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The Civil Service and 'Everyday' Science

DURING the Great War, in 1917, a new scheme of examination was adopted for Class I of the Civil Service. This important administrative group of Government services in Great Britain now comprises the Indian and Ceylon Civil, the Foreign Office and Diplomatic, the Consular and Overseas Trade (Intelligence Officer) and Home Civil (Junior Grade of the Administrative Class). The revised scheme provided for examination in two sets of subjects—one compulsory and the other optional. The compulsory set was to include an essay and papers on English, Present Day (contemporary, social, economic and political subjects), Everyday Science (general scientific principles and methods), an auxiliary language, and a viva voce examination. Having passed this qualifying examination, candidates were given a wide choice of subjects, in which advanced knowledge of various branches of science could secure as favourable marks in the competition as classical languages and related literary scholarship. The scheme was generally welcomed because it afforded opportunities for men trained efficiently on varied lines to gain access to the important posts to which these examinations ultimately lead. A specimen paper on general science (for all candidates), appended to the original scheme, asked for just that amount of general scientific knowledge which all public servants might reasonably be expected to possess; and a wide choice of questions was allowed.

For nineteen years these regulations have been in force, and they have had an encouraging influence on the position of science in secondary-school and university education. They conceded the principle that the rudiments of natural knowledge are an essential part of education for modern life; and this recognition represented a remarkable advance in the official attitude toward scientific teaching. As to the scope of the "Everyday Science" paper, the existing regulations define it as follows: "Such knowledge will be expected as candidates will have who have studied science intelligently at school and have since kept their eyes open. A liberal choice of questions will be given. Attention should be paid to orderly, effective, and exact expression."

It should be noticed particularly that with the inclusion of "Everyday Science" among the compulsory subjects of the examination, *all* candidates for the administrative group of the Civil Service were expected to have been taught science while at school, whatever subjects they might specialise in afterwards, and also that they were supposed to maintain interest in scientific matters generally, without practical familiarity with technical details. In other words, all candidates were assumed to have acquired an acquaintance with fundamental scientific principles and methods during their school course, and thus to have been equipped for progressive development in the scientific environment of modern life.

These very admirable intentions have, however, recently been abandoned by the Civil Service Commissioners; and apparently it was not considered necessary to consult scientific authorities before arriving at the decision. In September last the Commissioners announced that, with effect from this year, the subject of "Everyday Science" will be omitted from the compulsory qualifying examination, and that, in its place, some optional questions on science will be included under the subject entitled "Present Day". It appears from

a question asked by Sir Arnold Wilson in the House of Commons in December last, and a full reply to it communicated by letter to Sir Arnold by Mr. W. S. Morrison, Financial Secretary to the Treasury, that, in taking this step, the Commissioners "obtained the concurrence of the Universities of Oxford and Cambridge, whose considered advice may be taken as representative of general well-informed opinion". What exactly is to be implied by the phrase "Universities of Oxford and Cambridge" we do not know, but if it means that competent scientific authorities were consulted, and that they, after due consideration, deliberately decided that candidates for Civil Service appointments need no longer give evidence that they had "studied science intelligently at school", then we can only conclude that they do not care whether science is taught in school or not. It is difficult to understand how any responsible authority familiar with the science teaching now carried on in our secondary schools could have consented to a decision which must have an adverse effect upon its development.

For several years, there has been a reaction against specialisation of science subjects in schools, and the Board of Education, as well as school examination authorities and the Science Masters' Association, have been engaged in drafting courses of general elementary science. Such schemes are intended to provide suitable scientific education for all, and not intensive study of particular branches of science for pupils who propose to specialise in physics, chemistry or biology for professional reasons. Objections can, of course, be raised to general science courses as being so indefinite and wide in scope that nothing is learned of scientific method, and only confused and incoherent ideas are acquired of the meaning of scientific knowledge. But even if this view be accepted, it does not follow that we must abandon as hopeless the attempts to devise courses of school science suitable for the rank and file and to enable all young people to take intelligent interest in scientific developments in the world around them, whether they leave school at sixteen years or so in age or whether they proceed to a university or other place of higher education.

Among the reasons given by Mr. Morrison for the decision of the Civil Service Commissioners to omit "Everyday Science" from the qualifying examination was that "many candidates at these examinations make this subject in particular one for special cramming, which is one of the most dangerous defects to which the examination system lends itself. In the result, only a very superficial knowledge of the subject was acquired by candidates and a formidable addition was caused to the already severe strain of the examination". The difficulty is a real one, but we suggest that it arises chiefly because of the neglect of the very condition which was intended to be met when "Everyday Science" was made a compulsory subject in the qualifying examination, namely, that candidates would be expected to have "studied science intelligently at school". Many of the candidates have not studied science at all in school, on account of the demands made upon their time by classical languages and literature or other subjects in which they are specialising. The result is that they have to resort to cramming up a subject which ought to have been taught to them while at school, and the experimental character of which is despised by their superior minds.

It may be that, to a certain class of mind, natural phenomena and experimental inquiry make no appeal, and that for pupils of this type the science course should be of a more philosophical kind, or have closer relation to human history. That, however, is not a sufficient reason for omitting all science from the qualifying examination, but only for endeavouring to construct courses which are suitable for sixth form pupils of scholarship standard on the classical side. The inclusion of questions on scientific topics in the "Present Day" paper cannot in any way be accepted as equivalent to the setting of suitable questions to test whether or no a candidate has followed a natural science course while at school and has maintained an interest in what he has learnt.

Whatever opinion may be held as to the value of instruction in natural science of any kind while at school, the result of the decision of the Civil Service Commissioners is that specialists in classical or modern languages, in history and other literary subjects, are no longer encouraged to study science at any time in their educational careers, and that they may enter the Civil Service without even the knowledge required to pass in elementary general science in a School Certificate examination. To us this seems deplorable, and if the scientific societies in Great Britain could speak with a united voice, as the Federation of British Industries does for organised industry, such a disastrous blow to science teaching in schools and the scientific comprehension of our future administrators would never be tolerated.

Personalities in Physics

IN his presidential address to the Physical Society delivered on January 24, Lord Rayleigh gave a highly interesting and historically valuable account of some of his personal recollections of a number of eminent scientific men of recent times and of the circumstances in which they carried out their work.

"There is," he contended, "a difference of opinion as to how far personal idiosyncrasies and details of private life are worthy of record when they have little direct bearing on results. Usually such details of the lives of scientific workers are but scantily preserved; and to judge by the frequency with which the few available details are quoted and requoted, one may guess that most people are eager for them, and wish that contemporaries had handed them down to a greater extent than they have done. For my part, I think that the history of science is quite as much involved with the personalities of the men who have made it as is any other kind of history. The familiar process of digesting original memoirs into text-books, however necessary, can only be accomplished at the expense of some sacrifice of true historical perspective; and the limitation of knowledge and the narrowness of the basis on which generalisation rests are too often lost sight of in the process. To know something of the personalities of the men of science themselves, the conditions of their lives, and the point of view from which they worked, may often be a useful corrective to this tendency. Those who have had the good fortune to be in personal contact with the great workers of the generation above them should not neglect to record what they think may possibly be valued by posterity. There is no doubt that this duty has been too little regarded in the past. It is hard to realize when one is young that what we see to-day may be gone to-morrow and irretrievably forgotten the day after: and still harder to realize how eager posterity may be to know it."

Among many recollections of Kelvin in his later life, Lord Rayleigh spoke of his tireless mental activity, his insensitiveness to interruption especially when carrying out calculations in the famous 'green book', which was carried and used everywhere, in drawing-rooms, trains and hansom cabs, in the chair of the Royal Commission on Arsenical Poisoning from Beer (1901), and even on the platform of the British Association, where during a not very inspiring address its owner was observed to be busy on matters that he doubtless considered of greater significance. He spoke of Kelvin's efforts in the earlier days of his Glasgow professorship to encourage students to work in his laboratory at a time when it was very difficult to gain even the simplest practical acquaintance with the carrying out of experiments, although he seems to have had no other idea than that they should make themselves useful, seeing that he set Ramsay to work on removing the kinks from some old copper wire. Reference was also made to his caution and careful thinking, his deep insight into the essentials of an engineering problem, his careful composition—he would sometimes pause for long periods until he had got the right word—his fondness for mechanical analogies and his consequent dissatisfaction with the electromagnetic theory of light, which he sometimes would not rank as a theory at all.

In an interesting comment on this theory, Lord Rayleigh pointed out, as Kelvin had many years ago pointed out to him, the apparently little-known fact that Kirchhoff had shown some six years before Maxwell that the velocity of light could be derived from electrical measurements. Kelvin mentioned this in a conversation on Maxwell's theory as a reply to Lord Rayleigh's remark that at any rate it seemed a great step to have shown that the velocity of light could be derived from such measurements. Among other interesting details, Lord Rayleigh recalled Kelvin's curious taste for puns, his simple humour, his suggestion that a correspondent in an electrical journal had better be submitted to the action of the "silent discharge", his enthusiasm for experimental work, his courtesy, his inability to adjust his matter to the capacity of his audience, his violence against Home Rule, his dislike of motor-cars and his emphasis on the wisdom and necessity of the ten miles per hour speed limit, his scepticism about the practical possibility of the aeroplane, his fondness for the theatre, his boyishness and simple kindliness, his apparently complete unconsciousness of his success in life, and that great dignity and impressiveness which he could assume.

Lord Rayleigh then proceeded to deal with various reminiscences of the Royal Institution, making some reference to his father's work, partly carried out there, on the separation of argon from air. Of Sir James Dewar, he recalled the early liquefaction of air on a large scale, the liquefaction of hydrogen and the attempted liquefaction of helium, a triumph of which Dewar was robbed probably through using crude gas from the Bath spring instead of monazite, since the former contained neon which blocked the tubes of the liquefying apparatus.

"From this point of view," said Lord Rayleigh, "it seems a considerable misfortune for British science that helium was ever found in the gas at the Bath spring. If Dewar had extracted his helium from monazite, as Kamerlingh Onnes did afterwards, he would probably have succeeded in the liquefaction. Nevertheless, his large-scale operations with the Bath gas may be considered the prototype of those modern ones which have led to the collection of helium in quantities adequate even for use in airships. It must have been an acute disappointment to Dewar that he was outstripped in the race to liquefy helium. But he took it with a good grace and himself gave an exposition of Kamerlingh Onnes' work at the British Association meeting at Dublin in 1908."

Lord Rayleigh spoke also of Dewar's refusal to admit the danger of the work on the liquefaction of gases; his apparently grudging admission that it was a little "tricky" was no overstatement considering that Lennox and Heath, his two assistants, each lost an eye in the course of the work. He referred also to Dewar's unorthodox engineering, his neglect of proper safety factors, his dislike of unannounced visitors, his secrecy with regard to his laboratory work—he civilly begged to be excused showing his laboratory to Kamerlingh Onnes, saying that then no awkward question could arise—his quarrelsome but essentially kind-hearted nature (was it Scots dourness in an exceptional degree?), his sleeplessness—he was glad to get even three hours sleep a night—his amateur pharmacology, his generosity to those in need and his refusal to accept thanks, and his curious and almost impenetrable mental processes. Dewar's earliest publication of the idea of a vacuum vessel dates so far back as 1874, and the suggestion that he was anticipated has no justification: "Dewar gave his invention of the vacuum flask freely to the world, and never made a penny by it, though he might have realised a fortune." If only, as Lord Rayleigh remarked, vacuum-jacketed vessels had come to be called Dewar flasks instead of thermos flasks, their inventor's fame would doubtless have penetrated to a very wide public. (But is it really too late for us to place the 'Dewar flask' alongside the 'Davy lamp', another invention freely given to the world?)

