear out his opinion that the early history of Palestine has been more fully explained on this site than on any other in the country. The evidence it has afforded extends from the rock-cut tombs of the Copper Age, *c.* 3400 B.C., in which copper daggers and pottery were found, to the age of Thothmes III., after whose day the site was abandoned until it was occupied again by Arab squatters in the Middle Ages. No less than five palaces were erected on the limestone hill, of which the limits were artificially extended to take the greater area covered by the later buildings. The first palace was erected by the people who introduced bronze from North Syria and whose invasion founded the Eighth Dynasty of Egypt. The second palace, Sir Flinders considers, was probably erected by the founders of the Twelfth Egyptian dynasty, while the third and fourth were the work of the Hyksos. The later Hyksos palace has afforded evidence of a foundation sacrifice in which the body of a horse was flung into a pit. Its shoulders and the bodies of two other horses afforded the

material for a sacrificial meal. One of the most noteworthy finds was a gold torque, in form similar to the torque found at Troy and presumably of Irish origin. Lectures on the work of the season are being given at University College, London, on May 19 at 2.30 P.M. and May 21 at 3 P.M., entrance free, without ticket; and the usual exhibition will be open at the College on July 11–Aug. 6.

Animals and Electric Shocks

IT is well known to electricians that animals are much more sensitive to electric shock than human beings. Quite low voltages, of the order of 20 volts, are dangerous to cattle and horses. About twenty years ago, when rural electrification began to increase on the Continent, fatalities to these animals began to occur, and it was found necessary to devise methods for mitigating the danger. As the electrification of farms has now been begun in Great Britain, the paper by T. C. Gilbert in the *Electrician* for April 29, in which he discusses some of the effective safety devices used abroad, should prove useful. Wiring systems where the 'live' wires are surrounded by metal which is connected to 'earth' are perhaps the safest, at least in towns, where the mains of the water supply system, into which any leakage currents usually flow, form an excellent earth. In rural districts, earths are made by burying metal plates or pipes. In this case the resistance of the earth may be of the order of 50 ohms, and so even if a leakage current be less than an ampere, the difference of potential of the ground near where the pipe is inserted and four feet away may cause a dangerous shock to a large animal standing with a foreleg near the pipe and a hindleg four feet from it. Mr. Gilbert records a very exceptional case where no less than six cows in one farm were killed from this cause. So far as we know, no fatalities to human beings have ever occurred in this way. We have heard of cases where mild shocks have been felt in the street, when a pedestrian steps from one part of the pavement to the other, due to a fault in an underground main. The effective methods used abroad show that the risks to cattle can be made almost negligible.

Spore Dissemination through the Upper Atmosphere

DURING the War, aeroplanes came to be used to an increasing extent for the direct investigation of meteorological conditions in the upper atmosphere. We learn from an article that forms one of the "Why the Weather" series, by C. F. Talman, issued by Science Service, Washington, D.C., that the aeroplane is being used in analogous biological investigations by the U.S. Bureau of Plant Industry to determine, among other matters, the height to which the spores of the dreaded black stem rust occur in the American spring wheat area. The spores are collected on glass microscope slides covered with a very thin coating of vaseline. It has been found that they extend up to a height of about 10,000 ft. above the earth. From the results of other investigators on the rate of fall in still air of the spores of white-pine blister rust, a spore only slightly smaller than the black stem rust spore, it may be concluded that the black rust spores would occupy about two days in falling from 10,000 ft. to the ground, in the absence of any net upward or downward component of the wind. Since it is no rare event for the wind above the first few hundred feet to travel a thousand miles or more in a day, it is evident that regions lying far to leeward of infected areas may receive spores from these great altitudes.

Cave Exploration in Western China

THE United States National Museum has received a large collection of objects which have been obtained from the caves of Szechwan, Western China, by Mr. David C. Graham, of the Smithsonian Institution, Washington, D.C. This explorer has found that a large number of the innumerable caves of Szechwan and the Tibetan border were used as tombs by the Chinese at about the beginning of the Christian era; but no evidence is forthcoming to support the view that they were once inhabited by aborigines who preceded the coming of the Chinese. The caves are generally found in steep places, both singly and in groups. They are difficult of access, and vary in depth from a few feet to 130 feet, being about six feet wide and six feet high. Some show signs of chisel marks. Nearly all the caves have coffin niches, the coffins being of earthenware. Some coffins, however, are merely cavities chiselled in the stone and fitted with stone lids. Among the funerary offerings, the large number of figurines of human form is noteworthy. Some of these in costume and general appearance present a remarkable similarity to the people of to-day.

Norman Lockyer Observatory

SIR FRANK DYSON, Astronomer Royal, will open the new Mond photographic equatorial and dome at the Norman Lockyer Observatory, Salcombe Regis, Sidmouth, on May 28. The Norman Lockyer Observatory is the only astronomical observatory in Great Britain founded and maintained by a private corporation under the Companies (Consolidation) Act of 1908. Since it was started, nearly twenty years ago, it has been equipped and maintained entirely by private donations. The equipment includes two twin telescopes, one with a 10 in. object glass and a 12 in. prismatic camera, and the other with a 10 in. object glass and a 9 in. prismatic camera for photographing the spectra of stars and other celestial bodies. A very large collection of such photographs, numbering 6500, has already been taken at the Observatory, affording valuable records of the nature and movements of objects in the stellar universe. Dr. Robert Mond, who has been a generous supporter of the Observatory since it was founded, has now presented a unique photographic equatorial, with a separate building and dome to house it. The instrument consists of a battery of four cameras with clock mechanism, so that it will be possible to follow automatically movements of the heavens over a wide field of the sky.

Expeditions of the Soviet Academy of Science

THIS year the Soviet Academy of Science is sending out ninety-nine scientific expeditions to explore

remote regions of the Union, including the Kola peninsula, the Ural-Kuznetsk Basin, Transbaikalia, the Turukhan region, East Sayan, the Irkutsk region, the Minusinsk region, Buriat Mongolia, and Tanu-Tuva, also the salt and soda lakes of the Kulundin steppe in western Siberia. Aeroplane photography will be used to establish the extent of the Siberian forests. The expedition to Kazakstan is to explore the natural resources of the Karagandin, Koundar, and the Dzeskazgan regions of the Altai and Ridder, and to investigate the possibility of reconstructing the agriculture of north Kazakstan. Seventy-five detachments are starting for Central Asia to explore the natural resources of Tadzhikistan, Turkmenia, Uzbekistan, and Pamir. It has been decided to start to explore this year the natural resources of Khirghizia, which possesses much potential hydraulic power and big deposits of ferrous and non-ferrous metals, and has suitable lands for cattle-breeding. The expedition to the Crimea is to concentrate on the exploration of the salt lakes. The expedition to Transcaucasia will examine the possibilities of utilising hydraulic power in the region, that to the northern Caucasus is to explore the deposits of rare elements such as cadmium and the mineral resources of the main ridge of mountains of the region. In Balkaria an investigation will be made of the soil of the mountain grass-lands. To cover the cost of the expeditions, the Government has allocated six million roubles, and additional sums will be supplied if necessary. These expeditions are to follow up previous exploration work carried out by the Academy of Science in the Yakutsk, Buriato-Mongolsk and Transbaikal regions, which resulted in the discovery of medicinal and other plants suitable for export, and of new areas for rice-growing.

Buildings for Science Departments

AT the instigation of the British Science Guild, the Royal Institute of British Architects has undertaken an inquiry into the design of science departments with the view of affording guidance in the matter of accommodation, fittings, finishings, and supply services. An elaborate questionnaire has been drawn up in convenient column form asking for particulars of the sizes of rooms for definite numbers of students, their aspect, wall and floor surfaces, and various laboratory fittings considered desirable. Replies are to be sent to Mr. Alan E. Munby, Science Standing Committee, Royal Institute of British Architects, 9 Conduit Street, London, W.1. Science departments, of course, fall into different categories, and the present inquiry is confined to provisions for higher teaching and research and has been sent to the heads of departments of the universities of the British Empire and certain research institutions. Should an analysis of the returns justify it, the Council of the Royal Institute of British Architects may issue a short report which would put architects and engineers into closer touch with the specific needs of science departments. There can be little doubt that, given adequate response, the questionnaire will give designers of new science departments a valuable body of data on which to base their work.

Mice Plague in Australia

PROF. W. A. OSBORNE, University of Melbourne, sends us the following cutting from the Melbourne *Argus* of March 30, dealing with the present mouse plague in Victoria, Australia: "After all wheat had been trucked from the Lah railway station, near Warracknabeal, a raid was made upon the mice. The site was fenced, and two 40-gallon oil drums were sunk in the ground. The dunnage was then cleared and the mice driven into the drums. On the first night the catch, placed on the weighbridge, weighed one ton, and on two successive nights 8 cwt. and 10 cwt. were caught, the weight for the three nights being nearly two tons." Prof. Osborne informs us that the greatest visitation of these pests occurred in 1917, when enormous stacks of bagged wheat remained in various railway sidings. The plague was first noticed in February and March of 1917; it was at its acme between April and August of the same year. At Lascelles, three tons, approximately 200,000 mice, were caught in one night. Until the end of June 1917, the recorded total caught was 544 tons, at least 32,000,000 mice.

International Congress of Scientific Management

THE Fifth International Congress of Scientific Management will be held at the Koloniaal Instituut, Amsterdam, on July 18-23. The subjects to be discussed include costing, markets, technical and mental education of foremen for rationalisation, systems of promotion, rationalisation as a part of education, costs of retail distribution, agricultural labour, and rationalisation in various types of industry. Papers from many countries have been contributed through the national associations or committees and are being published in two volumes in advance of the meeting; summaries only will be read at the sessions of the Congress. Excursions in Amsterdam, to Eindhoven, the Zuider Zee, and to Rotterdam are being arranged, and continental railways are giving special facilities for those attending the Congress. The general secretary for the Congress is Mr. V. W. van Gogh, Herrengracht 209, Amsterdam—C. English visitors can obtain particulars from the honorary secretary, Institute of Industrial Administration, 44 King William Street, London, E.C.4.

South-Eastern Union of Scientific Societies

THE thirty-seventh annual Congress of the South-Eastern Union of Scientific Societies will be held in London, at the Civil Service Commission, Burlington Gardens, W.1, on June 1–4, under the presidency of Dr. R. E. Mortimer Wheeler. The presidential address, on "Field Archæology in Great Britain", will be delivered in the evening of the first day of the Congress. The sections, their presidents, and the subjects of the presidential addresses are as follows: archæology, Dr. W. E. St. L. Finny, "Medieval Games and Gaderings"; botany, Mr. J. Ramsbottom, "Fungi as Scavengers"; geology, Prof. H. L. Hawkins, "The Structure of the South-East of England"; zoology, Mr. Hugh Main, "The Camera as a Naturalist's Recorder"; regional survey, Mr. G. L. Pepler,

" Town and Country Planning ". Evening lectures will be delivered by Sir Arthur Thomson, on " The Drama of Animal Life ", and by Capt. Guy Dollman, on " Great Game Animals of Africa ". There will be an exhibition of regional survey material under the supervision of Miss E. W. Spear; and a number of excursions of specialised interest, as well as others of more general appeal, have been arranged. The honorary general secretary of the Congress is Mr. E. A. Martin, 14 High View Close, Norwood, London, S.E.19.

World Power Conference

A SECTIONAL meeting of the World Power Conference will be held in Scandinavia on June 26–July 10, 1933. All countries represented on the organisation are invited to attend and take part in the discussions, which will be mainly in connexion with large factories taking power in bulk and traction. The iron and steel industries, railways, and marine transport will be specially considered. Many attractive excursions have been arranged, and receptions will be held in Copenhagen, Stockholm, and Oslo. A contingent will also make a visit to Finland by aeroplane. In a bulletin issued from the office of the World Power Conference, 63 Lincoln's Inn Fields, W.C.2, D. N. Dunlop, the president of the International Executive Council of the Conference, contributes an interesting article on its functions. He says he has little belief in the ability of politicians and bankers by themselves to solve the problems that at the present moment menace our civilisation. By 1933 the immediate problems will probably have changed, but no real beginning to economic reconstruction can be made until the nations of the world embark on a rational policy for the organisation of production and distribution. The world needs practical vision. Without this, what we have already brought about in the way of technical and scientific co-operation may be swept away. The scientific and technical industries of the world are the result of the creative activity of men of all nations; it is on us that there now falls the task of seeing that this activity is fully utilised.

Announcements

THE Lister Medal for 1933 for distinguished contributions to surgical science has been awarded by the Royal College of Surgeons to Sir Charles Ballance, who will deliver the Lister Memorial Lecture at the College on some date in 1933.

IT is reported by the Madrid correspondent of the *Times* that a great part of the University of Valencia was destroyed by fire on May 12. Much damage was done, the astronomical observatory and the faculties of natural history, physics, and chemistry, with their collections and laboratories, being destroyed. Most of the contents of the library have apparently been saved.

THE need of qualified people, able to interpret scientific thought and activity so as to make it available to a larger public, has led the School of Journalism of Paris (part of the Institut des Hautes Études) to arrange a course of lectures on scientific journalism. It is intended both for students and for practising journalists. The lecturer, M. René Sudre, scientific editor of *Le Journal*, is well qualified for his difficult task. The journalistic profession will certainly benefit by its realisation that scientific reporting is a branch of journalism that requires special training.

A CATALOGUE (No. 19) of some 321 second-hand books on gardening and botany has reached us from Mr. J. H. Knowles, 23A Beulah Hill, S.E.19.

THE latest catalogue of Messrs. Dulau and Co., Ltd., 32 Old Bond Street, W.1 (No. 199), relates mainly to second-hand botanical books and periodicals, herbals, floras, and general natural history. There is also a section of interesting miscellaneous works. Copies may be had free upon application to the publishers.