Of Dewar's extraordinarily interesting chief assistant, Robert Lennox, Lord Rayleigh had much to say. Lennox worked with Dewar for twenty-seven years (1881–1908) and, as Lord Rayleigh remarked, his "services to science have not been sufficiently recorded". Lennox, it appears, had some training in engineering under Prof. James Thomson of Glasgow and had been chemical assistant to Dittmar at Glasgow Technical College; although he had not taken a science degree, his general scientific capacity was far beyond that of the ordinary graduate. Lennox, it is believed, said Lord Rayleigh,

"was mainly if not wholly responsible for the design of the compressors and liquefiers in their engineering aspect. By a rather curious arrangement they were made by a firm, Lennox, Reynolds and Fyfe, of which he was the leading spirit. . . . But how he was able to find time for this while he was in regular attendance at the Royal Institution it is hard to understand. He must have relinquished all leisure and recreation. . . . The large air pumps used in Dewar's laboratory for evaporating liquid air and liquid hydrogen *in vacuo* were of his design and construction. They were of the rotatory type with an eccentric barrel and sliding feathers, and so far as I know they were the first successful air pumps of this design, though the fundamental idea as applied to water pumps is a very old one."

Dewar himself, of all men the least given to passing the base coin of insincerity, wrote that but for Lennox's "invaluable aid . . . engineering skill, manipulative ability, and loyal perseverance" the successful liquefaction of hydrogen "might have been indefinitely delayed". Lord Rayleigh spoke also of Lennox's stoic courage, his confidence and his cynical wit. Lennox was interested in an acid-resisting alloy, the peculiarities of which had led a puzzled workman to remark "t'aint iron", whereupon the trade name of "Tantiron" was adopted. "It is curious," Lennox remarked afterwards, "that so many analysts should find tantalum in it."

"A serious accident," added Lord Rayleigh, "occurred when he was trying the generation of acetylene under pressure, with a view to storing it liquid in cylinders. There was a violent explosion. Sir Joseph Petavel was in the next room. The first thing he heard after the explosion itself was Lennox's voice saying 'Look out, you men, put out the gas in there'. Next, he saw Lennox, his face streaming with blood and one of his eyes torn to pieces and the fragments spread all over his face, but quite calm. His first thought had been to prevent any further accident from the escaping acetylene."

Passing to Sir William Crookes, Lord Rayleigh remarked on his resemblance to Faraday in his early life, his work, his methods and his equipment; of his scrupulous tidiness, of the many absolutely new 'hares' that he started in science—according to Kelvin, more than any of his scientific contemporaries had started—his friendliness, his resolution when action was called for, his reserve when pressed for information and of his great annoyance at having missed the discovery of X-rays.

"According to the account he gave in my hearing," said Lord Rayleigh, "he had definitely found previously unopened boxes of plates in his laboratory to be fogged for no assignable reason, and, acting I suppose in accordance with the usual human instinct of blaming someone else when things go wrong, he complained to the makers, who naturally had no satisfactory explanation to offer. I believe it was only after Röntgen's discovery that he connected this with the use of highly exhausted vacuum tubes in the neighbourhood. He had, at least, less to reproach himself for than another English man of science, who, it is said, knew that high vacuum discharge tubes were apt to fog photographic plates anywhere near them, and only drew the moral that the plates should be stored elsewhere".

In conclusion, Lord Rayleigh spoke of Sir Arthur Schuster, until recently one of the now fast diminishing band who derived personal inspiration from Clerk Maxwell. Schuster showed complete indifference to the practical applications of science and the plaudits of the gallery. He always retained an open mind to scientific 'heresy'. His reserve and sensitiveness received a great shock at the treatment he met with in the early days of the Great War. He narrowly missed the discovery of the Zeeman effect, and was diverted by Röntgen's discovery from provisional conclusions on his measurements of the deflection of cathode rays in a magnetic field, in both of which problems "he had the root of the matter".

DOUGLAS MCKIE.

Animal Intelligence

TWO lectures on animal intelligence were recently given at the Royal Society of Arts* by Dr. David Katz, formerly professor of psychology and education at the University of Rostock, Mecklenburg. Although addressed to a juvenile audience, the matter and form of Dr. Katz's lectures raise serious issues regarding the scientific study of animal behaviour, and for that reason no less than for their attractive quality, the lectures merit close consideration. Their substance and sequence were briefly as follows.

Intelligence is defined as the capacity to adapt to new conditions. In estimating its manifestations in animals, we can easily be misled by spurious performances—as is amply shown in the history of the Elberfeld counting horses, whose activities were such as to persuade the gullible that horses are able to solve even the cube roots of numbers running into millions. The study of animal behaviour has, therefore, to be approached with circumspection, and no simple answer can be given to the question of the comparative merits of animal and human intelligence. The worlds in which animals live are often so different from our own—mainly because of differences in sensory capacities—that it is frequently impossible to find any means of explaining their activities. For example, the manner in which some animals accurately find their way from one place to another, often hundreds of miles distant, remains, in spite of much investigation, a complete mystery.

An analysis of animal intelligence demands a recognition of three forms of behaviour. The first is instinctive behaviour, which is perhaps best manifested in the insect world. "Instinct," stated Dr. Katz, "is what a whole species has learned to do, as distinct from what an individual member of the species learns for itself." What an animal learns for itself is a higher form of adaptation, and learning through 'trial and error' thus constitutes the second form of behaviour. It is manifested, so far as is known, by most living creatures. The third and highest form of animal intelligence is adaptation, through insight, by the exercise of reason. Behaviour which merits such description occurs only amongst the larger apes, and is exemplified by the well-known instance of the chimpanzee who, in order to reach a banana suspended from a ceiling, climbed on to boxes which it stacked for the purpose.

In appraising Dr. Katz's lectures, it has to be remembered that they were addressed to a juvenile audience, for that fact probably explains why it was that the discourse followed the classical lines laid down for such discussions towards the end of the last century. The question arises, however, whether or not the scheme still provides an adequate framework for the numerous facts about animal behaviour which have been gathered experimentally during the past fifty years, and whether the time has not been reached when even popular reviews of the subject should expand less on its traditional issues, such as instinct, about whose inner nature little or nothing is known, and concentrate more on forms of behaviour the scientific analysis of which has added a little light to the general mystery by which much of the subject is encompassed.

The shortcoming of the classical approach

* *J. Roy. Soc. Arts*, **84**, 281.

results mainly from its too rigid adherence to concepts which have little scientific value. For example, the definition of instinct as something that a species, as opposed to one of its individual members, has learned to do, is eminently sound as a broad description of a type of behaviour. As a hypothesis in the scientific sense of the term, it is valueless. The term 'instinct' covers a multitude of complex activities, each compounded of distinct units, each of which in turn may comprise a number of separate physiological reactions. How these separate reactions are linked, and become linked in the course of evolution, is a problem about which almost nothing is known as yet. Instinct, in short, is a broad term by which we cover our ignorance of a very complex question. The same, in no less degree, is true of the concept of 'insight', which we discover is a term used to designate certain rapid complex adaptive reactions, the essential steps of which are no less obscure than those of 'instinct'.

Dr. Katz told a story of two dogs, the larger of which had a bone which the smaller wished to get. When the smaller animal approached, it was frightened away by the menacing attitude of the other. After a time, the big dog ran out of the house, unnoticed by the smaller one, who, after hearing barks coming from the direction of the garden, immediately went and secured the bone. The original describer of the incident apparently interpreted this as a manifestation of reasoning in the little dog, which, when it heard the big dog barking in the garden, argued that it was now safe to steal the bone. There can be little doubt that a child behaving in the same way would also be regarded as having exercised a certain amount of reason. Dr. Katz, however, suggests that it would be better to suppose that growling at close quarters was a more effective inhibiting factor to the small dog than barking from a distance, and that the smaller animal's final response represented, not the product of a reasoning process, but a release from inhibition. In the circumstances, it is difficult to escape the feeling that were someone to uncover the hidden steps through which an ape solved a problem by so-called insight, there would be many who would cease to see in the performance any attributes of a higher reasoning power—in the same way that Dr. Katz's explanation seems to remove from the behaviour of the little dog any similar quality. The estimation of what constitutes reason in animals is clearly far too arbitrary a process.

The shortcoming of the concept of insight in the study of animal behaviour does not, however, end here. Insight may have been of use when it was a concept designating the highest and most complex stage in an evolutionary scale of behaviour, but behaviour which by definition cannot be denied similar description has recently been encountered not only among monkeys as well as apes, but also in cats, and even in rats. However humble the organisms in which it has been found, behaviour with insight still remains an altogether mysterious and complex phenomenon. It is well known that the peculiarities of a particular animal may be such as to transform an experimental problem with which it is presented into a meaningless situation, or into something completely different from what was intended ; in consequence, most students of behaviour to-day recognise the fact that problems which animals are set in experiments must be carefully arranged with regard to the animal's known sensorimotor capacities. What does not appear to be sufficiently well emphasised is that a successful performance of an animal in an experiment may give the appearance of brilliant reasoning as much because of our own incapacity to understand what is happening as because of the animal's inherent genius. We only shelve our problems by using terms like insight and instinct as if they added anything to our original knowledge of the situations to which they refer, and we only confuse ourselves by adhering to traditional concepts which, for all their antiquity, may be barren of any promise.

Were the spurious issues of the classical approach to animal psychology laid aside, there would remain a vast choice of true scientific material for popular expositions of the subject ; and by so doing it would be possible to put before the uninitiated points of view which would be in close sympathy with those that prevail in places where the subject is vigorously pursued by experiment. For example, although the conditioned reflex is primarily a physiological concept, some recent investigations of animal behaviour have shown that its laws have a wider bearing as characteristics of many forms of learning. The statistical study of delayed reactions and delayed alternations, again, has provided much useful and exact information about memory in animals. Discrimination experiments using visual, auditory, temporal and tactile stimuli have given extremely interesting data about perceptual capacities—a topic considered by Dr. Katz. Specific issues such as these are the ones that form an inner nucleus of knowledge from which a fruitful expansion of the study of animal behaviour could be expected. Observations of normal behaviour, or an experimental method which shows qualitatively what an animal can do, and what it cannot do, provide the subject with much of its material, and are undoubtedly necessary for its well-being, but in themselves they cannot provide the necessary data for the integration of a real scientific system of animal psychology.

Obituary

Prof. K. C. Browning

KENDALL COLIN BROWNING was one of three sons of the late Captain Browning, R.N., and was educated at Dulwich College, where he studied chemistry under H. Brereton Baker, and gained a leaving scholarship to St. John's College, Cambridge. Here he was senior foundation scholar, afterwards obtaining a first in both parts of the Natural Science Tripos. He was also Hughes Prizeman in 1890. He rowed for his college, was awarded a half-blue for cycling, and was a captain in the University Volunteers.