AN interesting catalogue (New Series, No. 27) of upwards of 800 second-hand books on gardening (including herbals), agriculture, and husbandry (1481–1800) has just been issued by Messrs. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2. Many rare volumes are offered for sale, and useful bibliographical notes are appended to some of the titles.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A teacher of chemistry for day and evening classes at the Wandsworth Technical Institute—The Secretary, Technical Institute, Wandsworth (May 25). A full-time teacher of engineering subjects at the Acton Technical College —The Principal, Technical College, Acton, W. (May 27). A Graham scholar in pathology in the University of London—The Academic Registrar, University of London, South Kensington, S.W.7 (May 29). A lecturer in mechanical and aeronautical engineering at the Northampton Polytechnic Institute—The Principal, Northampton Polytechnic Institute, St. John Street, E.C.1 (May 31). A lecturer in production engineering in the Department of Mechanical Engineering of the Birmingham Central Technical College, and a lecturer in building and allied subjects in the Department of Building and Structural Engineering —The Principal, Central Technical College, Suffolk Street, Birmingham (June 3). A joint professor of mining in the University of Glasgow and the Royal Technical College, Glasgow—The Secretary, University Court, The University, Glasgow, W.2, or The Secretary, Royal Technical College, Glasgow (June 11). A secretary of the Chartered Surveyors' Institution—The Hon. Secretary, Chartered Surveyors' Institution, 45 Parliament Street, S.W.1 (June 20). A Tennent professor of ophthalmology in the University of Glasgow—The Secretary, University Court, University, Glasgow. A woman temporary lecturer in mathematics at the Lincoln Training College—The Principal, Training College, Lincoln. A director of the West of Scotland Neuro-Psychiatric Research Institute, Glasgow—The Secretary, Hawkhead Asylum, Crookston, Glasgow.

Letters to the Editor

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Suggested Wireless Observations during the Solar Eclipse of August 31, 1932

AT a recent Geophysical Discussion at the Royal Astronomical Society (an account of which has been published in the March issue of the *Observatory*) the possibility of deriving information concerning the nature of the solar radiation responsible for upper-atmospheric ionisation by means of wireless observations made during a solar eclipse was discussed by us. It is known that the agents principally responsible for the ionisation in both of the atmospheric ionised layers travel rectilinearly, so that both ultra-violet light and swiftly moving neutral particles may be considered as possible causes. Because of the difference in velocity with which these two types of radiation travel, it turns out that there are important differences in the incidence in time and place for what may be called the 'optical eclipse' and the 'corpuscular eclipse', when the moon cuts off the solar stream from the earth.

In consequence of the motions of the moon and the earth, the stream of supposed neutral particles will be interrupted more than an hour before the ultra-violet light is stopped; the eclipse effect on the incidence of the neutral particles may, in fact, be entirely over before the optical eclipse begins. The eclipsed region in the case of the particles will also be much to the east of the optical eclipse track. The difference between the two eclipses, in time and space, will depend on the velocity of the particles; if this is assumed to be 1000 miles/sec., as suggested by E. A. Milne's theory of emission of solar particles, the difference in time is about two hours.[1]

In consequence of the marked difference between the eclipse effects on the two kinds of solar radiation, wireless observations on the equivalent height and reflection coefficient of either ionised region, continued through the eclipse period, are well suited to decide between alternative hypotheses as to the cause of their ionisation, since abnormal effects would be expected in either case, due to the temporary cessation of the production of ions. In the case of ultra-violet light this effect would be most marked in the region of the optical eclipse and immediately after totality, while in the case of neutral particles the maximum effect would occur earlier and in a different region.

In the solar eclipse of 1927 in Great Britain the experiments made by one of us have been interpreted as supporting the view that ultra-violet light is partly if not wholly operative in the lower region, since a partial return to night-time wireless conditions was experienced round about optical totality. But the possibility of fortuitous variations in the ionised layer cannot be entirely ruled out, and it is highly desirable that more numerous observations of a similar character should be made. The known great variability of upper-atmospheric conditions renders it important that check observations should be made outside as well as inside the areas of both optical and particle eclipses.

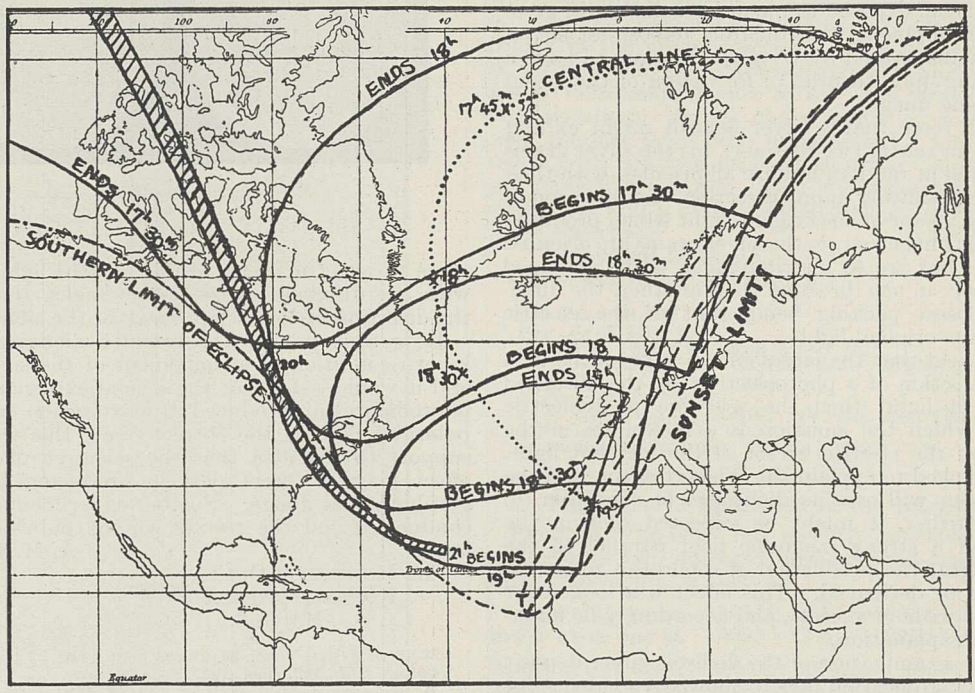

FIG. 1.

We wish to direct attention to the excellent opportunity afforded by the solar eclipse of Aug. 31, 1932, for testing this point. By the courtesy of the Royal Astronomical Society, we are enabled to reproduce here a map (Fig. 1) made by Mr. J. C. P. Miller, in which the corpuscular eclipse on this occasion is indicated, on the above assumption as to the speed of the particles. The eclipsed region, at various times, and the central line, are shown; all the times are G.M.T. The shaded band is the track of optical totality. Special wireless observations at a site on the track of the optical eclipse are to be made in Canada under the joint auspices of the Canadian National Research Council and the Physics Department of McGill University, Montreal, but these should be supplemented by observations at as wide a network

of stations as possible within or near the belt of the corpuscular eclipse.

We shall be glad if anyone who is able to make observations of either a simple or more ambitious character on this occasion will communicate with the first mentioned below. In this connexion we may add that, in the case of the 1927 eclipse, wireless observations of great value were obtained with apparatus of modest character, a simple galvanometric record of signal intensity being obtained.

E. V. APPLETON.

Wheatstone Laboratory,
King's College, London.

S. CHAPMAN.

Imperial College of Science
and Technology, London.

[1] *Monthly Notices*, R.A.S., vol. 92, March 1932, pp. 413-422.

Photodichroism Produced by α-Particles

A PHOTOGRAPHIC plate of specially prepared fine grain emulsion, exposed to plane polarised light, gives rise on development to a dichroic deposit of silver. This effect, discovered by Weigert,[1] appears to have a vital bearing upon theories of formation of the latent photographic image.

It would seem that a silver deposit might exhibit dichroism for one of two reasons: (*a*) the silver grains are scattered at random but are all oriented with their longest axis pointing in one direction, the direction of the electric vector of the original light which produced the dichroic image; or (*b*) the silver grains are oriented at random but are so distributed as to be arranged more densely in one direction than another, the direction of closest packing being that of the electric vector of the original light.

If it be held that the latent image is produced as a result of ejection of a photoelectron by the absorbed quantum of light, then the selective photoelectric effect, in which the emission is a maximum in the direction of the electric vector of the incident light, may be invoked to explain the Weigert effect, and the silver deposit will owe its dichroism to condition (*b*) above. Further, it might be expected that in the presence of a strong magnetic field parallel to the incident light, the production of dichroism might be diminished or destroyed. This effect was looked for by Cotton [2] without success, and accordingly he abandoned the explanation.

Although examination of the dichroic silver deposit with high magnification fails to show any evidence for either (*a*) or (*b*), as the grains are too small for complete resolution, yet it is possible to produce, artificially, a deposit of silver grains in which the distribution is linear and approximates to condition (*b*), by bombarding the photographic plate with α-particles at a small glancing angle. With very fine grain plates each α-particle produces a track [3] consisting of a number of silver grains depending upon the residual range on impact. The spacing of the grains in a single track varies, but on the average, for the particular photographic plate used, their centres are about 0·5 micron apart. They are in a medium (gelatine) of refractive index about 1·52, so that their separation is rather larger than a wave-length of yellow light, which is rather less than 0·4 micron in such a medium.

Seen under a microscope with a twelfth of an inch oil immersion objective and a magnification of 25, the individual grains in the α-particle tracks are well resolved when the electric vector of the light by which they are seen is perpendicular, and poorly resolved when it is parallel to the length of the track. This is well shown in the photomicrographs (magnification 1350 times) in Fig. 1. In other words, the light transmitted through the gaps between adjacent particles in the α-ray track is polarised with the electric vector perpendicular to the track.

To test this further, a fine grained photographic plate was exposed for equal periods to an intense polonium source of α-rays, so that on development two adjacent portions of the plate had silver deposits of equal density, one with the α-ray tracks in one direction, and the other with the tracks in the direction at right angles to the former. The two deposits were thus formed of silver grains of which the directions of closest packing were mutually at right angles. Under these conditions it was possible to observe a very minute but distinct dichroism of the silver deposit, the optical density of the deposit being greater

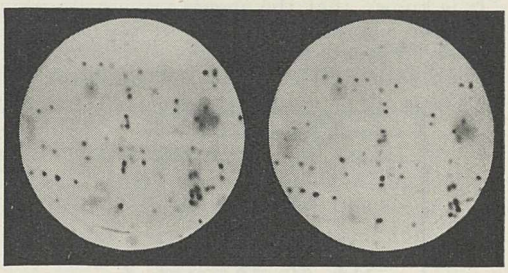

FIG. 1.

when the electric vector of the incident light coincided with the direction of the α-ray tracks, that is, with the direction of closest approach of the silver grains.

It is thus possible to produce dichroism with a known condition of arrangement of the silver grains, and it would seem that the second explanation of the photodichroism produced by excitation with plane polarised light is the correct one; this would lend support to the idea that the selective photoelectric effect plays a direct part in producing the photographic latent image. Further experiments are being conducted, and the results will be published in full later.

A. M. TAYLOR.

The Institute of Optics,
Rochester, New York,
March 3.

[1] Weigert, *Z. wiss. Phot.*, **30**, 95 and 177; 1931.
[2] Cotton, *C.R.*, **189**, 599; 1929.
[3] M. Blau, *Ber. Akad. Wiss. Wien*, **139**, 2A, 328; 1930.

Stark Effect for Argon

THE Stark effect on argon lines has earlier been investigated by E. Böttcher and F. Tuczek [1] and by W. Steubing.[2] These investigators have worked with relatively small electrical field strengths, 26 kv./cm. and 38 kv./cm. respectively, and could not observe any effect. Using higher field strengths ($E_{max.}$ about 170 kv./cm.), T. Takamine and N. Kokubu [3] succeeded in showing some very small displacements, towards the red of the violet lines, belonging to the so-called 'red spectrum' of argon, the structure of which was unknown at that time. The series analysis of this spectrum was given by K. W. Meissner [4] and F. A. Saunders.[5] From this we now notice that the affected lines observed by Takamine and Kokubu all belong to the principal series. It was to be expected that these lines would be very little displaced, whereas on the subordinate series lines a greater influence of the electrical field would be anticipated. Probably owing to deficient intensity, these lines have

not been observed. For this reason I made an attempt to investigate the electrical effect on these lines.

The source of light was a Lo Surdo tube of the same type as earlier described by me.[6] The light was analysed by a plane diffraction grating spectrograph, constructed by Prof. J. Koch. The grating, having an effective surface of 8 cm. × 5 cm., was ruled at the National Physical Laboratory at Teddington. Using autocollimation according to Littrow, the light from the slit was made parallel by a large Zeiss Tessar

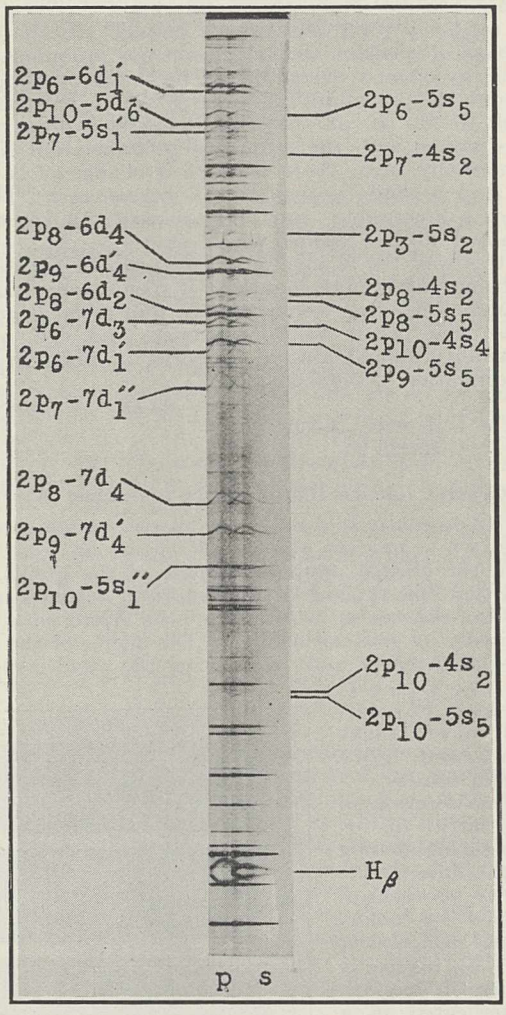

FIG. 1.—Spectrum of argon (dispersion about 14 A. per mm., magnification about 1½), maximum field 92·7 kv. per cm.

with 60 cm. focal distance and by the same lens system focused on the photographic plate. Thus brilliant spectra were produced in the first and second order. One of the photographs obtained is reproduced in Fig. 1. The maximum field strength, as determined from the Balmer lines of hydrogen, present in the discharge tube, was 92·7 kv./cm. About ninety lines, belonging to the subordinate series, have been observed in the region λλ6500-5100, and nearly all of them show greater or smaller displacements, the main part of them towards the red.

Compared with the electrical influence on the analogous spectrum of neon that was earlier investigated,[7] the displacements of the energy levels of argon in electrical fields are considerably smaller. This is intimately bound up with the hydrogen differences. The diffuse subordinate series terms $m\,d_i$ and $m\,s_1^{(j)}$ (according to the notation of Paschen for the neon terms) have appreciably larger hydrogen differences than the corresponding neon terms. Thus the magnitude of the displacements is in agreement with the rule that greater displacements correspond to smaller hydrogen differences, and conversely. The greatest shifts are observed at the most hydrogen-like terms $m\,d_2$, $m\,s'_1$, $m\,d'_1$, and $m\,d''_1$, whereas the terms $m\,d_6$, $m\,d_5$, $m\,s_1'''$, $m\,s_1''''$, and $m\,s_1''$ with the greatest hydrogen differences are the least affected. Among these terms the $m\,d_6$ are quite unaffected. For the main part of the terms, the term value decreases in the electrical field. Only two of the observed terms, $6d_5$ and $5s_1''$, increase with the field.

The large hydrogen differences give rise also to another phenomenon predicted by the theory, namely, that the displacements of the terms are proportional to the square of the field strength. This may be observed at several terms. The general view of the Stark effect for argon is quite different from that observed in the helium or neon spectrum. In the latter, the diffuse series lines are accompanied on the violet side by combination lines of the type $2p_i$-mf, $2p_i$-mg, etc., forming characteristic groups. There are no such groups in the argon spectrum. The position of the $2p_i$-mf lines may be computed from the known terms,[8] but no combination lines at all have been observed with certainty. Among the s_i terms ($i = 2, 3, 4, 5$) a great number have been investigated. They all decrease with the field strength and the displacements are remarkably large. The investigation is being carried on, and a more detailed account is to be published elsewhere.

NILS RYDE.

Physical Institute,
University of Lund, March 8.

[1] *Ann. Phys.*, **61**, 107; 1920.
[2] *Phys. Z.*, **23**, 427; 1922.
[3] *Proc. Math. Phys. Soc., Tokyo*, **9**, 405; 1918.
[4] *Z. Phys.*, **37**, 238; 1926: **39**, 172; 1926: **40**, 838; 1927.
[5] *Proc. Nat. Acad.*, **12**, 556; 1926.
[6] *Z. Phys.*, **71**, 124; 1931.
[7] J. S. Foster and W. Rowles, *Proc. Roy. Soc.*, **123**, 80; 1929. N. Ryde, *Z. Phys.*, **59**, 836; 1930.
[8] E. Rasmussen, *Naturwiss.*, **18**, 1112; 1930.

The Auroral Spectrum in the Infra-Red

PROF. L. VEGARD [1] has recently reported the observation of two infra-red lines or band-heads in the auroral spectrum, namely,

a strong one at λ7883 ± 12 A. ν12682 ± 20 cm.$^{-1}$.
and a weak one at λ8095 ± 12 A. ν12350 ± 20 cm.$^{-1}$.

Pointing out that, since the spectrum shows bands of the N_2 second positive system strongly, it might also be expected to contain bands of the N_2 first positive system, Prof. Vegard calculates the positions of three bands of the latter which are within a few Ångström units of the stronger auroral line λ7883, and points out that one of the three corresponds to an improbable transition, but leaves open the question as between the other two.

The main object of the present letter is to correct the numeration used in Prof. Vegard's, and eliminate another one of the three calculated bands.

Poetker's observations [2] in the far red and near infra-red region of the first positive system required a revision of the vibrational quantum numeration first given by Birge [3] and now employed by Prof. Vegard. The correct numbering is obtained by diminishing Prof. Vegard's n_2 by unity to give v'', his n_1 being identical with v'. Birge's revised band-head formula [4] is

$$\nu_{\text{head}} = 9518{\cdot}59 - (1718{\cdot}40v' - 14{\cdot}437v'^2 - \ldots) - (1446{\cdot}46v'' - 13{\cdot}929v''^2 - \ldots),$$

and the v',v'' numeration of the three bands *calculated*

by Prof. Vegard is: 1, -1 (λ7885), 7,6 (λ7896), and 12,12 (λ7863). The first of these is meaningless. The third is improbable, since 12,12 is remote from the course of the Condon intensity curve in the v',v'' scheme of the band system. Only the 7,6 band need therefore be considered. A band near the computed 7,6 position was *observed* in N_2 by Croze [5] at λ7887, ν12676 and by McLennan, Smith, and Peters [6] at λ7894, ν12666; both of which are within the observational error of Prof. Vegard's strong auroral line or band-head.

The N_2 first positive band nearest to the weak auroral line or head, λ8095, is the 6,5 band observed by Poetker at λ8047·2, ν12423·2; the difference is much bigger than the estimated error of observation of the former; this therefore remains unidentified.

The idea of the presence of N_2 first positive bands in the auroral spectrum is not new. About ten years ago, I think, Lord Rayleigh (unfortunately I cannot now turn up the actual paper) suggested that the auroral line or band λ6320·1, ν15818, might be identified with one of the first positive bands which appear especially strongly in the spectrum of active nitrogen, namely, the 10,7 band λ6321·1, ν15815·7.

W. JEVONS.

Military College of Science,
Woolwich, April 28.

[1] NATURE, **129**, 468, March 26, 1932.
[2] *Phys. Rev.*, **30**, 812; 1927.
[3] *Phys. Rev*, **23**, 294; 1924: and *N.R.C. Bulletin*, No. 57.
[4] "Int. Crit. Tables", **5**, 415; 1929.
[5] *Comptes rendus*, **150**, 860; 1910.
[6] *Trans. Roy. Soc. Canada*, **19**, 39; 1925.

Sound-change and Indeterminism

THE recent tendency towards indeterminism which is apparent in the natural science of to-day raises the question whether it would not be equally profitable to adopt a somewhat similar attitude in considering the most difficult of all the problems of the science of philology: Why do changes in language take place? In this letter I wish to put forward the suggestion that, of those sound-changes usually known as 'spontaneous', in which one sound of a language (which we may call X) gradually changes to another (Y), some at least may be due to pure chance. At a given period in which the sound X is present in the language let us consider the pronunciation of the children learning to acquire this sound. While the majority will acquire a pronunciation X identical with that of the earlier generation, some will acquire slightly 'erroneous' pronunciations (X', X'' . . . etc.), that is, pronunciations differing slightly from that of the majority.

In attempting to explain changes of the type considered here it is usually assumed that, at the moment when the change is commencing, there is some *a priori* reason (physiological or otherwise) why there should be a tendency towards a particular erroneous pronunciation; in this case towards a pronunciation X_1, erring slightly in the direction of the sound Y. I suggest, however, that the change can be explained without the assumption of such an *a priori* reason. We know, from the theory of probability, that, even if there is no such *a priori* reason, the erroneous pronunciations X', X'' . . . etc. will not be equally represented. But so long as the number of speakers with any one of these erroneous pronunciations is not abnormally high, there can be no tendency towards a change in the sound X in the language as a whole. Suppose, however, that *by chance* we have an exceptionally high proportion of speakers with the erroneous pronunciation X_1 (just as we might have an exceptionally long 'run' on one colour at roulette), then in a comparatively short space of time the pronunciation X_1 may become the prevailing one; in other words, a change of X to X_1 will have taken place.

Let us now consider the conditions at this stage of the language. As before, there will be a certain proportion of speakers with erroneous pronunciations (X_1', X_1'' . . . etc.); of these, let us consider two: X (which has now become erroneous) and X_2 (erring still further in the direction of Y). If the proportion of speakers with any one of these erroneous pronunciations is not abnormally high, there can be no tendency towards a further change. If the proportion of speakers with the erroneous pronunciation X is, by chance, exceptionally high, this may again become the prevailing one; in this case X_1 will change back to X. If, on the other hand, the proportion of speakers with the erroneous pronunciation X_2 is abnormally high, there may be a change of X_1 to X_2 and a stage nearer Y will be reached. Thus, given a favourable 'run', it may easily happen that finally Y itself is reached via the stages X_1, X_2 . . . etc. In this way the change of X to Y can be explained as being due to pure chance. Of spontaneous sound-changes, therefore, some may be due to an *a priori* cause and others to pure chance, and the latter possibility should always be borne in mind in the investigation of these changes.

ALAN S. C. ROSS.

The University, Leeds,
March 24.

Crystal Lattice Distortion in Stretched Wire

THE process of cold-rolling or drawing certain metals is known to produce a permanent irregular departure from the normal atomic structure of the grains. I find that this type of lattice distortion occurs also in wires of constantan which have been stretched longitudinally by gradual loading. The degree of the distortion increases most rapidly as the yield-point is approached. Nickel, copper, and most alloys examined give similar results.

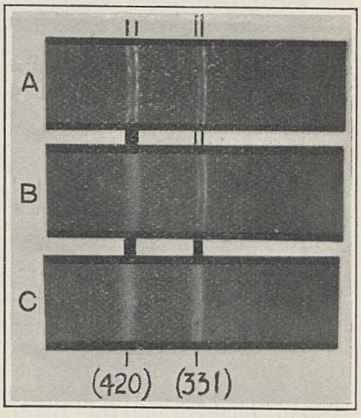

FIG. 1.

The criterion of true lattice distortion is a broadening of the lines in the X-ray spectrum formed by reflection of *monochromatic* X-rays. A change in breadth is indicated in a sensitive manner by the state of resolution of the $K\alpha_1$, α_2 components of the incident radiation. The α_1, α_2 doublets reflected by the (420) and (331) planes of constantan, photographed under identical conditions, are shown herewith. Fig. 1, *A*, is taken of the initial wire; and Fig. 1, *B* and *C*, of the wire under increasing load. It is clear by comparison that as a result of the tension the doublets in Fig. 1, *A*, diffuse into unresolved bands, and thereby illustrate the production of lattice distortion. This structural change will call for some consideration in any theory of the changes of properties of wires under tension.

A simple practical proof that these observations indicate lattice distortion and not a very fine-grained structure, which also causes diffusion of X-ray spectra,

has been highly desirable. Such evidence is provided by Fig. 1, *B*, where (1) the (420) is diffused even while the (331) line is still a sharp doublet, despite the addendum (2) that the (331) occurs at the small reflection angle where the resolution on geometrical grounds is much less. Now this means, on the small crystal theory, that the dimensions of the grains in the [331] directions are large (*c.* 10^{-4} cm.), whilst in the [420] directions they are very small (*c.* 10^{-7} cm.). These two aspects are mutually contradictory. Therefore the small crystal hypothesis is here untenable.

A similar differential resolution of the doublets has been found well marked in rolled α-brass.

W. A. WOOD.

Physics Department,
National Physical Laboratory,
Teddington, Middlesex,
April 18.

The True Weight of Benzopurpurin 4B, and the Electrical Conductivity of its Aqueous Solutions

A PAPER has recently been published by Robinson and Mills [1] in which certain properties of Benzopurpurin 4B are precisely defined. The concentration of the solutions has been determined by these authors by drying in an oven at 105° C.

The purpose of this communication is to point out that many direct cotton dyestuffs are so extremely hygroscopic that one or two per cent of moisture remains at this temperature. In the course of exact work in this laboratory on the absorption of direct dyestuffs by cellulose, Benzopurpurin 4B (amongst other dyes) has been prepared in a pure state, and the apparent dry weight determined under various conditions, with results of which the following are typical:

	I.	II.
Relative wt. air dry	113·6	114·4
„ „ dried in 110° oven for 24 hours	101·7	101·5
„ „ dried at 110° C. *in vacuo* over P_2O_5	100·0	100·0
„ „ in 110° oven again . .	101·5	101·7

The moisture content of this substance, and of the other direct dyestuffs so far examined, appears to vary continuously with the relative humidity of the surrounding atmosphere. (R.H. in 110° C. oven is of the order 1 per cent.) It appears, therefore, that the electrical conductivities and other constants given by Robinson and Mills will be in error by about 1·9 per cent, the approximate moisture regain at 105° C.

The general principles of the drying of hygroscopic substances at high temperatures are illustrated in a paper, "The Dry Weight of Cotton", by Davidson and Shorter.[2]

S. M. NEALE.
J. HANSON.

Chemistry of Cellulose Laboratory,
College of Technology,
Manchester, March 24.

[1] *Proc. Roy. Soc.*, A, **131**, p. 576; 1931.
[2] *Shirley Inst. Mem.*, **8**, p. 197; 1929.

Formation of Periodic Precipitates in the Absence of a Foreign Gel

RECENTLY many workers [1] have reported on the formation of periodic precipitates in the absence of another gel. We have obtained periodic precipitates in the slow coagulation of sols of ferric hydroxide, chromic hydroxide, and stannic hydroxide by small quantities of univalent electrolytes like potassium chloride and sodium bromate. Freshly precipitated ferric hydroxide was peptised by the minimum quantity of acetic acid, which was then boiled off; the sol was further purified by hot dialysis. The concentration of the purified sol was 39·2 gm. per litre. The chromic hydroxide sol was obtained by adding ammonium carbonate solution to hot chromic chloride and then purified by continuous hot dialysis. The concentration of the purified sol was 32·5 gm. per litre.

We obtained the stannic hydroxide sol by peptising stannic hydroxide (freshly precipitated from stannic chloride and freed from chloride) with ammonia and afterwards driving it off by boiling. The sol contained 12·4 gm. of SnO_2 in a litre.