At Cambridge Browning studied under Ruhemann, and in 1898, jointly with Ruhemann, published the results of his first research—on the formation of ethyl-dihydroxy-nicotinate from ethyl-cyano-acetate. This was published in the *Journal of the Chemical Society*, as were several subsequent papers. From 1898 until 1900 he was Hutchinson research student, and from 1897 until 1903 demonstrator and lecturer at St. John's College. From 1899 until 1903 he supervised the instruction of medical students in chemistry and physics. During this period he published papers on a variety of subjects, one jointly with R. H. Adie on the interaction of sulphuric acid with potassium ferrocyanide, and others on hydro-ferrocyanic acid, phosphorus suboxide, and quadrivalent oxygen.

In 1904 Browning was appointed Government analyst and professor of chemistry at the University College of Colombo, Ceylon. His work there was of a very varied nature, including routine and research work connected with Customs and Excise, also criminological investigations for the police, for which the country afforded unusual opportunities. The results of some of his work during this period are published in the *Journals* of the Chemical Society and Society of Chemical Industry, on alcohol estimation in the tropics, on a convenient thermostat for specific gravity determinations, and a gas regulator, on the detection of mercury for toxicological purposes, on coco-nut toddy, jointly with C. T. Symons, and on ghee, jointly with M. Parasarthy.

In 1916 Browning was commissioned in the Royal Engineers, for which he carried out work on the purification of water supplies for the Army in Mesopotamia. Owing to ill-health, he later returned to England, and was transferred to the Ministry of Munitions. Here he worked with Prof. T. M. Lowry, technical director of gun ammunition filling, on problems connected with the high explosive fillings of shell. At the conclusion of the War, he was joint author, with Prof. T. M. Lowry and J. W. Farmery, of a paper on the decomposition of nitric esters by lime. This work had its origin in experiments carried out by the late Prof. Hodgkinson (at the Ordnance College), and continued by the Waste Explosives Committee under the direction of Prof. T. M. Lowry, with the view of devising methods of usefully disposing of the immense quantities of cordite and other explosives which remained surplus at the end of the War.

On demobilisation, Browning worked for a short time with his old teacher, Prof. H. B. Baker, at Kensington, and in 1921 he was appointed professor of chemistry and metallurgy at the Artillery College, formerly Ordnance College, and now Military College of Science, Woolwich. In the following years he made a special study of the chemistry of fuels and lubricants, with reference to their properties and uses in the internal combustion engine. He was an enthusiastic teacher, and a chemist in the broadest and truest sense, possessing an encyclopædic knowledge which was always at the disposal of those who were privileged to work with him. He continued to work in the face of great physical difficulties until within a few months of his death, which occurred suddenly at Dawlish, on January 26, in his sixty-first year.

R. C. G.

WE regret to announce the death at the age of forty-two years of the eminent Brazilian biologist, Dr. Lemos Monteiro, of the Butantan Institute of the medical faculty at São Paulo. He was best known for his work on yellow fever and Rickettsia diseases; but he was also the author of works on cattle plague, the Twort-d'Hérelle phenomenon, antitetanic immunisation, diphtheria and vaccine virus. His death was due to accidental inoculation in the laboratory with *Rickettsia neotropica*, the virus of São Paulo typhus.

WE regret to announce the following deaths:

Prof. A. Hanák, professor of physiology in the University of Prague, aged forty-six years.

Mr. Francis A. Mason, for thirteen years secretary, and lately president, of the Yorkshire Naturalists' Union, aged fifty-eight years.

Prof. Stefan Minovici, professor of organic chemistry in the University of Bucharest, and president of the Rumanian Society of Chemistry.

Prof. C. Lloyd Morgan, F.R.S., emeritus professor of psychology in the University of Bristol, on March 6, aged eighty-four years.

Dr. G. T. Prior, F.R.S., formerly keeper of minerals in the British Museum (Natural History), on March 8, aged seventy-three years.

Mr. James H. Scarr, principal meteorologist of the United States Weather Bureau in New York since 1926, on February 14, aged sixty-nine years.

Prof. Stephen Soudek, professor of applied zoology in the Agricultural College, Brno, known for his work on pests of agriculture and forestry, on February 20, aged forty-six years.

News and Views

"Gmelins Handbuch der anorganischen Chemie"

PROF. RICHARD J. MEYER, having reached his seventieth year, has recently resigned his position as editor-in-chief of the eighth edition of "Gmelins Handbuch der anorganischen Chemie". His name as a research worker in the field of the rare earths, as an authority on the chemistry of scandium, and as a member of the International Commission on Atomic Weights is well enough known, but there can be no doubt that for many years to come his name will be especially honoured in connexion with the editorship of the new "Gmelin". This handbook, in its seven previous editions, had been valued by generations of chemists as a most comprehensive reference book on inorganic chemistry, but little was done to help the reader to winnow the chaff from the wheat. When, in 1921, the German Chemical Society took over the sponsorship of the eighth edition and entrusted it to the care of Prof. Meyer, it was decided to introduce, without sacrificing the completeness of the references, not only the necessary criticism, but also to give due prominence to the role which physico-chemical considerations now play in questions of inorganic chemistry. Since the last edition, in 1906, the number of publications to be considered has enormously increased; and as the German Chemical Society wished the term 'inorganic chemistry' to be understood in its widest sense, thus including material valuable also for the neighbouring sciences of metallurgy, mineralogy, geology and physics, it was obvious that practically a new work would have to be written, on such an ambitious scale that publication would only be possible if substantial financial assistance were forthcoming from the chemical industry in Germany.

THIS is not the place to describe what has so far been achieved. More than forty parts—dealing with some twenty-five elements—are already printed, providing authoritative and clearly arranged information on the topics discussed. It is safe to say that there exists no other comparable work on inorganic chemistry in any language. This, of course, does not detract from other publications which may have the combined virtues of being completed, shorter and cheaper; but in the critical quality of the work, undertakings on a smaller basis can scarcely hope to compete with the staff of forty chemists and fifteen technical helpers working under Prof. Meyer, in direct contact with various departments of the German Chemical Society. Prof. Meyer deserves the thanks of chemists of all countries for having organised and so successfully started the volumes, which are destined to be the 'Beilstein' of inorganic chemistry. One of his oldest co-workers, Dr. E. Pietsch, has now been asked to take his place as chief editor, and it is hoped that in eight years the monumental work will be completed.

British Patent Law: Defects and Remedies

DR. HERBERT LEVINSTEIN has done a service to chemical industry by directing attention, in an address on "The Grant of Trading Monopolies" delivered on March 6 to the Institution of Chemical Engineers, to the failure of our patent system to follow the political and industrial changes that took place after the passing of the Statute of Monopolies in 1623. The original ideal of the avoidance both of "idleness . . . and the drawing out of our treasures for foreign manufacture" contemplated the establishment of a new home industry as a corollary to every grant. Yet in 1932, while less than 17,000 patents in all were sealed, some 13,000 applications were made by foreigners who are not compelled by law to work their patented inventions in Great Britain. It is Dr. Levinstein's opinion that this is a defect now of relatively minor importance, since import duties have caused the foreign manufacturer to establish works in Great Britain. He suggests that a further defect is to be found in the fact that patent grants are esteemed so lightly that more than half are abandoned when a renewal fee of £5 becomes payable, and less than 4 per cent are maintained for the full period. Patent litigation he also finds too costly because it is too lengthy, and reminds us that an important chemical action recently occupied the courts for some 74 days and cost well over £100,000!

THE defects which Dr. Levinstein attributes to our patent system call, in his opinion, for reforms which are in substance the same as those suggested by the "Business of the Courts Committee", the third and last report of which was recently issued. Dr. Levinstein deprecates any curtailment of the right of appeal but submits that much time and money would be saved if, prior to trial, both parties were called on to prepare and to exchange documents setting out their case and the gist of the expert evidence they proposed to produce. He insists that the grant of patents should be enormously curtailed and, to this end, would empower the Comptroller of the Patent Office to deal with questions of subject matter, common knowledge and utility. This reform is more likely to be acceptable than his arguments in support of it, as he implies that the Comptroller should save the inexperienced applicant from himself, and inexperience can exist in a firm that has taken out 430 patents. He would like to see the Comptroller empowered to issue under suitable conditions a qualified "certificate of validity", and many in industry would be glad to get some sort of official guarantee of the validity of their grant, having in view Dr. Levinstein's statement that in 22 patent actions fought in the years 1934 and 1935, 13 patents were held invalid. Dr. Levinstein's last suggestions are non-contentious. He would like to see every chemical engineer with a sound working knowledge of patents and patent principles.

Cosmic Rays Near the South Magnetic Pole

ADMIRAL R. E. BYRD'S book, "Antarctic Discovery" (Putnam and Co., Ltd.), which has just been published, contains a preliminary note on the cosmic ray records made by his expedition near the South Magnetic Pole. In an aeroplane flight from Little America (828 miles from the magnetic pole), a height of 12,000 ft. was reached and maintained for three hours while A. A. Zuhn made his observations. While the analysis of the records obtained during this flight, and also during regular ground-level observations, has not yet been completed, Admiral Byrd states that he has been informed by Zuhn that the intensity of radiation was fifteen times greater at 12,000 ft. than at ground-level in Little America, and eight times greater than that recorded in any observations made in the United States. It is to be regretted that it was necessary to replace the original argon of the ionisation chamber with carbon dioxide, owing to a leak which developed during the long transport of the instrument. As, however, a radium capsule was available for standardisation, Admiral Byrd expresses the opinion that the validity of the records obtained will not be affected. He adds that a crucial test of this point is to be made before the records are formally published.

Exhibition of Chinese Art at South Kensington

THE exhibition of Chinese art at the Royal Academy, Burlington House, closed on March 7, when the number of visitors had reached the remarkable total of 422,048. This number constitutes a record for all the recent winter exhibitions, with the exception of the exhibition of Italian art. It justifies the opinion expressed at the time the exhibition opened that the quality of Chinese art, when once certain conventions had been assimilated, was such in its general outlook and approach to reality as was likely to appeal to the susceptibilities of a British public. This was most strikingly manifested in the attention attracted by the transcendent qualities of the scroll landscape paintings; but it was also to be noted that the bronzes and other exhibits belonging to the early prehistoric period and the T'ang figures received little less detailed inspection, so far as conditions allowed. The popularity of the exhibition did not, indeed, conduce to a full appreciation of the subtler qualities of this great art, and it is, therefore, all the more gratifying to learn from the Directors of the British Museum and Victoria and Albert Museum that arrangements are being made for the exhibition at South Kensington at an early date of the Eumorfopoulos collection of Chinese art. This exhibition will include not only the purchased objects already assigned to South Kensington and the British Museum respectively, which will be brought together again for this purpose, but also that part of the collection of which the purchase is not yet complete, through the generous public spirit of the owner. If the public displays an interest in this collection in any way comparable to the enthusiasm shown at Burlington House, it should prove a strong incentive to early action in providing the much desired Museum of Asiatic Art, so greatly needed in London.