These observations can be explained from the theory of periodic precipitation given out by Dhar and Chatterji.[2] The theory states that periodic precipitation is caused by the adsorption of the sol by the precipitate of the same substance; hence, according to this theory, periodic bands are obtained only when the sol and the precipitate co-exist. In the present case, when the sol is coagulated slowly by the addition of small quantities of univalent electrolytes, the sol and some of the precipitate coagulated from it exist together for a sufficient length of time. Hence adsorption of the sol by its precipitate occurs, giving rise to periodic bands. On the other hand, when the sol is rapidly coagulated by the addition of large quantities of electrolyte, the sol soon passes from the sol to the precipitate condition. The sol and the precipitate thus do not co-exist for a sufficient length of time. Hence no ring formation takes place.

It will be interesting to note in this connexion that we could not obtain periodic precipitates by the coagulation of the same sols with polyvalent electrolytes.

N. R. DHAR.
R. N. MITTRA.

Chemistry Department,
University of Allahabad.

[1] NATURE, **128**, 1042, Dec. 19, 1931; **129**, 205, Feb. 6, 1932.
[2] N. R. Dhar and A. C. Chatterji, *J. Phys. Chem.*, **28**, 41; 1924. *Kolloid. Zeit.*, **37**, 3, 89; 1925. *Z. anorg. Chem.*, **159**, 129, 186; 1926.

Winter in the Ionosphere

IN a recent Geophysical Discussion at the Royal Astronomical Society,[1] I suggested that there is evidence of a close connexion between the mechanisms of ionisation of the Kennelly-Heaviside and Appleton regions of the ionosphere. The evidence depends on coincidences in the annual variations of received long and short wave signals.

Hollingworth [2] reported a very abrupt change in received signal intensities measured at Slough, Manchester, Glasgow, and Aberdeen, and in polarisation measured at Slough, on wave-lengths of more than 10,000 metres, "during the last week of October and the first week of November 1924". The new mean values attained at this onset of the radio winter were maintained "until the beginning of May 1925", although the May change was much less spectacularly abrupt than the November change. The phenomenon, which I have called the Hollingworth anomaly, was repeated at the end of October 1925, and it was shown that the primary characteristic of the radio winter is the persistence of abnormal polarisation throughout the hours of daylight.

Wilkins, observing here daily from July 1931, was receiving radio telephone signals from Rome and Sardinia on the ultra-short wave-lengths of 10·06 metres and 9·8 metres respectively with fair regularity until Nov. 1, 1931. From that date no signals in the ten-metre region were heard, despite daily observation.

Hollingworth was undoubtedly dealing with waves returned from the lower parts of the Kennelly-Heaviside region—he had in fact measured the equivalent height of reflexion as about 75 km.—and Wilkins was almost equally certainly concerned with an electron

limitation effect in the upper part of the Appleton region, the electron density even in the most heavily ionised part of this region having become insufficient to 'reflect' the very high frequency waves even at grazing incidence. My suggestion was, then, that the very striking coincidence in date between the two phenomena pointed to a similarity in the mechanism of ionisation in the two regions, which must not be overlooked in discussion of the rival claims of ultra-violet light and corpuscles as the effective agents for one region or the other.

The argument is now very notably reinforced by the fact that Wilkins again heard the 10·06-metre signals from Rome, and heard also signals on 10·02 metres from Oslo (the third harmonic of a telegraph station) on May 2, 1932, daily observations throughout the ionospheric winter thus so accurately delimited having failed to give any trace of signals between Nov. 2 and May 1. The signals from Sardinia (9·8 metres) reappeared on May 6. We are without detailed long-wave data for 1931–32, but it should be remarked that 1924–25 and 1931–32 are approximately symmetrically disposed about the somewhat indefinite 1928–29 maximum of the present solar cycle, so that the comparison here made is the next best thing.

It would be unwise to infer forthwith an identical mechanism for the two regions, but clearly both involve agencies of solar origin, and both have curves of annual variation in which a six months' 'summer' gives place to a six months' 'winter', and vice versa, on dates common to the two regions. The dates are somewhat oddly displaced relatively to the astronomical reference points of solstice and equinox, yet they suggest a twelve-monthly variation rather than one related to the two equinoctial maxima of magnetic disturbance.

R. A. WATSON WATT.

Radio Research Station,
Slough, May 10.

[1] *The Observatory*, March 1932, p. 80.
[2] Radio Research Board, Report for the period ended March 31, 1929, p. 34.

The Tectonics of the Albertine Rift

IT has been represented to me that misconception with regard to this matter, so far as my own views are concerned, may arise in consequence of my passing, without comment, some remarks made by Prof. J. W. Gregory in his able review of Prof. Bailey Willis's book, "Living Africa".[1] Gregory quotes my early description of the local rift valleys correctly thus: "fracture valleys running along linear upwarps".[2] That was the view I put forward in 1921, but we have learnt a good deal since then, and Sikes pointed out to me, in 1925, that the faults I invoked to explain the Albertine rift are of a type difficult to accept, because of the immense depths from which they would have to emerge. I agreed; but this in no way weakened my general thesis. Writing to my friend Prof. Arthur Holmes, I afterwards suggested that the rift fractures rose from nearly flat soles, after the manner of the highland thrusts; but he at that time was unable to agree, and I delayed publishing this view until further evidence should be forthcoming; and then, in 1928, Bailey Willis produced his ramp hypothesis to explain the Dead Sea Valley—an explanation more complete but essentially similar to that which I had suggested to Holmes to account for the Albertine depression and the high scarps bordering it. I adopted the ramp explanation, as I stated, in Pretoria in the following year.[3]

That the Albertine Rift did not originate along the crest of a linear upwarp has now been clearly demonstrated by our studies of the riverine history of Uganda; for it is found that the eastward drainage away from the present escarpment did not commence until the rift valley appeared, and is an inversion consequent upon the uprise of the valley sides; nor did this occur at the inception of the rift. The main reversal indeed was not until late-middle or post-middle Pleistocene times, when renewed movement gave us the present scarp topography.

It is interesting to note that further evidence in support of the compression hypothesis is provided by recent petrological studies. It is brought out by Holmes and Harwood's work on "The Petrology of the Volcanic Fields East and South-East of Ruwenzori, Uganda",[4] and still more strikingly by A. W. Groves in some as yet unpublished work on rocks in the rift valley zone in Uganda, wherein he shows that crushing becomes increasingly pronounced as the rift is approached, and reaches its maximum in mylonisation in the neighbourhood of the faults. I have Dr. Groves's permission to mention this.

E. J. WAYLAND.

Geological Survey Office,
Entebbe, Uganda,
March 8.

[1] NATURE, **128**, 89, July 18, 1931.
[2] *Geog. J.*, **74**, p. 133.
[3] Vol. 2, *Compte rendu*, XV. International Geological Congress, South Africa, 1929, pp. 323-353.
[4] NATURE, **128**, 977, Dec. 5, 1931.

An Inherited Abnormality in Rhode Island Red Poultry

A SEMI-FEATHERLESS condition, associated with dwarfism, occurs in several breeds of poultry. It is usually attributed to some food or vitamin deficiency. Dakin and Hamilton described specimens in 1928 and suggested that the condition might be due to sub-thyroidism.[1]

In 1929 certain facts suggested to us that the abnormality might be an inherited character, and breeding experiments were undertaken. Three Rhode Island Red males of this type were reared and at about eleven months old appeared to be practically normal. They were mated to normal hens and produced chicks of both sexes showing every conceivable degree of the abnormality. Some were almost completely naked even at six months old, whilst others seemed almost normal throughout. Both sexes showed the abnormality, but the most extreme cases were nearly all males. All the extremely abnormal specimens died, but the less abnormal of these F_1 individuals survived, and the best of the females were mated to a male from a normal stock. This mating also produced chicks of both sexes showing every degree of abnormality. The worst of the F_1 females which survived were mated back to the parent cock to test whether such a mating would produce living offspring. The percentage hatched was as high as in a normal stock, and again every conceivable degree of the abnormality was produced.

That the condition is not due to infection or other environmental factor is practically certain, for a few birds from an unrelated stock, hatched and reared at the same time under the same conditions, showed no sign of the abnormality. It appears certain, therefore, that the condition is inherited, but the exact mode of its inheritance is not yet known. It is apparently not sex-linked.

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[1] *Proc. Zool. Soc.*, London, 1928.

Research Items

Ancient Egypt and Medieval Europe.—Interesting parallels are drawn between certain customs of ancient Egypt and those of medieval and even modern Europe by Mr. L. B. Ellis in *Ancient Egypt*, 1931, pt. 4. The 'rearing feast' given to workmen in Westphalia by the owner of a newly erected house, finds its counterpart in the sacrifice offered in ancient Egypt for the workmen who had built a tomb. The splendour of the burial equipment of Tut-Ankh Amen is not far removed in spirit from that which was responsible for the burial of Henry II. of England, according to Matthew Paris, in royal robes, crown, ring, gloves, boots of gold-work, gilt spurs, and sceptre and sword; while a bishop or abbot was buried in full vestments, and a bishop of the eleventh century had with him his liturgical comb, with which he had smoothed his beard as he approached the altar. The use of the canopic jars for the storing of the viscera is paralleled by the separate burial of the heart and of the viscera of Eleanor of Castile, and of the heart of Prince Arthur, son of Henry VII. The desire of the medieval devout to be buried, or to have a tomb, in Palestine, takes the form in Egypt of burial at Abydos, or failing that, the erection of a tomb or stele. The concern for burial in both instances is shown in the arrangement for the tomb during lifetime, as Henry VIII. contracted with Torrigiano for his tomb in Westminster Abbey. The effigies on Egyptian tombs show grandparents, parents, children, grandchildren, friends, and even a favourite dog. On Elizabethan and Jacobean tombs, married couples appear with their progeny, even those who have died in infancy. Similarities in funerary inscriptions are very close, even when the Egyptians compare themselves with their gods. Rekhmara was "Thoth in judgment, the image of Ptah, the equal of Khnum"; while Lady Cope D'Oyley, *ob.* 1633, was "Rebecca in grace, in heart an Abigail, in works a Dorcas, for the church a Hanna, and to her spouse Susanna; prudently simple, providently wary, to the world a Martha and to Heaven a Mary".

Cuna Indians' Conception of the Soul.—The significance of certain words current in the religious and magical beliefs of the Cuna Indians of Panama has recently been discussed by Baron Erland Nordenskiöld (*J. Américanistes, N.S.*, **24**). One word, *purba*, may be translated soul; but it has a multiplicity of meanings. It, or rather an aggregation of *purbas*, is a man's double, and leaves his body at death. A very old chant speaks of a man's *purba*, and of the *purbas* of his hair, his fingers, his heart, etc., leaving the body while his *purba* sits at the foot of his hammock weeping. Innumerable dangers assail it on its journey to the Empire of the Dead, where it lives for the future very much the same life as on earth, but in better and happier conditions. In some cases of illness the *purba* is carried off by demons to the home of the demons, and unless it is brought back in time the patient will die. It is common for the Kuna to speak of events witnessed by the *purba* during sleep. Thus one man saw his daughter, who had died while quite young, and, with her, her five children who had been born in the spirit world. Animals have *purbas* which are generally men, though sometimes they are animals. The *purbas* of plants are women. Stones, the sun, and other inanimate objects have *purbas*, and the *purbas* of books, newspapers, etc., burnt in front of the hut of a sick man serve to divert the attention of evil spirits who come to do him harm.

Feeding Habits of the Zebra-fish.—In the first number of this year's *Bulletin* of the New York Zoological Society (vol. 35, p. 31), C. M. Breder gives an account, illustrated with photographs, of the manœuvres of the zebra-fish (*Pterois volitans*) of the Indian Ocean in capturing prey. On the introduction of a small fish into its tank, the fish, which is vertically striped with black and white, began to wave its long exserted fin-rays, very slowly and not in unison. When the small fish came to investigate, and was in most favourable position in front of its foe, it was snapped up. Later on the zebra-fish took a more active part and would itself approach prey, waving its fin-rays; the prospective victim did not move off, but swayed from side to side in the water as if dying. This went on until the two were about an inch apart, when the small fish was seized by its foe, from which it might easily have escaped, as the zebra-fish is not adapted to active chasing. The explanation of this behaviour on the part of the prey may perhaps be the dazzling effect of a pattern of narrow stripes, which affects even the human eye; and in this connexion it may be noticed that the barred pattern in hawks is especially characteristic of the active bird-killing genera, and is rare among those which feed on prey where dazzling would be ineffective.

Sex-linked Inheritance in Ducks.—Having previously shown how the facts of sex-linkage in fowls could be turned to economic account, Prof. R. C. Punnett (*J. Genetics*, vol. 25, No. 2) has now found that the same principle can be applied to the breeding of ducks. When the common mallard (*Anas boschas*) is crossed with the Indian runner duck, the male ducklings are uniformly of a darker olive-brown than the females, thus enabling the sexes to be distinguished at an early age. When the mallard is the male parent, the ducklings of both sexes are alike and resemble the mallard. The F_2 from this cross gave two male dark brown, one female dark brown, one female light brown. The runner duck came from the East nearly a century ago, and differs markedly from the mallard in body-shape and carriage. It lays many eggs but does not brood them, while the broodiness of the mallard is dominant in the F_1 birds, as is also its habit of taking to flight. The runner is not observed to fly (see also NATURE, **126**, 757, Nov. 15, 1930).

New Observations on *Cephalodiscus*.—Up to the present, sixteen species of *Cephalodiscus*, some of them of doubtful validity, have been described. The *Discovery* Expedition collected examples of five species, two of which are described as new by C. C. John (*Discovery Reports*, **3**, 223-260; 1931). The greater part of this material was obtained in the neighbourhood of the Palmer Archipelago, the Falkland Islands, and South Georgia. The observation of Andersson (1907) that the living zooids of *Cephalodiscus* come out of the cœnœcium and creep, using the disc as a sucker, on the surface of the colony is confirmed by observations made on living specimens by Dr. Stanley Kemp. Two kinds of zooids are present in *C. hodgsoni*—red zooids, with twelve arms, which are females, and brown zooids, with ten or eleven arms, which are males. In *C. densus* a gill sac lies between the external gill opening and the pharynx. The collar pores, which have thick walls and are ciliated, lead by short canals into their respective collar cavities and control the water-currents which maintain the turgidity of the collar and arms. The author notes that during the development of a bud the notochord is very conspicuous. In *C. densus* the heart is situated not on the tip of the notochord, as in *C. dodecalophus*, but on its ventral

surface, so that the pericardium extends backwards almost parallel to the notochord. The evidence suggests that the dorsal vessel, which gives off two branches—the pharyngeal vessels—which enter the gills, conveys blood from the heart to the gills, arms, and proboscis, and that the ventral vessel returns blood to the heart. An account is given of the details of the vascular and nervous systems and of the characters of the four subgenera (one new) and of the eighteen known species. It would have been helpful to the reader to have the magnification of the figures stated.