Palæolithic Implements of the Warren Hill Gravel

A SELECTION from nearly 1,300 flint implements in the Sturge Bequest, from the gravel on Warren Hill, near Mildenhall, Suffolk, is on special exhibition at the British Museum, Bloomsbury, and will remain there for about three months. It will be found at the head of the main staircase, and is arranged in two desk-cases, one containing representatives of the main types and the other the specimens illustrated in the Sturge volume, with exceptional pieces showing the remarkable local patina and other special features. The exhibition is intended to show the sequence or association of implements in the same gravel, and to direct attention to the deposit, which is a geological puzzle. The long hill between Mildenhall and Icklingham lies at right angles to the River Lark near its south end, and was evidently formed before the valley was cut. The gravel seems to belong to an interrupted line of high-level deposits in a curve from Lakenheath to Snailwell, following the south-eastern boundary of the Fens. It is now generally held that this gravel bank is a glacial moraine; but there were thousands of implements included in it, and some in an unrolled condition enable a limiting date, if not a sequence, to be supplied on archæological grounds. The collection shows that, besides first-class hand-axes of St. Acheul character, there was also a striking proportion of flake-implements resembling in form those from High Lodge near the north end of the same ridge; and these are now thought to mark the third stage of the Clacton industry. Their horizon elsewhere is evident, but at Warren Hill it remains to determine the relation between the Clacton and St. Acheul series, and to identify the glaciation producing this apparently homogeneous gravel, which must have been derived from an area, once thickly inhabited, in the neighbourhood. There is now a good opportunity to draw on the archæological material for a solution of the geological problem.

Archæological Investigation in Cornwall

AT the close of the present month, the Cornish Excavation Committee will begin the excavation of Castle Dore, a hill-camp which lies between Lostwithiel and Fowey. The excavation will be carried out by Mr. C. A. Ralegh Radford, who was in charge of the recent excavations at Tintagel. The Castle Dore camp, being situated on the line of a trade route which linked up Ireland, Cornwall and the Continent in prehistoric times, holds out every prospect by its geographical position alone of yielding material of interest and importance for archæological studies; but in addition, recent research, notably by the late Prof. Loth, the Celtic scholar, and by the late Mr. Charles Henderson, whose untimely death was a great loss to Cornish archæology, indicates that Castle Dore may be a focusing point of traditions which seem to indicate a connexion here with the King Mark of Arthurian story, whose bride Iseult was brought from Ireland by Tristan. King Mark lived at "Lancien" which Prof. Loth suggested may be the original form of the name of Lantyan, the parish in which Castle Dore is situated, and he also

traced a possible connexion with the St. Samson who is the patron saint of the nearby Goland Church. A menhir known as the Castle Dore stone, which once stood near the camp, is also thought to be connected with King Mark under the name Conomonus or Quonomorius, while a doubtful interpretation of a much obliterated commemorative inscription would point to Tristan being his son and not his nephew. Other suggestions, derived from like sources, have been put forward, of connexion with figures of Arthurian tradition. Although it is scarcely to be expected that excavation will bring to light anything in the nature of concrete evidence to support the connexion, the body of tradition which clings to this valley of Fowey encourages the hope that it preserves a folk-memory of what was once an important centre of early civilisation.

International Cancer Congress

THE second International Congress of the Scientific and Social Campaign against Cancer will be held in Brussels on September 20–26. The Congress is under the patronage of His Majesty the King of the Belgians and of Her Majesty Queen Elizabeth, and has the support of the Government. The National Executive Committee consists of Dr. Lerat (*chairman*), president of the Belgian National League against Cancer, Profs. Delrez, Dustin, Goormaghtigh and Maisin, directors of the Anti-Cancer Centres of Liège, Brussels, Ghent and Louvain respectively; Dr. Sluys, president of the Belgian Society for Radiology; Dr. Timbal, director-general of the Government Department of Hygiene; Mr. H. Marchal, treasurer, and Mr. W. Schraenen, general secretary of the Belgian National League against Cancer and of the Congress. The programme of the Congress has been divided into two main groups, embracing the scientific campaign and the social campaign against cancer, and the subjects on which official reports will be prepared and upon which individual communications are invited are grouped together under the following headings: (1) The experimental investigation of cancer, which comprises the study of carcinogenic substances, transmissible agents and viruses, growth substances, and factors of predisposition and resistance such as heredity, metabolism and immunity; (2) the diagnosis of cancer by histological, radiological and serological methods; (3) the treatment of cancer by surgical, medical and radiological methods. In the second group, on the social campaign against cancer, the subjects dealt with are: (1) Access of patients to diagnosis and treatment; (2) medico-social assistance to incurable cases; (3) cancer and demography including statistics and racial incidence. The list of official *rapporteurs* is not yet complete, but among those who have agreed to present reports are: M. Borst, J. W. Cook, W. Cramer, H. F. Deelman, L. Dublin, A. P. Dustin, J. Ewing, W. E. Gye, H. Holthusen, E. L. Kennaway, J. Maisin, M. Nagayo, F. Pentimalli, Cl. Regaud, P. del Rio Hortega, G. Roussy, C. Rowntree, H. Schinz, F. Carter Wood. Further particulars may be obtained from Mr. W. Schraenen, General Secretary to the Congress, 13 rue de la Presse, Brussels, Belgium.

Colonial Administration

A SYMPOSIUM on "Peace and the Colonial Problem" published by the National Peace Council (39 Victoria Street, S.W.1. 6*d*.) contains the speeches delivered by Sir Arthur Salter, the Marquis of Lothian, Prof. N. Bentwich, Sir John Harris and others, at a Conference organised by the National Peace Council and held at the Livingstone Hall, Westminster, in October 1935. Sir Arthur Salter states that he considers that it would be both wrong and impracticable at this moment to transfer colonies to the dissatisfied countries of the world. He holds, however, that a remedy might be found in an extension of the mandate principle, whereby colonies would be held under a double trusteeship (1) to the inhabitants of the country and (2) to the world in general. Countries holding mandates should be responsible for the execution of their trusteeship to an international authority under a mandate, and the terms of this mandate should be extended so as to remove so far as possible the economic disabilities suffered by countries not possessing colonies.

PROF. NORMAN BENTWICH, in referring to the question of equality of economic opportunity, said that there should be real equality of opportunity for investment of capital and for obtaining concessions in the colonies. This would provide some alleviation of the economic grievances of those countries which are without colonies. He also advocated that the administrative services in colonies brought under mandate and in mandated territories should be open to the subjects of States other than the governing power. In Palestine it has been developed to some extent, and no difficulty has been found, for example, in working the medical or engineering services with persons coming from different countries. The adoption of a system of mandates and international responsibility would give an opportunity to foreign subjects and an assurance and a greater confidence to the native inhabitants of those countries.

Rapid Growth of the Use of Electricity

THE annual report of the Electricity Commissioners for the year ended March 31, 1935 (H.M. Stationery Office. 3*s*.), records a noteworthy expansion of the public supply of electricity. There is an increase of 1,715 million units on the output of the previous year. This is the largest actual increase hitherto recorded, and is equivalent to a growth of 12·1 per cent. The expansion is largely due to the increase of the domestic load. The Commissioners point out that owing to the persistent demand for the facilities and amenities capable of being provided by a public supply of electricity, there will doubtless be a great increase in the present consumption before 'saturation point' will be reached. There will be a wide field of opportunity presented for the electrical and mechanical equipment of industry when the present factory generating plant and prime movers become obsolete. There are possibilities also attached to the further development of railway electrification. The steam-driven power stations included in the returns account

for 95·5 per cent of the total units generated. The effect of the progressive improvements in steam power station practice which have taken place in the stations of authorised undertakers during the past four years alone is shown by the fact that the average number of electric units generated per ton of coal and coke consumed has risen from 1,200 in 1930 to 1,425 in 1934, an increase of more than 18 per cent. The Commissioners deprecate the custom of some public supply authorities, when advertising for tenders, of specifying that the particular plant or materials should be the product of a particular firm or group of manufacturers.

Thermal-Electric Stations

A STRONG case is made, in a paper read before the Institution of Civil Engineers on December 10 by Mr. S. B. Donkin, for the adoption, where possible, of the thermal-electric power station. The ordinary electric power station, using coal as a source of energy, has an overall thermal efficiency of about thirty per cent, whereas in a thermal-electric station which, besides supplying electric energy, also distributes the latent heat of the steam for domestic, horticultural and industrial heating, an overall efficiency of 60–70 per cent can be obtained. Where this system could be successfully adopted, it would solve the difficulty which is likely to arise if coal prices advance. That it is practicable is shown by the stations established in the United States, in the U.S.S.R. and elsewhere. Industrial plants operating on this system have been installed in England, but these are necessarily limited in effect to the requirements of the individual factory.

THE success of a public station would depend upon maintaining a balance between the electricity demand and the heat demand, for the waste heat available rises and falls with the rate of electricity generation ; as a general rule, the heat requirements would be greatest in the early part of the day, while the electricity peak occurs in the late afternoon ; seasonal variations are much more marked. A solution might be found in the inter-connexion of the electric side with that of the authorised electrical undertaking in the district. It is admitted that such stations could not easily be established in our older manufacturing towns owing to the cost of installing the heat-distribution network in congested streets already provided with electricity, gas, water, sewerage and drainage services. Mr. Donkin claims, however, that in laying out new industrial areas it would be possible to arrange for the supply of heat and electricity from a combined thermal-electric station, high-grade heat being supplied for manufacturing purposes, medium for domestic uses and low-grade for horticultural needs. To attain the high thermal efficiency quoted, it is necessary to use boilers operating at pressures of 2,000 lb. per square inch or more. The paper includes the diagrammatic lay-out of an ideal industrial town planned on these lines, and reference is made to existing stations.

New Australia–Tasmania Submarine Cable

THE new submarine cable which was successfully laid across the Bass Strait last November marks a notable advance in the technique of submarine cable transmission. Before laying this cable, the Australian Government made a searching inquiry into the relative merits of radio and cable systems of communication, and came to the conclusion that for the objects in view the cable system was the more desirable as it is more trustworthy and easier to make the messages secret. In the Engineering Supplement to the *Siemens Magazine* of January, a technical description is given of this new cable. It links the telephone and telegraph service of the mainland of Australia with Tasmania. Its length of 161 nautical miles is divided into two sections. The northern section, 79 miles in length, joins King Island to Apollo Bay, Victoria, and then by overhead lines and underground cables joins the trunk exchange at Melbourne. The southern section from King Island goes to the northern coast of Tasmania and then by land line to the Launceston exchange. Inter-connexion is thus effected with the existing network of communications in Australia and Tasmania. This cable, although it has only one insulated conductor, allows no less than five telephone and seven high-speed telegraph channels to be operated simultaneously. In addition, it provides for the transmission of a broadcast programme. Subscribers in Tasmania can now communicate directly with Great Britain by telephone. The adoption of a high-frequency carrier system was influenced by the fact that it is easy to repair. Cable ships are not always available for immediate service in Australian waters and this type of cable is the easiest to repair. There are already two carrier frequency submarine cables in operation. One connects Teneriffe with Gran Canaria, a distance of forty miles, and the other Key-West to Havana, a distance of 109 miles. Both these cables operate only three telephone circuits.