Spike Disease of Sandal.—A study of the initial infections of spike disease in a large number of sandal plantations suggested that proximity to cultivated land tends to bring out the disease ("Investigations on the Spike Disease of Sandal, III.—Report of Progress to Sept. 30, 1931." Indian Institute of Science, Bangalore.) This suggested a study of the host range of the disease, and a wide variety of plants is being raised for this purpose. Entomological work has taken the unique form of compiling a list of some eight thousand species of insects normally found on the sandal tree; their relation to the disease in question has yet to be tested. Laboratory experiments show that arginine and cystine are present in greater quantities in healthy plants than in diseased, whilst hystidine and lysine are less abundant in the healthy specimens. The pamphlet is intended primarily as a progress report for forest officers, but more technical details of the work will ultimately be published in the *Journal of the Indian Institute of Science* or in other scientific periodicals.

Enzyme Distribution in Growing Tissues.—The micro-method of measuring minute quantities of amino-acid recently developed by Kinderstrøm-Lang and Holter has now been applied by them (*C.R. Lab. Carlsberg*, **19**, No. 6) in determining the rate of breakdown of peptides by sections (200 μ thick) cut from the roots of germinating barley. Their results are of considerable interest in that they show a maximum rate of peptide hydrolysis about 0·8 mm. behind the root tip, that is, in the region of elongation. This result is obtained when either leucyl-glycine or alanyl-glycine is employed as substrate, but the rate of hydrolysis of the former decreases more rapidly than that of the latter. In barley leaves, on the other hand, peptidase activity was less and also less variable, but it showed a steady increase from the tip of a leaf to its base.

Recent Earthquakes in the United States.—*Earthquake Notes*, for Dec. 1931, issued by the Eastern Section of the Seismological Society of America, contains some brief notes on recent earthquakes in the United States. The most important shock was that of south-west Texas on Aug. 16, 1931. Though the maximum intensity, observed at Valentine, did not exceed 8 (Rossi-Forel scale), slight damage occurred over a large district, and the shock was felt over an area of nearly 450,000 sq. miles, of which rather more than half lay in Texas and the rest in Mexico. The first analysis of the seismograms places the epicentre in about lat. 29·9° N., long. 104·2° W., or fifty miles or more to the south-east of Valentine. The Western Ohio earthquake of Sept. 20, 1931, had an intensity 7 at Anna, Botkins, and Houston, and disturbed an area of about 40,000 sq. miles. From a study of the few seismograms available, Father Joliat, *S.J.*, found the epicentre to lie on the south side of, and close to, Anna.

Effect of Pressure on Weston Standard Cells.—The effect of pressure on the e.m.f. of the Weston cadmium cell, which was investigated up to 1000 atmospheres by Cohen and Sinnige in 1909, has been followed up to 12,000 atmospheres by T. C. Poulter and C. Ritchey (*Phys. Rev.*, March 1). The experiments, which were carried out in pressure cylinders with cells contained in glass, beeswax, or rubber, confirm the older work well over the common range of the two investigations; a pressure increase from 1 atmosphere to 1000 atmospheres is accompanied by a rise in e.m.f. from 1·018 to less than 1·026 volts. For higher pressures, the results for both 20° and 30° C. lie on a single smooth continuation of the initial curves up to about 4000 atmospheres, but beyond this, while the 30° curve continues on its original course, the 20° curve rises much less rapidly, and shows little change in e.m.f. between 6000 and 10,000 atmospheres. Insufficient data exist to correlate the changes with the properties of the components of the cell, but it is clear that the effect can be neglected for most ordinary conditions of operation.

The Hall Effect in Weak Fields.—The first part of the physics section of vol. 2 of the *Memorie* of the Royal Academy of Italy contains a memoir by Drs. M. Cantone and E. Bossa on the Hall effect, particularly in weak magnetic fields. The fields are provided by coils without iron and range from 0·020 to 800 gauss, the field of the earth being compensated. The Hall effect is amplified by the use of valves and can be measured to 10^{-10} volt. In neither iron nor nickel is the effect proportional to the field below 6 gauss, but above this field the increment of the effect is nearly proportional to the increment of the field. Neither the two metals nor their alloys show hysteresis in the effect. For four samples of bismuth, for tellurium, antimony, silver, gold, platinum, palladium, aluminium, cadmium, zinc, tin, lead, tantalum, and magnesium, proportionality of effect and field holds from 0·020 to 800 gauss, while for copper, particularly if heated to a dark red and slowly cooled, proportionality ceases at 20 gauss. Compression of iron or nickel produces little change of the effect at low fields but a considerable change at high. X-rays produce considerable change of the effect in non-magnetic metals.

A Large Permanent Magnet.—Most of the work on the separation of β-rays into groups with definite energies has been done by curling up their paths in the field of an electromagnet, but now that cobalt steel, with its special properties, is available, it has become practicable to use permanent magnets, and the design of an instrument for this purpose has been published by J. D. Cockcroft, C. D. Ellis, and H. Kershaw (*Proc. Roy. Soc.*, April). It looks like an ordinary large electromagnet superficially, but the magnetising coils are used only to produce the desired remanent magnetisation. The weight is one ton, and with an air gap of 5·5 cm. and pole faces of 500 sq. cm. area, a maximum field of 2300 gauss is obtainable. The initial expense is greater than for a similar electromagnet, but there is considerable subsequent saving in power. So far, it has been used only for fields of a few hundred gauss, which it has held constant to better than one part in two thousand for several days. The great advantage of the instrument for radioactive work is that it obviates the laborious control of the current of an electromagnet, but, from the account given, it also appears to be as easy and rapid to change fields with this as with the electromagnetic type.

Spontaneous Ignition Temperatures.—An important symposium on this subject took place recently at the Institution of Petroleum Technologists. Mr. F. A. Foord, Air Ministry, described the experiments carried out by Messrs. W. Helmore and F. C. Code Holland, at the Royal Aircraft Establishment, on the ignition

characteristics of liquid fuels and chemical factors tending to accelerate their combustion. Although their conclusions were on the whole indefinite, they have shown that the problem bristles with difficulties no less complex than those associated with detonation, on which so much work has already been done; they stated, however, that the spontaneous ignition temperatures of heavy fuels are one of the chief factors affecting smooth running, ease of starting, and the general life of the engine in which they are used. Mr. J. L. Chaloner gave an account of the determination of these temperatures by various German investigators in the past, and showed that, summarily, there seemed to be considerable divergence of opinion as to whether they were indeed any criterion of the behaviour of a fuel in an engine, with specific reference to the fuel knock; obviously, in methods of experiment differing so widely as they have done, it is difficult to arrive at generally acceptable conclusions, while even the merit of the Jentzsch tester, the only developed type of spontaneous ignition meter available, has been called into question. Mr. L. J. Le Mesurier made useful comparisons of these temperatures with starting and ignition delay tests in engines, and insisted on the essential need of developing a flexible design of testing unit to ascertain its behaviour under all possible conditions, with the view of accumulating data for setting up requisite standard test conditions covering each broad class of commercial engine.

Precision Photographic Equipment.—The firm of Leitz has recently made considerable improvements in the Leica camera. This little camera takes 36 pictures on one spool of standard-sized cinematograph film. Each picture is 36 mm. × 24 mm. In the latest model, a focal-plane shutter is fitted; this is automatically wound up when the film is moved for the next exposure, so that double exposures are impossible. Interchangeable lenses may now be obtained varying in aperture from f 2·5 to f 4·5 and in focal length from 3·5 cm. to 13·5 cm. In addition to a direct vision view-finder, a tiny range-finder is fitted on the camera itself. The range-finder is coupled to the focusing mechanism of the lens, so that while the range is determined the camera is automatically focused. This coupling arrangement operates for each of the interchangeable lenses. A 'depth of focus' scale is engraved on the mount of each lens so that the depth of sharp definition at any distance and setting of the diaphragm is indicated. There should now be no difficulty in obtaining film packed specially for this camera, as both the Kodak and Selo companies are issuing film wound on special spools, and one of them is packing the film on spools which admit of daylight loading and unloading. A very extensive series of accessories specially designed for the Leica camera includes developing apparatus, printers, enlargers, projectors, stereoscopic attachment, and many others. Three accessories deserve special mention: after unscrewing the lens and its mount, the camera may be attached to a microscope in such a way that visual focusing may be carried out up to the moment of exposure: with another set of apparatus, photographs of small objects may be made at natural size, half size, or one-third size: lastly, a special apparatus for taking snapshots of surgical operations can be supplied; this is arranged with a special telescopic view-finder so that, after previous setting, the apparatus may be carried towards the object until the latter is sharply defined in the view-finder, the camera is then in focus, and its field of view is exactly the same as that observed in the finder.

Astronomical Topics

The Delporte Planet.—A Science Service *Bulletin* of April 18 describes the views of Drs. F. L. Whipple and L. E. Cunningham on this object. They have obtained a value of the period as approximately 3 years, which does not differ greatly from Dr. Kahrstedt's value of $2\frac{3}{4}$ years. But they prefer to call it a comet, not a minor planet, on the ground of its rapid decline in brightness, which certainly was much greater than would be expected in a planet. They still suggest that the body is identical with the comet Tuttle-Giacobini, seen in 1858 and 1907. The writer of this note held a similar view when the body was first discovered, but has abandoned it, on the ground that the observations of the comet of 1858 will not admit of a period much less than six years, while the present period is less than three years. Jupiter is the only planet that could produce such a great change of period, but if Jupiter had been the cause of the change, the orbit would still pass close to Jupiter's orbit, which it does not. The least distance between the orbits is about two units.

Mars during the Last Two Oppositions.—*L'Astronomie* for April contains a paper with this title, by M. E. M. Antoniadi, whose long-continued studies of this planet are well known. He notes that there were some nights of superb definition. That of Sept. 20, 1909, was the best within his experience; his view of the planet with the great Meudon refractor on that night is described as a veritable revelation. The region to the south of the Syrtis Major had the appearance of being clothed with herbage; some regions, resembling forests, had a darker hue, the whole being studded with small white dots. Reference is made to a similar description by Prof. Barnard, using the Lick refractor, in 1894; and it is stated that fine detail has also been seen at Mt. Wilson. The article is illustrated with numerous drawings, which bring out certain changes that were noticed in various regions.

Greenwich Observations, 1930.—This annual volume has recently been published; it does not contain any change of system as compared with preceding years. The new sidereal clock, Shortt No. 3, was brought into use on April 1; its daily gaining rate was then 0·12^s; it diminished steadily to 0·06^s at the end of the year. The time service is based on observations with a small reversible transit instrument, reversed on every star, as the time derived from the transit-circle appears to have a systematic error. The reductions were carried out to 0·001^s, and included the short-period lunar nutation terms; the star-places of Prof. Eichelberger's catalogue were used. The mean correction to the tabular longitude of the moon (Brown's tables) was +5·08″ from observations of the limb, and +5·40″ from observations of the crater Mösting A. The correction for the sun (Newcomb's tables) was +1·64″.

Observations of solar flocculi with the spectrohelioscope form a new section of the volume; the quantities given are radial velocity, size, and distance and direction from neighbouring sunspots; also the distance of these from the central meridian; observations were made on 65 days, beginning with April 10. The volume also contains the magnetic observations, made at Abinger, and the meteorological observations. There are also measures of 176 double stars, observed with the 28-inch equatorial between 1922 and 1931; all were observed on at least three nights.

Scientific Management in Industry

FEW documents can give a clearer idea of the ramifications of rationalisation in industry to-day than the annual Report of the International Management Institute (2 Boulevard du Théâtre, Geneva). The Report for 1931, which has recently been issued, although confined to the work and internal administration of the Institute, indicates that in spite of the difficulties created by the economic depression, the interest in scientific management and rationalisation is steadily expanding and the Institute's endeavours to realise the resolutions of the World Economic Conference of 1927 are having important results.

The relation of rationalisation to the economic crisis has attracted much attention, and, in Austria, Dr. Ernst Streeruwitz has issued an important survey of rationalisation in relation to world economy, while the urgent need for economy in many quarters has raised the question of extending rationalisation methods to public administration. The drastic curtailment of public expenditure since 1930 has in many countries taken place on unscientific and haphazard lines, and the reductions are likely, while seriously decreasing the efficiency of the public services concerned, to produce no lasting economies.

Practically no machinery yet exists for the comparative study of public administration, and in most countries the idea of a special planning section continuously engaged in the improvement of great departments of State has yet to be born. Even in large scale industry, knowledge of the principles of organisation and administration is often only superficial. Useful activities are curtailed, while waste which would pay their cost many times over proceeds elsewhere unchecked. Even in the twentieth century, administrators still tend to perform surgical operations with an axe rather than with a scalpel.

The value of the Institute in this field, where widespread research is urgently required, if only as a clearing-house of information, is illustrated by the fact that the Institute receives every month more than 800 periodicals dealing with every phase of rationalisation in every country of industrial importance, and in addition, some hundred books and pamphlets are added monthly to its library. The analysis of these sources of information enables the Institute to avoid the incompleteness which characterises some of the reports included in "The Social Aspects of Rationalisation", issued by the International Labour Office.[1]

Certain aspects of the work of the Institute, including its association with the World Social Economics Congress at Amsterdam, its own annual discussion conference, and with the Department of Industrial Co-operation, organised for the first time under Section E at the centenary meeting of the British Association, have already been noted in our columns. In addition to this, various publications dealing with "Scientific Management in a Small Group of Factories", "Railway Systems: their Organisation and Management", etc., have been distributed to members, and work has been carried out for the League of Nations, the International Labour Office, the International Committee for Scientific Management, the International Federation of Consulting Engineers, and the International Chamber of Commerce.

The report demonstrates clearly that there is a widespread and definite desire for an international clearing-house of information on rationalisation. Within its narrow resources, the Institute has greatly increased the efficiency with which it is meeting that need, and the work has been increasingly accomplished by means of subscribed income. The limits of administrative economy have, however, been reached, but it appears almost certain that with continued support from its founders for a further five years, the Institute should become self-supporting so far as its general services are concerned.

The continued services of the Institute are of real importance for the more rational arrangement of the world order in the interests of the general community. As the report rightly observes: "Only by patient research leading to the gradual enlargement of exact knowledge can the world hope to win a more perfect control over the economic organisation of the machine processes which progress in the physical sciences has developed so rapidly during the past century". To persuade men of all nations to adopt a more scientific outlook on economic problems is the fundamental purpose of the Institute, and, forbidden by its statutes to participate in current political controversies, it has sought to facilitate the discovery of the essential facts or laws of the situation upon which alone, and not on political theory or dogma, a modern industrial community can effectively organise its social and economic life.

[1] Studies and Reports, Series B, Economic Conditions, No. 18.

The Idu (Japan) Earthquake of 1930

IN the accompanying map (Fig. 1), the principal faults formed during the Idu earthquake of Nov. 26 are indicated by broken lines, the most important being the Tanna fault, running nearly north and south. In the Tanna tunnel that crosses the fault 525 ft. below the surface, the west side was shifted 7 ft. 10·5 in. to the south relatively to the other side, the movement on the surface, however, being distinctly less. In the recent number of the *Bulletin* of the Earthquake Research Institute (vol. 10, pp. 261-263, 1932), the results obtained from the renewal of the trigonometrical survey are given. The earlier survey was made in 1925–26, the later in Feb.–March 1931, so that the displacements measured may fairly be attributed to the Idu earthquake. They are represented in direction and magnitude by the arrows on the map, and they show that, as in the Californian earthquake of 1906, both sides were displaced, the west side to the south and the east side to the north. Near the middle of the Tanna fault, the triangulation point at Daiba on the west side was shifted 28 in. to the south, and that at Kurodake on the east side 39 in. to the north, the sum of the two displacements being 5 ft. 7 in. It is worthy of notice that during the previous interval, 1884–1925 (including the Kwanto earthquake of 1923), the whole peninsula drifted to the north, the point at Sano being displaced 103 in. to N. 70° E., that at Daiba 24 in. to N. 7° W., that at Osaka 46 in. to N. 18° E., and that at Enasi 48 in. to N. 47° E.

Some very interesting observations have recently been made by Mr. R. Takahasi on the movements of crust-blocks in the Tanna tunnel (*Bull. Earthq. Res. Inst.*, vol. 9, pp. 435-453; 1931). The object of his measurements was to determine if movements of the crust-blocks continued after the great earthquake, possibly with some of the numerous shocks that followed it. Bench-marks were fixed to

the concrete wall of the tunnel, in both west and east sections, at intervals of 20 metres, and their displacements were measured on six occasions, the last four series (on Feb. 5–12, March 3–9, April 13–18, and July 18–24, 1931) being the most accurate. Though the changes are very minute, the curves that represent the displacements are remarkably similar. It is interesting also to notice that the principal changes occur in the sections crossed by faults or in which the strata suddenly change in strength, such weak lines forming the boundaries of crust-blocks.

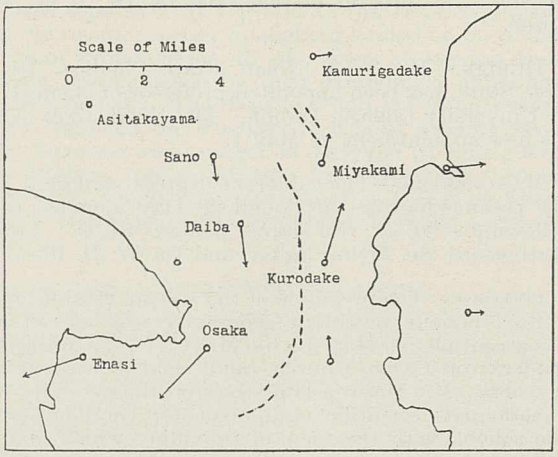

FIG. 1.

It has long been known that an earthquake may be destructive on the surface ground while, in a tunnel below, it may pass almost, or quite, unnoticed. Mr. N. Nasu has recently provided us with some useful measurements on this subject (*Bull. Res. Inst. Earthq.*, vol. 9, pp. 454-472, 1931). During the Idu earthquake, a few cracks were made in the walls of the Tanna tunnel. Otherwise it was unharmed, though in a village above, 55 per cent of the houses were destroyed. Mr. Nasu placed two similar seismographs, one in the tunnel and the other on the ground above, the rock being of the same nature at both places. During the six months that followed, fourteen strong or moderately strong shocks were recorded. If the period of the vibrations was less than one second, the amplitude was always more than twice, in one case 4·8 times, as great on the surface as in the tunnel. If, however, the period was as much as 4 or 5 seconds, the amplitudes at both stations were almost exactly equal.

Prof. Imamura and Mr. Kodaira have described some seiches that were observed in the lake of Asino-ko in the northern part of the epicentral area shown in Fig. 1 (*Japan J. Astr. Geoph.*, vol. 9, p. 115-125; 1932). The lake runs nearly north and south and is about $3\frac{3}{4}$ miles long. The limnograph near the southern end of the lake was thrown out of action by the earthquake at 4.3 A.M., but at 7.20 A.M., when it was repaired, seiches of unusual size were recorded, the amplitude at 9 A.M. being 3·5 in. and the period 6·68 min., showing that the seiches were binodal. On several other occasions, seiches were observed, usually on the days preceding swarms of earthquakes, for example, on Nov. 16, 19, and 20, when the numbers of fore-shocks on the following days were 64, 530, and 624, and on Dec. 1, 6, and 9, the numbers of after-shocks on the following days being 240, 286, and 592. The authors suggest that the seiches were caused by tiltings of the ground, which are known to precede the occurrence of earthquakes.

The tilting of the ground under different conditions is well illustrated in two recent papers (*Bull. Earthq. Res. Inst.*, vol. 10, pp. 130-144 and 145-170; 1932). In both cases, the instruments used were horizontal pendulums known as Ishimoto tiltmeters. Mr. W. Inouye describes the movements at the observatory of Mt. Tukuba. The short-period fluctuations, as well as the daily and seasonal variations, are connected with changes in air temperature, an increase in which causes a decrease in the inclination of the mountain-side. Earthquakes generally occurred when irregular fluctuations of short period interrupted the long period variations or when the directions of the earth-tilts were changing. Observations of earth-tilts were made at Ito and Kawana in the Idu peninsula from March 19 until July 12, 1930, in connexion with the swarm of earthquakes at Ito during the spring of that year. Mr. R. Takahasi shows that the tilts observed at Kawana must be attributed to changes in the tidal load, though there is some discordance, for which it is difficult to account, between the directions of the observed and calculated tilts.

The British Iron and Steel Industry

AMONG the great industries of Britain which are suffering most from the abnormal conditions of trade is the iron and steel industry, regarding which, for various reasons, many erroneous views are held. The basic facts and circumstances of the industry are described by Prof. W. A. Bone in an article in *Chemistry and Industry* for April 8, entitled "A Survey of the British Iron and Steel Industry, 1913 to 1929 and 1930–31". Referring first to a misleading view expressed in an editorial in the *Observer* for Dec. 6 last, on the changes in the relative position of the iron industry in the United States, Germany, France, and Great Britain, and the effects of fiscal policy, Prof. Bone says, "The truth is that the changes so indicated have inevitably resulted from natural causes combined with human invention and post-War territorial changes, quite independently of any fiscal conditions, and that no change in our fiscal policy can or will prevent the natural course of events".

The supersession of puddled iron by Bessemer and open-hearth steel, the opening up of immense deposits of iron ore in America, the working of the 'basic' process in Germany, the retrocession of Lorraine to France, and the comparative leanness of the iron ores of Britain are all factors which have led to other countries outstripping us as makers of iron and steel. Smelting and steel manufacture are, however, but two stages in the production of such things as railways, ships, bridges, and motor cars, and the really important question is: Which will pay us best to make, iron and steel or articles from partly imported materials?

Surveying the last nineteen years, Prof. Bone deals in turn with (1) production in 1913 and 1929; (2) a valuation of British iron and steel outputs in 1929; (3) imports of iron and steel raw materials and products in 1913 and 1929; (4) exports of iron and steel materials and products; (5) the slump since 1929; and concludes with some general considerations. In a series of valuable tables, he gives both the tonnage and the value of imports and exports, and from these it is seen that in 1913 the value of all the iron and steel products and manufactures exported from Great Britain was £111,775,000, the value of the corresponding imports was £36,175,000, leaving a balance in our favour of £75,600,000. The corresponding figures for

1929 were £160,930,000, £60,304,000, and £100,626,000. In 1929 the slump set in, affecting all the main iron and steel producing countries alike, and the world production of steel fell from 118,300,000 tons in 1929 to 93,330,000 in 1930 and 69,590,000 in 1931. In the United States, with its high tariff, the fall was no less than 54 per cent. At the conclusion of his survey, Prof. Bone remarks that, "in view of the foregoing facts, which demonstrate beyond dispute not only how great has been the value of our vast export trade in iron and steel commodities within recent years, but also the ineffectiveness of tariffs to protect a country against the effects of a world-wide 'slump', the Government may well hesitate about adopting any measures calculated to raise steel prices to home consumers". "Some temporary measure of relief may be necessary to tide over the present emergency, but such measures should be safeguarded so that the dependent export industries shall not suffer through enhanced prices."

The Plant in Relation to Water*

THE study of plant life in arid regions has more than an academic interest. It throws important light on the relation of plants in general to their water supply. All things being equal, the plant is most valuable to man either as a crop or as forage when it gives the greatest yield with the least expenditure of water.

An arid region is not constantly hot and dry. It is one of extremes of climate. Plants growing there are not always faced with water shortage; at times they have enough and to spare. Nor are they always growing under a high temperature; extremes of cold have to be met as well as heat. The plants growing in dry regions are not of uniform type but very varied. A large proportion of the species are not drought resistant at all, and grow flowers during occasional dry spells, then die off. The succulent type, familiar through the cacti, with great stores of water which they expend very slowly, are peculiar and very rare in the natural flora of many dry countries. In Australia they are practically absent, and it is only a strictly limited area of light rainfall country that is threatened by the pest pear, not the great arid areas in South, Central, or Western Australia. The seriousness of the prickly pear is its menace to land that is good pastorally, not the danger to the more arid parts.

The various hard-leaved shrubs and trees of the dry country flora are plants of a type suited to climatic extremes. A curious feature of the Australian flora is that the shrubs and trees over most of the continent are of the hard-leaved type. This is the case even in the Sydney district, where the rainfall is good and the loss by evaporation annually is less than the rainfall. The hard-leaved structure does not mean that these plants are necessarily economical of water all the time, but that they can undergo more or less prolonged dry periods without injury.

In studying the drought resistance of various crop and fodder plants, some surprising results have emerged so far as the water requirements are concerned; thus, lucerne is about three times as lavish with its water as is sorghum in order to produce the same weight of dry material. The fact is that no single basis for drought resistance is known. The success or failure of a plant for economic purposes cannot be judged by its economical use of water alone. Even more important is its ability to remain active while water is running short and to survive dry spells.

* From the presidential address to the Linnean Society of New South Wales delivered by Prof. T. G. B. Osborn on March 30.

University and Educational Intelligence

CAMBRIDGE.—Dr. G. P. Bidder has given 5000 lire, with the promise of a like sum next January, for the benefit of the occupants of the Cambridge table at the Zoological Station at Naples.

Mr. N. F. Mott, of Gonville and Caius College, has been appointed University lecturer in the Faculty of Mathematics.

The General Board has, on the recommendation of the Faculty Board of Mathematics, conferred the title of Stokes lecturer in mathematics on Dr. P. A. M. Dirac.

DUBLIN.—Dr. T. J. Nolan, State Chemist, Irish Free State, has been appointed professor of chemistry in University College, Dublin. Dr. Nolan took over his new appointment on May 1.

MANCHESTER.—The honorary degrees conferred at the commemoration of Founders' Day included the following:—D.Sc.: Sir James Jeans; LL.D.: Lord Rutherford, Sir Arthur Salter, and Dr. W. D. Ross.

OXFORD.—The preamble of the statute establishing a final honour school of geography was moved in Congregation on May 10 by Mr. C. G. T. Morison, student of Christ Church, and carried without a division. Mr. Morison laid stress on the necessity of an adequate scientific equipment for candidates in the school, with the view of providing which many different bodies have had to be consulted. The establishment of this examination will remove certain disadvantages under which graduates of Oxford have suffered in comparison with those of other universities.

THE Rockefeller Foundation, New York, U.S.A., has published the twentieth series of "Methods and Problems of Medical Education". It deals with many departments of study in medical schools in all parts of the world. The volume contains a number of admirable illustrations of the buildings and laboratories described, in many cases accompanied with plans to scale. The articles are not copyrighted, and may be reprinted or utilised in any manner without permission.

THE first award of the Swan Memorial Scholarship, established as a national memorial to Sir Joseph Wilson Swan, will be made this year by the council of the Institution of Electrical Engineers. The Swan Memorial Fund, the interest from which is devoted to the scholarship, was subscribed through the initiative of a committee composed of representatives of the County Borough of Sunderland, which was Swan's birthplace, and the Institution of Electrical Engineers. The scholarship has an approximate value of £140, and is tenable for one year. Candidates must be British subjects, less than twenty-seven years of age on July 1, and preference will be given to those associated with the County Borough of Sunderland. Awards of the following scholarships will also be made this year:—Duddell Scholarship: annual value £150 for three years, age limit, nineteen years; Ferranti Scholarship, annual value £250 for two years, age limit, twenty-six years; Silvanus Thompson Scholarship, annual value £100 and tuition fees, age limit, twenty-two years, for two years, for works employees. Applications (specifically mentioning the name of the scholarship) for particulars of any of these scholarships should be addressed to the Secretary of the Institution, Savoy Place, London, W.C.2.