Bats in Belfries and Elsewhere

THE problem of eliminating bats from church-steeples has puzzled many a churchwarden, and was responsible for the introduction to England of that unwelcome guest, the little owl. Solutions to that, and to the general problem of the roosting of bats in homes and occupied buildings, are offered by the United States Bureau of Biological Survey, in Leaflet 109 (Sept. 1935). The objection to the presence of bats is partly due to an aversion which many people feel towards them, but more substantially to the highly objectionable stench of the droppings and urine which collect where bats are roosting in numbers. There are two main lines of procedure in breaking up a bat-roost. The most satisfactory and the only permanent way is to make the building bat-proof by closing all entrances by strips of metal or wood or plugging them with rags (of course after the bats have left their roost in the evening). A good composition for larger openings is tarred hemp fibre such as is used for calking ships. The second method is sometimes simpler—the use of a repellant such as

naphthalene flakes, liberally distributed in and about the spaces occupied by the bats. A third method is the destruction of the bats by fumigation with, say, hydrocyanic acid generated from calcium cyanide; but the procedure is dangerous and demands handling by an expert, and it has the disadvantage of leaving the dead bodies of the bats to decompose and add to the odours of the roost.

The Albert National Park in the Belgian Congo

ON November 12, 1935, a decree was passed which doubled the area of what was already one of the most remarkable natural reserves in the world, the Parc National Albert du Congo Belge. The extension, carrying the park northward and westward to Lake Edward which it incorporates, increases the area of the reserve from 390,000 hectares to 856,790 hectares, and its average length and width to 270 km. and 40 km. respectively. Within this area, the greatest diversity of habitat is to be found, for it stretches from the equator to the extreme east of the Belgian colony, and rises from 850 metres in the Semliki Plain to 5,119 metres at Peak Marguerite. As a consequence, the region now included presents a succession of stages of vegetation from primitive tropical forest to the equatorial alpine zone, and in plants and animals contains a rich flora and fauna comprising many forms not elsewhere to be found. The value of the new extension is the greater since the Belgian reserve is contiguous with the British Uganda reserve, and ought to permit the adoption, through an extensive area in which the needs of the fauna and flora are similar, of common protective measures, such as were contemplated in the London Convention of November 1933 (Article 6) relative to the conservation of the natural fauna and flora, to which Belgium signified her adhesion.

Soil and Forest Conservation in the United States

THE United States has now awakened to the serious position brought about by the excessive felling and destruction of forests during the last fifty years. A great campaign is taking place with the object of impressing upon the people the valuable results to be expected from soil conservation and forest conservation, which are now regarded as national problems. The work of Mr. C. A. Connaughton of the U.S. Forest Service is commented upon in a recent communication from Science Service, Washington, D.C. This investigator has studied more than 3,000 test plots in burnt-over forest land, comprising both cut-over areas and virgin timber. In general, the more severe the fire the more severe also was the subsequent erosion. On the steeper lands, lightly burnt areas, on which the fire took only the top layer of the forest floor litter (the ordinary leaf fire, so termed), little erosion was perceivable, about 10 per cent of such plots being eroded. In the case of severe fires, so high as 80 per cent of the plots showed erosion. Mr. Connaughton's research would appear to merit attention from officers connected with these matters in the British Empire. "Of course," says the author, "where soil is eroded away from a burnt-over forest site, it is difficult to make trees grow there again—impossible, if the erosion is severe enough to lay bare the underlying rock. But the damage is apt to be felt by people who never see or think about the forests. Hundreds of miles away, the freshets that gush through the erosion gullies accumulate as floods, in the greater rivers, piling out of their banks to wreak destruction, and leaving behind them, on lowland farms and industrial areas, burdens of silt that should be up in the hills, growing trees." This might have been written in connexion with the outer Punjab hills. The paper is given in full in the current issue of the *Journal of Forestry*.

Efficiency of Wood as Fuel

IN an age of so much and such abstruse research, it is common to find that no exact answer can be given to some of the most everyday problems. The Canadian Department of Mines found this to apply to the relative value of wood as domestic fuel as compared with coals. In Canada, this question has an importance which has long since disappeared in Great Britain. The Fuel Division of the Department has published tests by E. S. Malloch and C. E. Baltzer (Report No. 761, Ottawa, 10 cents) on the efficiency of wood as fuel for heating water in a furnace of the type normal in North America, and previously used for tests on coal and coke. Tests with an American anthracite showed a thermal efficiency of 66 per cent. Under comparable conditions, the efficiency of hardwood (maple) varied from 50 per cent (green) to 57 per cent (seasoned wood). Corresponding figures for soft wood (pine) were 42 per cent and 49 per cent. By placing a perforated plate over the firebars, the efficiency could be slightly increased, and in all cases the loss in unburnt fuel was negligible. These figures are quite good, but the wood compared unfavourably with coals in output and in the weight and volume of fuel to be handled.

San Francisco Bay Bridge

THE project of building a bridge across San Francisco Bay was first discussed seventy-five years ago. Photographs of the bridge now under construction given in the *Electrician* of February 14 show that it is nearing completion. The twin suspension bridges are the largest in the world and are attached to hollow concrete anchorages about 280 feet above the water. The centre towers are 519 feet high and the outer ones 474 feet. The main spans of the twin suspension bridges are 2,310 feet long and the side spans 1,610 feet. A tunnel through Yerba Buena Island connects the two halves of the bridge. The eastern half of the bridge has a cantilever span 1,400 feet long which is still uncompleted. The bridge is to cost £15,500,000, and is being built for the California Toll Bridge Authority. The bridge will be lighted by the largest installation of sodium vapour lamps in the world; they are arranged along the fifteen miles of roadways for the double deck spans, the tunnel and the approaches at the San Francisco and

Oakland ends. On the upper deck of the bridge, to be used for six lines of passenger vehicles and other high-speed traffic, the illumination will be specially bright. A new type of reflector is used with the lamps which does not oxidise, has a very hard surface and has a reflecting factor of more than eighty per cent. Six 1,000-watt single lens rotary beacons and five 400-watt flashing beacons will warn aircraft of the proximity of the bridge. A large number of navigational lights will be required and fog warnings will be given by five large bells and six fog sirens driven by ten horse-power motors.

Significance of Classification of Organisms

THE study of form has revealed the importance of convergence in the evolution of plants and animals, as well as the inevitable influence of laws of growth which apply to creatures whatsoever their descent. But the significance of convergence would disappear did we not assume that it is superimposed upon some more fundamental structure, and this is the fundamental structure upon which classifications revealing natural relationships are based, according to Dr. W. T. Calman in his presidential address before the Linnean Society of London (*Proc. Linn. Soc. London*, 1934–35, p. 145). To illustrate the distinctiveness and significance of the taxonomic view, Dr. Calman traced the parallel between the morphological classification of the higher Crustacea and the evolution of the group. Here is a natural classification which does violence to none of the conclusions of morphology or of palæontology, and is consistent with an evolutionary history in which convergence may have played an important part, but never the dominant one.

Bibliography of Chinese Insects

THE *Journal of the Shanghai Science Institute* (Section 3, vol. 2, 1934, pp. 1–533) contains a bulky memoir by Mr. Yoshio Ôuchi entitled "Bibliographical Introduction to the Study of Chinese Insects". It takes the form of a catalogue of references of all systematic, and some other, papers dealing with the insects of China up to the year 1932. It is arranged in taxonomic fashion according to orders, followed, in most groups, by subdivision under the individual families. Facility of reference is thus assured and, it may be added, the work appears to be remarkably complete. An immense number of periodicals in many languages has been explored and the enterprise is one which deserves high commendation. A compilation of this kind will prove of the utmost value in a country far removed from the scientific centres of Western civilisation. In vol. 3, 1935 (pp. 17–88), of the same journal, the author brings this work further up to date in listing all papers of similar bearing published during the year 1933.

Clothes Moths and House Moths

THE British Museum (Natural History) has recently issued a second edition of a useful fifty-page pamphlet, entitled "Clothes Moths and House Moths" (British Museum (Natural History), London, S.W.7. 6*d*.). This pamphlet, which forms No. 14 (Economic Series) of the Museum publications, deals with the five British species of moths found in dwellings, outbuildings, etc., and the larvæ of which are destructive to clothing, blankets, upholstered articles, fur, feathers, etc. Each species is described and its habits explained, and the accounts are accompanied by very clear photographic illustrations. The control of these insects by preventive and remedial measures is fully discussed.

Certification of Blindness

IT has been found that the results of testing for defective sight by means of test cards may vary according to the degree and standard of illumination of the cards. As the matter is of importance in connexion with certification under the Blind Persons Act, 1920, the Ministry of Health has issued a circular on the subject (Circular 1520. H.M. Stationery Office. 1*d*. net). This suggests that test cards should preferably be illuminated by artificial light, which should be approximately, and not less than, 10 foot-candles, and a simple means is described for effecting this.

Thomas Gray Memorial Trust Awards for Navigation

THROUGH the Thomas Gray Memorial Trust, the objects of which are "The advancement of the Science of Navigation and the Scientific and Educational interests of the British Mercantile Marine", the Royal Society of Arts has divided the prize of £100 offered for an invention, publication, diagram, etc., which constitutes advancement in the science or practice of navigation, between H. J. Buchanan-Wollaston, of Lowestoft, for his current meter, and Dr. F. W. Edridge-Green, of London, for his colour perception lantern, which enables tests to be made under conditions very closely allied to those found in everyday practice, while the colours chosen are those which most rapidly and definitely disclose any defect in colour perception. A prize of £100 was also offered for an essay on modern navigational appliances made possible by electricity on board, and also appliances not depending on electricity. The prize was divided as follows: £40 to Lieutenant B. E. Druce, of Salop; £40 to R. J. Finch, Jr., Second Officer, Royal Mail Lines, Ltd., of Southend-on-Sea; and £20 to Captain J. G. Bisset.

Solar Eclipse Expeditions

Two British expeditions to observe the total eclipse of the sun on June 19, 1936, are leaving for sites selected from which to observe the eclipse. The path of the total eclipse stretches from Greece over Siberia to the Pacific Ocean. An expedition led by Prof. F. J. M. Stratton, of the Solar Physics Observatory, Cambridge, will station itself in northern Japan. The programme of eclipse observations consists chiefly of observations of intensities of lines in the flash spectrum; despite the vigorous growth of the technique of spectrophotometry in the last decade, very few spectrophotometric observations have been made on eclipses, chiefly on account of the ill-luck through cloud which has attended recent

expeditions. The second British expedition will be led by Prof. J. A. Carroll of the University of Aberdeen, and will proceed to a site in the U.S.S.R. where the eclipse will take place near midday. It is to be hoped that good weather will reward the efforts expended in organising both these expeditions.

Announcements

THE Bessemer Gold Medal for 1936 of the Iron and Steel Institute has been awarded to Mr. Fred Clements, director of the Park Gate Iron and Steel Co., Rotherham, in recognition of his distinguished services in improving the technology of the iron and steel industries and, in particular, blast-furnace practice. The presentation of the medal will be made by the president of the Iron and Steel Institute, Sir Harold Carpenter, at the opening session of the annual general meeting of the Institute on May 7.

THE following appointments have recently been made by the Secretary of State for the Colonies: R. E. Dean, to be curator, Royal Botanic Gardens, Trinidad; W. Richards, to be probationer, Meteorological Branch, Survey Department, Malaya; A. B. Killick (senior agricultural officer, Uganda), to be assistant director of agriculture, Trinidad; G. B. Gregory (agricultural assistant, St. Kitts-Nevis), to be agricultural assistant, St. Lucia; D. P. McGregor (geologist, Gold Coast), to be geologist, Nyasaland.