Calendar of Geographical Exploration

May 22, 1739.—The Ainu Race

Capt. Spangberg left the harbour of Bolshaya Reka in Kamchatka on a journey to Japan. The Russian Government had sent him out in 1738 on one of the numerous northern expeditions organised about that time. Drift ice prevented anything but a survey of the Kurile Islands to lat. 46° N. in the first year. But after wintering in the above harbour, Spangberg with a companion vessel commanded by Walton, though separated by fog and storm, reached Japan. On the return journey Spangberg landed on an island north of Nippon in lat. 43° 50′, where he saw the Ainu people, distinguished by their exceedingly abundant growth of hair. The Japanese and the Ainu everywhere received the Russians in a most friendly way. The Japanese archipelago, as surveyed by Spangberg and Walton, was so different from the maps then in use in St. Petersburg that doubt was cast on their results and Spangberg was ordered to make a second voyage.

May 22, 1795.—Mungo Park on the Niger

Mungo Park, then twenty-four years old, left England for the first of his African voyages of exploration. He had previously sailed as a surgeon to Sumatra and had considerable botanical and zoological interests. On Dec. 2, 1795, he set out on his journey to the interior, taking with him only a native and a slave boy. After a terrible journey, during which he was imprisoned and later suffered tortures from thirst and hunger, he succeeded in reaching Segu on the Niger and determining the eastward course of that river. On July 29, 1796, after following the Niger for eighty miles from Segu, he decided to leave the river and set out for the coast, a journey of 1900 miles, which he successfully accomplished, reaching the Gambia in May 1797. In January 1805, Park left England for the Gambia for the second time. He took with him a party of about forty Europeans, but most of them died before the Niger was sighted on Aug. 18. Park sent back his journal, and set out to sail down the river on Nov. 19. He and his party passed Timbuktu and reached the Bussa rapids in lat. 10° 45′ N., where the canoe stuck fast on a rock and the natives at the same time attacked the party from the shore ; all were drowned. Though Park did not succeed in solving all the problems of the course of the Niger, he eliminated many of them.

May 23, 1875.—Inland Exploration of Australia

E. Giles began his journey from Port Augusta at the head of Spencer Gulf to Perth on the west coast of Australia, passing Lake Moore on his way. From Perth he went northwards to the upper Ashburton River and crossed Gibson's Desert from west to east. Giles had previously, in 1872, examined the upper course of the Finke River, penetrating into Gibson's Desert from the east. He was, however, compelled by adverse conditions to return without crossing it.

May 26, 1616.—William Baffin

Bylot and Baffin sailed on the most memorable of Baffin's many voyages. Baffin's Bay was discovered and explored, together with the magnificent series of straits which radiate from it, which were named Lancaster, Smith, and Jones Sounds, in honour of the patrons of his voyage. For 236 years, Baffin's farthest north, about 77° 45′, remained unsurpassed in that sea. Baffin is first mentioned as chief pilot on a voyage to search for the north-west passage in 1612. In 1615 he carefully examined Hudson Strait, the accuracy of his soundings and observations being confirmed by Sir Edward Parry two centuries later (1821). In 1617–1619, Baffin surveyed parts of the Red Sea and the Persian Gulf, where he was killed in 1620. Baffin made numerous scientific, especially magnetic, observations : he was the first to determine longitude at sea by lunar observations.

May 27, 1926.—The Shaksgam Valley

Major Kenneth Mason reached Leh, whence he penetrated to the Shaksgam Valley, not visited by a European since Younghusband discovered it in 1889. Mason also explored the Aghil ranges and discovered the main features of the watershed between the Indian Ocean and Central Asia. His surveys altered the conception of the region and proved that the country beyond the Shaksgam River consists of a series of parallel ranges similar to those found on its Indian side.

May 28, 1789.—The Solomon Islands

Lieut. Shortland reached England after a voyage which added much to the map of Oceania. Shortland had accompanied the expedition of Capt. Arthur Philip, sent out to found a penal settlement in Australia. On the return journey Shortland discovered " Sir C. Middleton's " Island, and on July 31 sighted San Cristobal, the most southerly of the Solomon group. He did not realise that the islands were separate, but thought that they were all one large island, to which he gave the name of New Georgia. He touched at Simba, and then went through the strait between Choiseul and Bougainville islands, sighting many small islands to the west, to which he gave the name of Treasury Islands. Alu, the largest of this group, is now generally known as Shortland.

Societies and Academies

LONDON

Physical Society, March 4.—**L. G. Carpenter and T. F. Harle** : A vacuum calorimeter for high temperatures. A form of the platinum-thermometer type of vacuum calorimeter has been developed which is suitable for the determination of true specific heats at high temperatures, since it is constructed without any organic insulating materials. The design is novel, in that the heat is transferred from the platinum coil to the calorimeter by radiation.—**Hugh Carmichael** : A new tilted electrometer. A new instrument on the principle of the Wilson tilted gold-leaf electrometer. It has a quartz fibre ' leaf ' which moves in hydrogen to reduce sluggishness. Typical sensitivities of 3 mm. and 30 mm. fibre movement per volt (linear for 2 mm. and 1 mm. respectively) have been obtained, and a reliable eye-piece scale sensitivity of 1000 divisions per volt is within the range of the instrument.—**N. W. McLachlan** : The symmetrical modes of vibration of truncated conical shells with applications to loud-speaker diaphragms. With paper, glass, and aluminium shells, the modes crowd together as compared with the segregation which occurs in the case of a disc. With thick glass or aluminium of comparatively low loss, the nodal frequencies are very clearly defined peaks. In the case of paper cones driven by coils of small mass, the peaks disappear and the nodal region is indicated by a broad rounded contour. The influence of thickness, apical angle, and the mass of the driving coil are treated.

Society of Public Analysts, April 6.—**K. Culhane and S. W. F. Underhill** : The estimation of hormones. A description is given of the estimation of insulin,

pituitary posterior lobe extract, and adrenaline. The effects of variations in the sensitiveness of the different animals is reduced to a minimum by using fairly large groups of a uniform stock.—G. Middleton: The chemical assay of thyroid gland. For the determination of the iodine content of thyroid gland a method is recommended in which the material is ignited with sodium carbonate in a double crucible.—F. W. Jackson and Osman Jones: The water-protein ratio of lean meat, and its bearing upon the analysis of sausages. Data are given for the ratios of water to protein in samples of meat representative of the average quality used by the manufacturers of high-grade sausages. By the use of these ratios the proportion of meat in sausages may be determined with a close approximation to the amount actually present.—Osman Jones: Nitrite in cured meats. Nitrite-cured meats may contain 960 parts nitrite per million when brine has been repeatedly used for curing. The only function of the nitrate is to impart a red colour to the meat by reduction to nitrite. It would be advantageous to replace nitrates in curing by a very small amount of nitrite.—H. C. Lockwood: Notes on the freezing point of milk. An apparatus and method for the determination of the freezing point of milk are described.

Optical Society, April 14.—F. Twyman: A photometric eyepiece for visual quantitative spectrum analysis. A new type of eyepiece is described whereby a spectrum is split into halves, a selected line of one spectrum being brought vertically above a selected line of the other spectrum. The intensity of the brighter line is then reduced by means of a neutral tint wedge until equality of the two intensities is obtained. The eyepiece is used in an analysis of some cadmium-lead alloys, an accuracy of some 11 per cent of the content being obtained.—T. Smith and J. Guild: The C.I.E. colorimetric standards and their use. The new international standards, which define a standard observer, three standard illuminants, standard conditions of illuminating and viewing opaque specimens, a standard for evaluating the brightness factor of opaque specimens, and a standard trichromatic system for the expression of colour measurements, are stated and their origin explained. In addition to the numerical tables which are appended to the resolutions setting up these standards, there are given a table specifying the trichromatic co-ordinates for the standard observer of all spectral colours at wave-length intervals of 1 mμ, tables to facilitate the calculation of the standard co-ordinates and the brightness factor of a material illuminated by any one of the three standard illuminants from spectrophotometric measurements on the material, and a table giving the co-ordinates of some stimuli of special importance on the N.P.L. system, the standard system, and another system which occurs in the resolutions.

PARIS

Academy of Sciences, April 4.—E. Goursat: A partial differential equation.—Paul Stroobant was elected *Correspondant* for the Section of Astronomy.—E. Baticle: The probability of an election by an absolute majority in one or two ballots.—Georges Giraud: Certain cases of discontinuous data relating to the problems of values at the boundary.—Lars Ahlfors: The inverse functions of meromorph functions.—N. Théodoresco: The problem of Cauchy for the equations of Dirac.—Charles Florisson: Acoustic testing by echoes at the edge of noisy aeroplanes. Description of an acoustic altimeter capable of giving the height of the aeroplane above the ground to within about five metres.—L. Brillouin and M. Lévy: A reaction wiring independent of the frequency.—G. Rassat: The Curie point of ferro-cerium. Ferro-cerium with about 27 per cent of iron loses the property of being attracted by a magnet at about 40° C. Some possible applications of this property are suggested.—S. Rosenblum and Mlle. C. Chamié: The fine structure of the α-radiation of radiothorium.—Mlle. Suzanne Veil: The individual diffusion of the Liesegang reagents in gelatine. A study of the diffusion of potassium bichromate and of silver nitrate, taken separately, in gelatine. The action of the electric field on each is also described.—H. Hering: The heterogeneous equilibria in the system cadmium chloride, potassium chloride, and water.—J. Zawadzki and S. Bretsznajder: The influence of certain agents on the velocity of formation and of the thermal decomposition of some carbonates.—Pierre Dubois: A recording apparatus for potentiometric determinations. A description, with diagrams, of an apparatus which has been in use for more than a year for the automatic titration of manganese.—Ed. Chauvenet and P. Avrard: The determination of barium sulphate in iron ores. By heating the mineral to 450° C. in a stream of carbon tetrachloride vapour, iron and aluminium are removed as volatile chlorides, whilst barium chloride (with other non-volatile chlorides) are left in the boat, and can be separated without difficulty.—E. Carrière and Raymond Lautié: The determination of molybdenum by potassium permanganate. The conditions are described under which molybdenum salts can be reduced by zinc and dilute sulphuric acid to Mo_2O_3.—A. Kirrmann and R. Rambaud: A new example of the allyl transposition. The type of transposition is that indicated by the formulæ $CH_2 : CH . CHRX \rightarrow CH_2X . CH : CHR$. The case described is the production of $CH_2Br . CH : CH . (CO_2C_2H_5)$ by the action of PBr_3 on $CH_2 : CH . CH . (OH) . CO_2C_2H_5$).—Nicolas Drisch: Researches on the acetylenic arylcarbinols, *p*-bromophenylethinyldiphenylcarbinol and its derivatives; its transformation into the ethylene ketone.—J. P. Arend: The mode of formation of the oolitic deposits in Lorraine and Luxembourg.—Picon: The amount of organic carbon in different waters. A micro-method based on sulphochromic oxidation.—Emm. de Martonne: An attempt at the morphological synthesis of the Carpathians.—Ad. Davy de Virville: The distribution of lichens in the island of Cézembre.—Roger Heim: The formation of the spores in Podaxon.—Gard: Autumn frosts, oxidising diastases, and death of plants in full growth. The physical effects of exposure to frost are loss of turgescence, exudation of the water of the protoplasmic hydrogel and of the vacuome. From the chemical point of view, there is an increase in the peroxidases and the tyrosinases and a greater oxidation velocity.—Charles Pérez: Some differential characters of the sexes in *Eupagurus bernhardus*.—Serge Yourievitch: The value of the ocular movements in æsthetic emotion.—H. Bordier: Experiments on the biological effects of d'Arsonvalisation with short waves. From experiments on fish it is concluded that these high frequency waves do not act simply by their calorific effects, but have a selective action on living tissues.—René Chaux: Researches on the influence of the Δ_2-cyclopentenyl radical in the series of barbituric hyponotics. A pharmacodynamical study of Δ_2-cyclopentenylallylbarbituric acid. A series of barbituric acid derivatives containing the Δ_2-cyclopentenyl group has been prepared, and the hypnotic action studied on the usual animals (fish, mice, rabbits, dogs) compared with veronal as a standard. Δ_2-cyclopentenylallylbarbituric acid possesses hypnotic power nearly four times that of veronal. The security coefficient

(ratio of maximum dose tolerated to efficient dose) is 4, as against 2·5 for veronal.—**Paul Mathias**: The development of the egg of a phyllopod crustacean, *Artemia salina*.—**Maurice Lecamp**: The experimental production of supernumerary members in *Alytes obstreticans*.—**Georges Lakhovsky**: Concerning the bactericidal power of metallic silver. Reply to some criticisms by Ph. Lasseur, M. Pierret, A. Dupaix, and C. Maguitot.—**G. Mouriquand, A. Leulier, and Mlle. L. Weill**: Experimental hypotrophic rickets.—**P. Remlinger and J. Bailly**: A new enzootic disease of the rabbit: suppurating otitis of the middle ear.

GENEVA

Society of Physics and Natural History, Feb. 18.—**Fernand Chodat and Jean Landis**: Studies on the nutrition of the yeasts. The authors present a study of the nutrition of the yeast fungi, capable of transforming under economic conditions inorganic nitrogen into peptide nitrogen. *Endomyces anomalus*, which fulfils these requirements in a satisfactory manner, is studied from the points of view of its growth and autolysis.—**Léon W. Collett and Ed. Parejas**: Results of the geological expedition of Harvard University in the Canadian Rockies (Jasper National Park), 1929. (6) Geological section along the Rockies, the Athabasca length. The section surveyed by the authors extends over a distance of 50 km. from the eastern edge of the Rockies to the river Miette, an effluent of the Athabasca. It comprises seven distinct strata.

March 3.—**A. Borloz**: The pickling of copper-silver alloys in dilute sulphuric acid. Experience in the cleaning of these 82·5 per cent alloys shows that the operation is more successful when copper sulphate is added. In seeking for a theoretical explanation of this action, the author thinks that the copper cation acts as a surface catalyst, experiment having proved that electro-osmosis cannot be the cause.—**Léon W. Collett and Ed. Parejas**: Results of the geological expedition of Harvard University in the Canadian Rockies (Jasper National Park), 1929. (7) The geology of Mount Edith Cavell. The authors describe in detail some phenomena of detachment which are produced at Mount Edith Cavell and in the Tonquin Valley between an enormous mass of Cambrian quartzites and Pre-Cambrian clay schists.—(8) The broken strata of Moose Pass. Are the overlappings of Moose Pass and Pyramid equivalent? This is the problem of tectonics set by the authors.