AT the annual general meeting of the Geological Society of London, the following officers were elected for 1936–37: *President*, Prof. O. T. Jones; *Vice-Presidents*, J. F. N. Green, Prof. H. L. Hawkins, Prof. W. J. Pugh, Prof. H. H. Swinnerton; *Secretaries*, Prof. W. T. Gordon, Dr. L. Hawkes; *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, F. N. Ashcroft.

AT the recent annual general meeting of the Institute of Metals, the following officers were elected: *President*, W. R. Barclay; *Vice-Presidents*, Dr. H. W. Brownsdon, Prof. D. Hanson and E. L. Morcom; *Members of Council*, Dr. S. F. Dorey, Kenneth Gray, Lieut.-Colonel J. H. M. Greenly, D. J. MacNaughtan, Dr. C. J. Smithells and F. Tomlinson.

A MEETING is being held on Saturday, March 14, at 11.0 a.m., in the rooms of the Royal Entomological Society of London, at 41 Queen's Gate, South Kensington, S.W.7, to discuss the formation of a society for the study of the bibliography of natural history. Communications on the subject should be addressed to Mr. Francis J. Griffin, at 41 Queen's Gate, London, S.W.7.

THE Association of Special Libraries and Information Bureaux (ASLIB) is to hold its thirteenth annual conference at Balliol College, Oxford, during the week-end beginning Friday, September 18. Particulars may be obtained from the Secretary of the Association, 16 Russell Square, London, W.C.1. Dr. Cyril Norwood has agreed to accept nomination as president of the Association for 1936–37.

BY the courtesy of the Science Museum, South Kensington, several sets of photographs which the Museum exhibited recently, as illustrating developments in science and industry during the past quarter of a century, have been lent to the North East Coast Institution of Engineers and Shipbuilders, and are being exhibited in the Library of the Institution. The sets selected for exhibition are on the following subjects:—(1) Aeronautics and Structure of Matter; (2) Ships and Marine Engineering; (3) Land Transport and Power Production and Transmission; (4) Pumps and Fire Protection and Machine Tools; and (5) Electric Power and Communication.

THE fifteenth International Congress of Medical Hydrology, Climatology and Geology will be held at Belgrade in October. Further information can be obtained from Prof. Milontine Neskovitch, 3 rue Takowska, Belgrade.

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

A technical assistant (male) in a War Department Establishment at Biggin Hill, Kent—The Superintendent, Air Defence Experimental Establishment, Biggin Hill, Kent (March 18).

Technical assistants (male) for a War Department Establishment at Woolwich (physics or engineering)—The Superintendent, Signals Experimental Establishment, Woolwich Common, S.E.18 (March 18).

A Director of Experiments, Chemical Defence Experimental Station, Porton, Wiltshire—The Under-Secretary of State (C. 5), The War Office, S.W.1 (March 20).

Two inspectors in connexion with agricultural and horticultural research—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (March 23).

A biochemist to the Animal Diseases Research Association—The Secretary, Moredun Institute, Gilmerton, Midlothian (March 27).

A professor of engineering in the University of Sheffield—The Registrar (March 28).

A civilian technical officer in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (March 28).

An assistant lecturer in statistics in the London School of Economics and Political Science, Houghton Street, Aldwych, W.C.2—The Secretary (April 11).

Assistant keepers of zoology, entomology, mineralogy and botany in the British Museum (Natural History)—The Secretary, British Museum (Natural History), London, S.W.7 (May 31).

Civil engineering assistants in the drawing offices of the Admiralty and H.M. Dockyards—The Civil Engineer-in-Chief, Admiralty, S.W.1.

A professor of physics in Raffles College, Singapore—The Secretary, Universities Bureau, 88A, Gower Street, W.C.1.

An electrical engineer to the Government of Palestine for the Public Works Department—The Crown Agents for the Colonies, 4 Millbank, S.W.1.

Supplement to "NATURE"

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A Modern Sociology

The Mind and Society (Trattato di Sociologia generale)

By Vilfredo Pareto. Edited by Arthur Livingston. Translated by Andrew Bongiorno and Arthur Livingston with the advice and active co-operation of James Harvey Rogers. Vol. 1 : Non-Logical Conduct. Pp. xviii+497. Vol. 2 : Theory of Residues. Pp. vi+499–884. Vol. 3 : Theory of Derivations. Pp. vii+885–1432. Vol. 4 : The General Form of Society. Pp. vii+1433–2033. (London and Toronto : Jonathan Cape, Ltd., 1935.) 4 vols., £4 4*s*. 0*d*. net.

IT would seem that little is known about the personality and private life of this voluntary Italian exile who, at the age of forty-six years, was appointed to the chair of economics at the University of Lausanne. Up to that time he had been an engineer and had held a post in the railway administration. An intense interest in the concrete economic problems of the day led him to engage in political controversy. In the course of these activities—Pareto was an impassioned advocate of free trade—he made personal attacks on men prominent in politics, and in consequence he was, or he believed himself to be, persecuted by the Government. Thus he gladly accepted the Swiss offer when it came, and the remaining twenty years of his life were spent in a villa near Lausanne, where he seems to have lived very quietly and in considerable luxury. A year before he died, Mussolini came into power, and Pareto found himself hailed as an intellectual precursor of Fascism, created an Italian senator and otherwise honoured. He has also obtained a considerable following in the United States, where this work was translated.

The essential thesis of this immense work can be stated in a few words. Actions are either 'logical' or 'non-logical'. Pareto gives no precise definition of what he means by these terms ; he says very little about actions belonging to the former class, and the book is almost wholly concerned with the actions of the latter kind. When we consider these 'non-logical' actions as a group, we find it quite impossible to discover any fundamental common characteristic which distinguishes them from 'logical' actions. Indeed it scarcely seems appropriate to apply these adjectives to actions. Thus there is a serious weakness in the foundations which are used to support this vast superstructure. Passing over this not unimportant point, we come to the substance of the work which, as we have said, is the treatment of 'non-logical' actions. The author classifies them into groups each of which is inspired by a sentiment. These sentiments are enduring and common to all mankind ; to them he gives the name of 'residues'. Thus the urge to make combinations is a 'residue' ; for example, there is the tendency to correlate rare events, such as an eclipse, with extraordinary happenings in the history of men or of nations. But men are not content unless they can explain their actions ; therefore they invent apparently logical explanations for their actions which Pareto calls 'derivations'. Here we find that he is, in fact, concerned with the familiar phenomenon of rationalisation. We regard this subject as within the realm of psychology ; but it is remarkable how little attention Pareto paid to contemporary psychological inquiry ; he does not, for example, mention Freud.

The formal aspect of the scheme of this work does not bear critical examination ; it is not, as Pareto believed it to be, a valid method of scientific approach to the investigation of social experience. But the scheme gives Pareto an opportunity to plunge into a survey of social phenomena of all kinds in all ages ; launching out in this manner, armed with a very powerful intelligence, considerable practical experience and a wide range of knowledge, he lays bare the dishonesty and self-deception which so largely characterise the actions of men. The zest with which he pursues his quarry is amazing ; he delights to drag the hidden motive to light. The value of the work lies in its

destructive effect ; of constructive power there is no trace. Presumably it is because Pareto is so concerned with 'debunking' that he has attracted attention on the other side of the Atlantic.

The language, which we have been led to use in order to give some idea of the nature of Pareto's work, itself suggests that the motive which impelled him was not that which produces dispassionate scientific investigation. That he was driven forward by powerful emotions is well brought out by Dr. Franz Borkenau, whose recent book on Pareto is one of the first two in the new series dealing with modern sociologists under the editorship of Prof. M. Ginsberg and Mr. Alexander Farquharson. Dr. Borkenau explains how Pareto came to be inspired by certain enduring hatreds. His father was a follower of Mazzini and was imbued with the vague humanitarianism which characterised all this school. Against this, Pareto revolted decisively and for good. Then his experience of an inefficient and none too honest political system made him favourable to authoritarian government. It is on account of these opinions that he has become a hero to Fascists. Though he wanted authority in politics, he believed passionately in freedom in the economic, religious and moral fields ; as regards the latter, he was especially devoted to the advocacy of sexual freedom. Thus, his own opinions were a mixture of incompatibles, and moreover may be traced to something very akin to 'residues'. But while this goes far to destroy the scientific value of his work, it enhances and does much to explain the interest felt by the reader.

At first sight these ponderous volumes are scarcely attractive ; but the reader soon finds himself under the spell of a powerful and critical mind moved by deep emotions ; in consequence the work is likely to find a permanent place in sociological literature.

Soviet Geography

Soviet Geography :
the New Industrial and Economic Distributions of the U.S.S.R. By N. Mikhaylov. Pp. xviii + 232. (London : Methuen and Co., Ltd., 1935.) 10*s.* 6*d.* net.

THE Russian revolution is usually associated with a fundamental change in the economic and political structure of the country, but it has been far more pervading than this. It substituted a new type of scientific philosophy for the old one that has dominated Western science for many years, and the Russians themselves distinguish sharply between their own, which they call socialistic science, and the Western science, which they call capitalistic. In the West it is assumed that truth, beauty, justice, right and certain other attributes are something absolute, providing unvarying standards independent of time and change. The socialistic men of science, on the other hand, admit no absolute quantities : these, they say, are a relic of the Western belief in a Creator who is the absolute, while they, having given up all such ideas, accept only the life of the community as the essential reality to which all such attributes are to be referred. As this is necessarily changing, absolute standards must disappear : truth, science, art, morals, have meaning only in relation to the life of the time : their value is thus only relative.

Philosophical distinctions of this sort have a way of disappearing in practice, just as the shifting physical values that made such extraordinarily interesting reading in Einstein's semi-popular book have not in fact altered workshop methods. The socialistic scientific workers of Russia, however, are not content to leave matters unchanged in practice ; they treat their subjects in a new way. The chief interest of the present volume lies in its manner of presentation as an illustration of the new methods.

The application of science to the problems of the community is in Great Britain as old as organised science itself. The Charter of the Royal Society states that it was founded to pursue science "for use and discovery", and this dual purpose has been recognised ever since ; applied science has always in Great Britain developed simultaneously with pure science, though the rates of progress may have differed. But the new approach is entirely different. We have started with a science based on the conception of truth as something fixed, immutable, eternal ; this has been applied to the problems of a rapidly changing community. The new socialistic science, on the other hand, is an inherent function of this changing life ; it possesses no absolute attributes but can be referred only to ordinates expressing the trend of change in social life. The difference is well seen in the

Russian publications on soil science; the introductory pages setting out the problems read to the uninitiated Englishman like a political treatise, and seem to him to be irrelevant; for the new science they are not merely relevant but fundamental; the science would be meaningless without them.

The author of the present book is lecturer at the Stalin Institute of Transport Engineers, Moscow; he has also been associated with the Central House of the Red Army; his political ground-work can therefore be assumed to be sound. As geographer he has travelled much in Russia, and has taken part in exploration in Shan-Tengri, the Pamirs and Tien-Shan.