March 17.—**Th. Posternak**: The configuration of quercite. By controlled oxidation with alkaline permanganate, the author has obtained a substance identical with Kiliani's metasaccharonic acid. From this a configuration is deduced which completely explains all its properties.—**W. H. Schopfer**: The accessory growth factor of the micro-organism contained in the wheat germ: its action on the sexuality of the Phycomyces. The author's experiments make clear the existence in the wheat germ of a growth and sexuality factor the vitamin value of which is certain.—**J. and L. Deshusses**: An anguillulosis of hortensia (*Hydrangea hortensis*). The authors have studied the ravages caused by *Tylenchus Dipsaci*, more especially in certain varieties of hortensia, amongst others Maréchal Foch and Niedersachsen. The Goliath and De Vibraye varieties are less attacked. The authors make suggestions for fighting this parasite.

PRAGUE

Czech Academy of Sciences and Arts, Oct. 16.—**Boh. Němec**: Mixoploidy in *Allium cœruleum* Pal.—**V. Posejpal**: Fourth contribution to the study of universal ether. A formula for the intensities of the *K*-absorption edge is deduced on the assumption that the cross-section of a photon has the same area as that of an ether particle.—**B. Nováková**: The determination of differences of wave-lengths in spectra of the central region and limb of the sun measured by spectrocomparator and microphotometer.—**F. Valentin**: A study in the series of alcoholic sugars. Alcoholic sugars were converted by means of triphenylchlormethane into triphenyl-methylethers, and interesting regularities were found in the number of triphenylmethyl groups entering a molecule.

Nov. 13.—**J. H. Křepelka and B. Rejha**: The anhydride and hydrates of manganese sulphate. Six forms of manganous sulphate were found, namely, anhydrous, simple, and bimeric monohydrate, tetra-, penta-, hepta-hydrate; other forms mentioned in literature, such as the hemi-, di-, tri-hydrate, second form of tetra-hydrate, and hexahydrate, do not appear to exist. The melting points and ranges of existence are given.—**O. Pankraz**: On the divergence of the Dirichlet integral.

Dec. 11.—**V. Posejpal**: Fifth contribution to the study of the universal ether. From the conception of ether drift and on the assumption that the volume of ether carried away by molecules of water vapour equals that of water molecules calculated from viscosity, the author derives from the refractivity of water, vapour-radii a; these denote the sphere of ether inside water molecules, which is impenetrable for photons, a being given by $a + \beta\lambda$.—**F. Ulrich and J. Sandholzer**: Radioactivity of wells in the Riesengebirge in Bohemia.—**M. Mikan**: (1) An example of Cremona correspondence in penta-dimensional space. (2) Plane presentation of penta-dimensional forms.—**J. Chloupek and Vl. Daneš**: Solubilities and activity coefficients of silver sulphate in certain salt solutions. Exact solubility determinations were made in water and aqueous solutions of K_2SO_4, $(NH_4)_2SO_4$, KNO_3 from 0·08 to 2N at 25° C.; hence activity coefficients were calculated.—**V. Prelog, G. Dřiza, and V. Hanousek**: On the bis-β-halogenethylamines. These compounds were obtained from bis-β-hydroxyethyl-amines by means of halogen acids; they yield with potassium cyanide 2-imino-3-β-halogenethyl-oxazolidines, and with potassium thiocyanate the free bases 2-imino-3-β-halogenethylthiazolidines.

Forthcoming Events

FRIDAY, MAY 20

ROYAL SOCIETY OF MEDICINE (Physical Medicine Section), at 5.30.—Annual General Meeting.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.15.—Annual General Meeting.

ROYAL SOCIETY OF MEDICINE (Radiology Section), at 8.30.—Annual General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. H. E. Armstrong: Faraday at the Sign of the Hexagon: Coal Colour and Constitution.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Sedbury, Monmouthshire).—Summer Meeting (*continued on May* 21 *to* 23).

SATURDAY, MAY 21

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—Annual General Meeting.

GERMAN CONGRESS FOR PSYCHICAL HYGIENE (at Bonn).

MONDAY, MAY 23

VOLUNTARY EUGENIC STERILISATION (Conference at Caxton Hall, Westminster), 10.30 A.M. to 12.30.—Medical and Legal Aspects of Sterilisation; Sterilisation in Other Countries.—2.30 to 4.30.—Social and Moral Aspects of Sterilisation; Practical Proposals.—8.30.—Informal Discussion.

MIDDLESEX HOSPITAL MEDICAL SCHOOL, at 5.—Prof. Samson Wright: Certain Aspects of the Reflex Control of the Circulation. (Succeeding Lectures on May 26 and 30, June 2, 6, and 9.)

ROYAL SOCIETY OF ARTS, at 5.15.—Sir Ernest Graham Little: Dermatology as an Outpost of Medicine (Malcolm Morris Memorial Lecture).

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Prof. F. Silvestri: The Biological Control of Insects and Weed Pests (1). (Succeeding Lectures on May 25 and 27.)

UNIVERSITY COLLEGE, at 5.30.—Prof. A. M. Tallgren: Central Asiatic and Siberian Rock-Pictures (1). (Succeeding Lecture on May 25.)

IRON AND STEEL INSTITUTE (Additional Meeting) (jointly with Cleveland Institution of Engineers) (at Cleveland Technical Institute), at 7.30.—Presentation of Papers.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Annual General Meeting.

TUESDAY, MAY 24

ROYAL SCHOOL OF MINES (in Geological Lecture Theatre), at 12 noon.—Dr. H. Shaw: Field Practice with the Torsion Balance (1). (Succeeding Lectures on May 27 and 31.)

IRON AND STEEL INSTITUTE (Additional Meeting) (jointly with Sheffield Metallurgical Association) (in Mappin Hall, Sheffield University), at 2.45.—Presentation of Papers.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Annual General Meeting.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 5.—Discussion on Some Problems concerning the Prevention and Treatment of Acute Rheumatic Infection.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Rev. T. Cullen Young: Tribal Intermixture in Northern Nyasaland (Lecture).

WEDNESDAY, MAY 25

BRITISH SCIENCE GUILD (Annual General Meeting) (at Royal Society of Arts), at 4.—At 5.—Prof. S. Chapman: Polar Lights (Lecture).

SCHOOL OF ORIENTAL STUDIES, at 5.30.—Dr. M. de Z. Wickremasinghe: The Home of Pali, the Sacred Language of the Southern Buddhists (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Prof. E. V. Appleton: Our Present Knowledge of the Ionised Regions of the Upper Atmosphere (Lecture).

BRITISH INSTITUTE OF PHILOSOPHY (at University College), at 8.30.—Sir Herbert Samuel: Philosophy and the Ordinary Man (Presidential Address).

THURSDAY, MAY 26

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Annual General Meeting.

ROYAL AERONAUTICAL SOCIETY (in Science Museum, Aeronautical Section), at 9.15.—H. E. Wimperis: New Methods of Research in Aeronautics (Wilbur Wright Memorial Lecture).

FRIDAY, MAY 27

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. L. Hogben: The Biological Premisses of Historical Interpretation (Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE (Human Biology Research Committee), at 5.30.—Discussion on the Standardisation of Anthropometric Method.

BIRKBECK COLLEGE, at 6.—Dr. H. J. W. Hetherington: Theory and Practice (Haldane Memorial Lecture).

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Annual General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Walter Morley Fletcher: New Conceptions of Medical Research.

SATURDAY, MAY 28

NORMAN LOCKYER OBSERVATORY (Salcombe Regis, Sidmouth), at 3.30.—Opening by Sir Frank Dyson of the 'Mond' Photographic Equatorial and Dome. Other speakers: Sir Richard Gregory, Bart., Dr. R. L. Mond, and others.

ROYAL SOCIETY OF MEDICINE (Physical Medicine Section).—Annual Summer Meeting (at Alton).

Official Publications Received

BRITISH

Canada: Department of Mines: Mines Branch. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories) 1929. (No. 721.) Pp. 131+8 plates. (Ottawa: F. A. Acland.)

Ceylon Journal of Science. Section A: Botany. Annals of the Royal Botanic Gardens, Peradeniya. Edited by N. D. Simpson. Vol. 11, Part 4, February 20th. Pp. 307-359+plates 45-52. 3 rupees. Section B: Zoology and Geology. Spolia Zeylanica. Edited by Dr. Joseph Pearson. Vol. 16, Part 3, March 18th. Pp. 229-356+plates 43-66. 3 rupees. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.)

Memoirs of the Geological Survey of India. Vol. 61: The Geology and Coal Resources of the Raniganj Coalfield. By E. R. Gee. Pp. vi+343+xiii+20 plates. (Calcutta: Government of India Central Publication Branch.) 13.6 rupees; 22*s*.

Borough of Durban: Durban Museum. Annual Report for Municipal Year 1930-31. Pp. 7+4 plates. (Durban.)

London School of Hygiene and Tropical Medicine. Memoir Series No. 5: A Helminthological Survey of Southern Rhodesia. By William K. Blackie. Pp. viii+91+7 plates. (London: London School of Hygiene and Tropical Medicine.) Paper, 8*s*.; cloth, 10*s*. 6*d*.

The Board of Greenkeeping Research. Report for 1931. Pp. 26. (Bingley: St. Ives Research Station.)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1931, presented to the Annual Meeting, February 8th, 1932. Pp. 44+8+2 plates. (York: Yorkshire Museum.)

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 1, No. 6: The Primitive Conducting Mechanisms of the Vertebrate Heart—An Introduction to the Study of their Appearance and Development in *Lepidosiren paradoxa*. By Tudor Jones. Pp. 225-240+4 plates. 3*s*. 6*d*. Vol. 57, Part 1, No. 7: Differentiation in the Sills of Northern Trotternish (Skye). By Dr. Frederick Walker. Pp. 241-257. 2*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Northern Coke Research Committee. Annual Report, No. 3, 1931. Pp. 17. (Newcastle-on-Tyne: Armstrong College.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1932. Vol. 44, No. 3, April. Pp. 107-166+xxxiv. (London.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1429 (T. 3111): Flow of Compressible Fluid in the Neighbourhood of the Throat of a Constriction in a Circular Wind Channel. By S. G. Hooker. Pp. 9+6 plates. (London: H.M. Stationery Office.) 9*d*. net.

Transactions of the Faculty of Actuaries. Vol. 14, Part 1, No. 126: William Morgan, F.R.S., 1750-1833. A Lecture by W. Palin Elderton. Pp. 20. (London: Charles and Edwin Layton.) 1*s*. 3*d*. net.

FOREIGN

Cornell University Agricultural Experiment Station. Bulletin 529: The Social and Economic Areas of Yates County, New York. By Harold F. Dorn. Pp. 52. Bulletin 535: The Control of Bottom Rot of Lettuce. By G. R. Townsend and A. G. Newhall. Pp. 11. Bulletin 536: Soil-Acidity Studies with Potatoes, Cauliflower and other Vegetables on Long Island. By P. H. Wessels. Pp. 42. (Ithaca, N.Y.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 8, No. 3, March, Research Papers Nos. 416-426. Pp. 321-444. (Washington, D.C.: Government Printing Office.) 40 cents.

Field Museum of Natural History. Geological Series, Vol. 6, No. 2: Upper Canadian (Beekmantown) Drift Fossils from Labrador. By Sharat Humar Roy. Results of the Rawson-MacMillan Subarctic Expedition of 1927-28. (Publication 307.) Pp. 29-59+2 plates. (Chicago.) 25 cents.

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, Nr. 64: Researches into the Theory of Regression. By Walter Andersson. Pp. 198+8 plates. (Lund.) 14 kr.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 357-358: Note on the Hyperfine Structure of Mercury, by Kiyoshi Murakawa; La Kauzo de la Influo de Aldonitaj Substancoj al la Malmoliĝa Rapideco de Gipscemento, I., de Sigeru Yamane. Pp. 97-108. (Tōkyō: Iwanami Shoten.) 35 sen.

Bulletin of the American Museum of Natural History. Vol. 63, Article 3: A List of the Rhopalocera of Barro Colorado Island, Canal Zone, Panama. By E. Irving Huntington. Pp. 191-230. (New York City.)

Societas Scientiarum Fennica. Commentationes Humanarum Litterarum, III, 8: Marriage Conditions in a Palestinian Village. By Hilma Granqvist. Pp. vi + 200. (Helsingfors: Akademische Buchhandlung; Leipzig: Otto Harrassowitz.) 75 Fmk.

The Carnegie Foundation for the Advancement of Teaching. Review of Legal Education in the United States and Canada for the Year 1931. By Alfred Z. Reed. Pp. iii+51. (New York City.) Free.

U.S. Department of Agriculture. Technical Bulletin No. 281: Experiments with Insecticides for Codling-Moth Control. By E. J. Newcomer and M. A. Yothers. Pp. 29+4 plates. (Washington, D.C.: Government Printing Office.) 15 cents.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 7, No. 1, March. Pp. 156. (Tokyo and Sendai: Maruzen Co., Ltd.)

CATALOGUES

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 20.) Pp. 251-304. (Paris: Libr. Adrien-Maisonneuve.)

Van Cittert double Monochromators with Optical Systems of Glass or Quartz. (Mono. 32.) Pp. 4. Short Beam Analytical Balance in Brass Case. (Metan 31.) Pp. 2. Philips Fuses. (Phi. 32.) Pp. 2. (Delft: P. J. Kipp and Zonen.)

Catalogue of Botanical Books, Herbals, Floras, with a few items of General Natural History and an Addenda of Interesting Miscellaneous Works. (No. 199.) Pp. 48. (London: Dulau and Co., Ltd.)

Catalogue of Important Works on Gardening and Botany, Phanerogams, Floras and Cryptogams. (No. 19.) Pp. 12. (London: John H. Knowles.)