The purpose of the book is to describe the regions of the U.S.S.R. in relation to the developments proposed under the present Five Year Plan. Its basis is frankly political; but in the U.S.S.R., geography like any other science would have no meaning and no *raison d'être* if it were not. The transformation of rural into industrial areas is triumphantly depicted: "Bashkirians are building a motor works. Uzbek women have cast aside the veils from their faces and are working in new textile combines. Turkinens are becoming chemical workers. Kirghizians are producing their own cloth and sugar. From the nomad saddle to the complex machine, from the tambourine of the priest to the polytechnic education". The agricultural situation is very glowingly described. "The corn problem is solved. . . . Capitalist elements in the U.S.S.R. have been stamped out. . . . Agriculture in the U.S.S.R. is conducted on a larger scale than anywhere else in the world." The tables set out the official figures and they show a cultivated area in 1934 of 131 million hectares and an output of 14·8 'billion' roubles. It is not stated what a 'billion' is; but in almost every country except England it means a thousand million; the output is therefore 14,800 million roubles, an average of 45 roubles per acre. If one can assume the purchasing power of the rouble in 1934 was as much as 6*d*., this output is about one-eighth that in England and Wales per acre. A lower figure is arrived at when the comparison is made per individual instead of per acre; in the U.S.S.R., some 75 per cent of the population is peasant and produces the whole food of the entire population. In England and Wales some 10 per cent of the population is associated with the production of about 40 per cent of the food of the whole population; but the average consumption per head for all foods except bread and potatoes is double that envisaged by the end of the Five Year Plan. These figures are given only for purposes of illustration; it is, of course, very unfair to institute comparisons between the countries owing to the wide differences in natural and economic conditions.

As would be expected from the political basis, the tables include the figures for 1937, the end of the second Five Year Plan, and in the text no clear distinction is made between the part of the Plan actually accomplished, and the part that still remains to be done. In the socialistic order, such distinctions lose their force, science being a function of the social conditions of the time. To the Western reader the book is of special interest not only as an exposition of socialistic geography, but also as showing the vast changes contemplated in the utilisation of the land in Russia. The sketch-maps are numerous and very attractive.

E. J. Russell.

Man's Conquest of the Sea

Man and the Sea:
Stages in Maritime and Human Progress. By Dr. J. Holland Rose. Pp. xi+288+25 plates. (Cambridge: W. Heffer and Sons, Ltd., 1935.) 10*s*. 6*d*. net.

In the story of the world there have been numerous points or episodes which very aptly have been called 'seamarks' of history. In this book the author's aim has been to bring many of the more notable of those seamarks out of the obscurity which all too long has enveloped them. There is much justification for a statement in the preface that fame and riches have been for military heroes who, in general, effected little more than temporary shufflings of boundaries; while the great sea explorers, many of whom revealed new lands—even new continents—destined to be the homes of millions, received but paltry reward, remained unrecognised and unrequited, or even met with completely unknown ends.

As recent developments in man's mastery of the oceans are well known, Dr. Rose has concentrated mainly upon origins. His guiding motive, he explains, has been to correlate the work of ship-builders, inventors, explorers and statesmen, and to show how their combined and (sometimes!) co-ordinated efforts have helped to open up the

world for human habitation. This subject is so wide that all notice of naval wars, polar explorations, and all but the outstanding technical details of seacraft have had to be omitted. Also, as no new materials of importance have come under his notice concerning the best-known explorers, they have been treated comparatively briefly in order that others, less well known, might be dealt with more fully. In short, the author's extremely skilful choice of material, combined with his masterly treatment of the subject-matter included, has contributed to the production of a book of outstanding merit.

Taking Odysseus and Dampier as figures typical of man's search into the unknown, Dr. Rose, in Chapters i and vii, has endeavoured—and with success—to point out how their respective sea quests quickened primitive and eighteenth century inquiries into the ways of men and the workings of Nature. Chapter ii, devoted to the achievements of the age of oars, is largely occupied with a scholarly and well-balanced presentation of available evidence bearing upon the alleged circumnavigation of Africa by Phœnician ships at the order of King Necho of Egypt about the year 600 B.C. While due prominence is given to the weighty objections of the critics, Dr. Rose finally favours the belief that this circumnavigation was actually accomplished.

In order briefly but effectively to indicate in what direction maritime progress does *not* lie, a short chapter is devoted to the characteristics of that peculiarly non-seafaring people, the Hebrews. Then follows a review of the chief nautical developments from the Roman and Viking age of 'one-masters' to that of 'three-masters' in the Columbian age. Stress is laid upon the very slow progress registered by ancient and medieval navigation, in contrast with the spectacular advances of the fifteenth to the eighteenth centuries. At the same time, attention is directed to the static civilisation of those earlier ages as compared with the rapid progress and transformations of the latter, due, it is suggested, in large measure to man's ultimate mastery of the oceans.

A very useful section of the book is devoted to tracing the evolution and adoption of a sailing rig which enabled ships to use the wind's strength not only while running before the breeze but also for sailing to windward. For thousands of years, from the time of man's first sea excursions right up until about the end of the fourteenth century, man had remained powerless to sail in face of contrary winds. When at last he learned to beat against them, one of the biggest steps forward in the world's history had been taken. The various stages by which these and other advances in seacraft were made are briefly but lucidly described, as are also the conquests of the oceans which immediately followed in their wake. The achievements of Columbus, Vasco da Gama, Cabot, Drake, Tasman, Van Diemen, Magellan and all their worthy colleagues of the ocean, are set forth in such a way and with such reference to contemporary and future events and tendencies as to bring out their importance in the opening up and peopling of the 'outer world'. Those, and many such there be, who know not how much weight to place upon Adam Smith's statement that "the discovery of America and that of a passage to the East Indies by the Cape of Good Hope are the two greatest and most important events in the history of the world", ought, as a matter of principle, to study Dr. Rose's book.

A chapter is devoted to a survey of early human expansion in the Pacific. A very useful, if brief, résumé is given of available knowledge concerning the types of primitive craft in which tremendous and little-known voyages were made by Polynesian and cognate races, by which they spread in a most surprising way over all that vast region. The comparatively recent work of the enigmatical Captain Bligh, the ill-fated Captain Cook, and others in opening up new lands for Western peoples in and around those seas is then briefly surveyed.

The book fitly closes with a chapter—perhaps the most interesting of all—on the enormous effect exercised upon the problem of the abolition of the Atlantic slave trade by the introduction of steam-power into ships and the adoption of the screw propeller. The stamping out of this nefarious commerce after it had been prohibited by statute involved the enforcement of law and order over the great oceans—a task which fell, as usual, mainly upon the British Navy. The capture of speedy slaving frigates by ships of war, when both were wind-propelled, was often difficult or impossible. The introduction of swift, screw-propelled steamers, however, conferred enormous advantage upon the naval patrols. They could obtain fuel from local bases, while the slave ships, compelled to cover long distances without touching land, had still to depend upon the wind for propulsion. The latter, therefore, fell easy victims to mechanically propelled vessels. Thus did "the cause of civilisation and humanity prevail".

Written in a free and flowing style, and attractively produced, "Man and the Sea" is a book which will appeal at once to the merely interested layman and to the reader with more specialised knowledge of the subject. We have no hesitation in saying that it is worthy of a place on the bookshelves of every household in which the English language can be read and understood.

G. A. Steven.

Native Life in South-west Papua

Papuans of the Trans-Fly

By F. E. Williams. Pp. xxi+452+20 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 30*s*. net.

MR. F. E. WILLIAMS is the Government anthropologist of Papua, and has previously published several valuable researches on Papuan native life. The area which forms the subject of the present work is the far south-west of Papua, extending to the immediate vicinity of the boundary of Dutch New Guinea. This district, intersected by the Bensbach, the Morehead and certain other rivers, is very unattractive from the geographical point of view. The whole coastal region of the Morehead district, as it is generally called, lies exceedingly low and consists of clayey alluvial ground. During the rainy season a great portion of the country is flooded, and travellers have to plod ankle-deep, knee-deep, through water and mud for miles together.

In this terrain the native population lives in small scattered hamlets. They seem in certain respects a decadent race and have so far received very little scientific attention. As elsewhere in Papua, the natives are divided into a great many small tribes or groups, which in many cases speak different idioms. The district investigated by Mr. Williams is divided by him into six different linguistic areas, within which he distinguishes thirty-two various languages and dialects. There are no white settlers at all in that part of the country, and only indirect mission influence has reached it. Although the district has been under the control of the Government of Papua for many decades, the natives are very little affected by European contact.

In the present monograph Mr. Williams does not claim to give a complete survey of the whole of the Morehead district, but mainly concentrates on one people which he calls the Keraki. The book is the result of ten months' sojourn in the field, divided into five several periods. The information recorded has been gained by direct observation and with the aid of interpreters. Mr. Williams professes himself reluctant to believe that field-work done through interpreters is as useless as some who have worked in the vernacular maintain.

The field of research chosen by Mr. Williams is in itself of exceptional interest, as it has hitherto represented a big gap in our knowledge of Papuan anthropology; for it lies between the country of the Marind-Anim in the west, carefully studied by Dr. P. Wirz, and the comparatively well-known estuary of the Fly in the east. But apart from the opportunity of comparison in a general sense, the fresh first-hand information collected by Mr. Williams opens up a very interesting field which offers itself for an intensive comparative study of the most promising description, that is, regarding the almost unlimited variation of native customs, beliefs, and even languages among the numerous small tribes and groups over the whole of the Trans-Fly country. In the Kiwai-speaking tribes and their neighbours, alone, to give one example, we meet with instances of practically all the various funeral customs recorded in anthropological literature. How can this extraordinary disparity of aboriginal thought and mode of living be explained? One thing seems certain: the forms of native mental and material life must be subject to much greater fluctuations than has in general been assumed. But what influences have brought all these changes about, and how have the separate instances of change taken place? One of the many merits of Mr. Williams's book is, in my opinion, its contribution of material to a coming comparative study of the changes of Papuan aboriginal cultures, a very important study from an evolutionary point of view.

The most elucidative chapters in Mr. Williams's book are those describing phases of native life which have come under the author's direct observation, such as scenes of village activities and the routine work of the day, feasts and festivities, totemism, the regulation of marriage, etc. A certain vagueness is noticeable in some of the author's statements and descriptions, which is to be attributed to his conscientiousness as a scholar, inasmuch as he prefers to give information in a general sense on dubious points rather than to risk error by being too explicit.

Like all workers in the field, Mr. Williams has experienced the difficulty of obtaining information regarding matters which are looked upon by the natives as sacred and secret, such as supernatural beliefs, the inner meaning of ceremonies and rites and, above all, black magic and sorcery. In this respect, Mr. Williams had to face one particular difficulty, and that was caused by the necessity of using interpreters: one condition of obtaining forbidden information from a native

and of inducing him to open his heart is to maintain the deepest secrecy before everybody else.

It is gratifying to science that under the distinguished leadership of the Lieutenant-Governor of Papua, Sir Hubert Murray, himself one of the foremost experts in Papuan anthropology, the scientific investigation of the natives has been given so much encouragement by the Papuan Government. In his books Mr. Williams has proved himself a very prominent and successful worker in the field. GUNNAR LANDTMAN.

Typhus in Relation to History

Rats, Lice and History :
being a Study in Biography, which, after Twelve Preliminary Chapters Indispensable for the Preparation of the Lay Reader, deals with the Life History of Typhus Fever. By Hans Zinsser. Pp. xii+301. (London : George Routledge and Sons, Ltd., 1935.) 10*s*. 6*d*. net.

AN unusual book, in which science, history, philosophy and the author's own personality are presented to the reader in discursive leisurely manner. It was written as a relaxation from work on typhus in the laboratory and the field—and it can well be read as relaxation by all. The scientific worker will gain by this dip into history ; the historian will feel how broad-minded and well-informed he has become on scientific matters ; and the lay reader will have a pleasant glow of self-satisfaction that he can find these deep matters so easy to understand.

This work is described as the biography of typhus fever. The subject of the biography makes a first appearance in the second half of the volume, after a leisurely discussion of the art of biography, the relation of science to art, the development of the science of biology from the philosophic speculations of the ancients to the experimental methods of the present day, and a review of the great epidemics recorded in the history of the world.

In dealing with epidemiology, stress is laid on the modifications in relationship between parasite and host, resulting in new forms of the same disease and variations in virulence. Thus it is improbable that improved sanitation is the only cause of the disappearance from western Europe of such plagues as bubonic, leprosy, sweating sickness, and it is an undoubted fact that syphilis is now a less virulent disease than formerly. A study of the classics shows how materially civilisation and national life were affected by epidemics. We can identify with reasonable certainty mumps, typhoid, pink eye, Malta fever, bacillary dysentery and possibly cholera from classical writings. The great plague of Athens in the fifth century B.C. was probably smallpox, and the fear of it caused the withdrawal of the Peloponnesian armies from Athens. The terrible outbreak of plague in Justinian's reign undoubtedly played its part in the fall of a mighty Empire. It is, however, impossible to identify typhus as a disease known in Europe at this date.

The study of typhus itself is bound up with that of lice, ticks and rodents. The rat and its fleas have been the hosts of typhus for so long that a certain degree of immunity now exists between hosts and parasites. But the unfortunate louse dies of typhus with some greater certainty than do the men whom it infects. Nicholle made the great discovery that typhus was transmitted by the louse to man, and modern research started from this point. The puzzle of the survival of the virus between epidemics, the infecting lice of course being dead, was solved by the later discovery of the rat and its fleas as carriers. Scientific reasons are given for the belief that typhus was 'born' when the bacillus-like body known as its germ first met a rat. The infection of the louse came later, but all the great epidemics of typhus seem to be due to louse infection, the rat and its flea causing only sporadic appearances of the disease. Although rats are known to have existed in prehistoric times, they seem to have vanished from human ken for thousands of years. Ancient Rome and Greece seem not to have known them, and if bubonic plague existed then, we must suppose either that mice carried it, or that the ancient writers confused the two animals. From the Crusades onwards we have records of man's fight against these rodents.

Typhus almost certainly came to Europe from the East. Spain had the first recorded epidemic, carried from Cyprus by soldiers going to Granada in 1489. From that date, European history has been changed by visitations of this scourge. In the Great War, the terrible outbreak of typhus in Serbia prevented an early invasion by the Central Powers, and the author believes that the fear of typhus prevented the transfer of troops from the Eastern to the Western Front.

There is reason for believing that typhus existed in the New World before Spain's conquistadores arrived there, and from mummied remains of

Aztecs we know that the louse was ready to play its part. In the New World the disease shows a little modification. Lastly, modern research has brought forth the disquieting fact that man himself may act as a reservoir or carrier, even as he can for typhoid.

The author closes on a note of hope, and believes that typhus will be in the end a controlled disease. But it must be confessed that he has made one reader's flesh creep; in anticipation of a journey in foreign parts the reviewer would welcome heartily the discovery of a louse-proof unguent.

The whole book is permeated by humour, and the reader is refreshed by the author's slightly acid comments on his fellow men and their ways.

E. G.

Cleanliness First

Milk:
Production and Control. By Dr. Wm. Clunie Harvey and Harry Hill. Pp. viii+555. (London: H. K. Lewis and Co., Ltd., 1936.) 21*s*. net.

JUST over three hundred years ago, Sir Hugh Myddleton built his New River to furnish a better water supply to London. Like a watch tower, the Town Hall at Palmer's Green, from which the present book was written, overlooks the old New River. To-day the supplying of water to cities is a problem of quantity rather than of purity; but regarding the purity of milk we have not much to boast about: we are in the stage only of emerging from uncleanliness. Provided it obtains the attention it deserves, this book should help considerably towards formulating, and indeed implementing, a positive policy of cleanliness in the production of milk.

The authors deal solely with the production and control of cows' milk, and are not concerned with cream, condensed milk or other products. It is not clear whether the purely dairying parts of the book have been written at first-hand or from knowledge acquired in other ways, but even as a compilation the work must compel admiration. It has no pretension to literary style, and there is occasional unevenness, as in the treatments of centrifuging (p. 402 and p. 424), but there are remarkably few flaws in matter. Of the few slips, the only one that need be mentioned is the recommendation to use a *clinical* thermometer (p. 421) for determining the temperature of milk at about 60° F. More space might have been given to the non-pathogenic acid-fast bacteria, possibly by sacrificing the section on water-softening. Though obviously many sources have been consulted with care, the inadequacy of the citations will annoy some readers, and the "Bibliography" is a misnomer. The index is good, as is the printing.

The poverty of the references emphasises the fact that the book has essentially a practical aim, which it thoroughly fulfils. For anyone not a research worker in dairy science, the book is complete in itself. As a working manual, it is excellently contrived, and in the sphere of milk production is probably unrivalled, and likely to remain so. The book contains instruction on every relevant subject from the milking of cows to the design of byres; its treatment of legislation is particularly full—almost encyclopædic within its scope—and even liquid manure is considered, though the advice to pour the liquid over the solid manure appears unsound to the reviewer. The chapter headings will give some idea of the contents of the book. After a brief introduction on the composition of (cows') milk, there follow: milk and disease, the cow, the cowshed, the dairy, clean milk production, the distribution of milk, designated milks, treatment of milk by heat, laboratory and other control, and the future of the milk industry. The treatment of most of these subjects is as full as could be desired. Three appendixes contain specimen forms and record cards and some admirable specimen bulletins in popular language, suggested as propaganda to producers and others.

Pasteurisation and other modes of heat treatment are discussed in a rational manner. The authors look upon them as regrettable necessities in present conditions, but regarding the effects of heat treatment upon the nutritive properties of milk, no experiment published after 1928 is quoted. Every requisite for real cleanliness, however, finds its place, and the authors at no time 'cry for the moon'. Many farmers, believing that medical officers of health and other sanitary officials aim at converting the cowshed into something like an operating theatre, are suspicious of recommendations which they also believe to be born of ignorance of farm conditions. No such suspicion can attach to this book, for it is highly practical throughout.

The book appears to be just the right size, and the reviewer hopes that it will not be spoilt by accretion of detail in later editions. As it is, it will surely be of the highest value to all who are concerned with, or interested in, the production and distribution of good milk.

HUGH NICOL.

Mechanics and Human Locomotion

Mechanics of Normal and Pathological Locomotion in Man

By Prof. Arthur Steindler. Pp. xix+424. (London : Baillière, Tindall and Cox, 1935.) 36*s*. net.

THIS book by the professor of orthopædic surgery in the University of Iowa is a praiseworthy effort to bring together the recent contributions to the physiology of locomotion and the newer practice of orthopædics on the basis of the general laws of mechanics as applied to human locomotion. The first half of the book deals with the general mechanics of locomotion with special reference to the structure of bone, the centre of gravity of the body, muscle action and fatigue. The second half deals with the special mechanics of locomotion and with 'pathomechanics'. The spine, posture, respiration and the individual joints of the limbs are studied in detail, both in the normal and the abnormal. The final chapters deal with the human gait in walking, running, jumping and climbing. The abnormal gaits of the infirm and crippled are analysed with special reference to the possibility of increasing their physiological efficiency.

The book is a mine of information, but like so many other books in the realm of medicine, it savours strongly of the card index system. There is no attempt to trace a direct path through the maze of theories, hypotheses and laws propounded by anatomists and surgeons who suffered from the static point of view, as distinct from the dynamic point of view of an experimenter such as John Hunter. The book is thus overloaded with tables, statistics and mathematics of doubtful value to such an extent that the reader is apt to be alarmed. Stripped of these, the book still presents a mass of information which could be shaped into a more purposive and more effective essay on locomotion. The illustrations are mainly culled from "Anatomie des Menschen" by Braus ; the mechanical drawings are largely original ; the legends are often disturbing, for example, cruro varum for crus varum, or gravital for gravitational. Although the author justifiably makes an appeal for more interest and less criticism, yet the reader has a right to expect some measure of style and some historical perspective. The distinguished regius professor of physiology in Glasgow is referred to as one of the "more recent American contributors" ; Robert Gasser is rechristened "Gasserer" ; John Hunter, Hugh Owen Thomas, Robert Jones in Great Britain, and Whitman of Harvard are not mentioned.

Pruned and trimmed, this book should take a prominent place in the literature of kinesiology and orthopædic surgery.

Plant Study and its Cultural Value

Intermediate Botany

By L. J. F. Brimble. Pp. viii+562. (London : Macmillan and Co., Ltd., 1936.) 8*s*. 6*d*.

THE task which the author has set himself in planning the book under review has not been an easy one. The exigencies of the examinations for which it is meant to serve as a text-book require the adherence to certain specified aspects of botany, which may be taken to constitute an introductory study of this science. Some text-books limit themselves to these essentials, and aim at giving a compendium, which can be used with the least trouble, but often with little educational profit, by the student in preparing himself for a definite examination.

The successful teacher should and does clothe these bare bones of a syllabus with an attractive covering of related facts, and endeavours to present the science of botany as a living whole. In that way he not only stimulates those who are entering upon a prolonged study of the subject, but also creates an interest in the minds of those who need to obtain a knowledge of botany as a preliminary requirement before proceeding to medicine, pharmacy or some other science. Text-books rarely attempt this fuller and more really educational treatment of the subject, but this Mr. Brimble has set out to do and he has achieved success.

At the outset, the author emphasises the scope of botany as one of the biological sciences and discusses the characteristics of both groups of living organisms—plants and animals—and their

relationship one to the other. His historical survey is a welcome addition to a text-book for junior students, and will help to vitalise their studies, recalling as it does the names of the great men of science who were the pioneers in various branches of botany. The classification of the plant kingdom, which might be made a dull catalogue of the various groups of plants, is enlivened by references to useful and harmful forms as in the case of the fungi, to the dominance of the horsetails and other fern allies during the Coal Age, to the size and longevity of some of the conifers, suitably illustrated by photographic reproductions of the Big Trees of California and Mexico. This is the way to render the book not only instructive but also attractive.

This aim is kept in view continuously throughout the book, and every branch of the subject is found to lend itself to such enrichment. The physiology of nutrition is not confined to the food of plants, but is treated under the title of "the food of living things". This enables the author to enlarge the scope of the chapter so that he can deal with the nutritive importance of plant products for man, and is able to point out the dietetic value of various vegetable and animal foods.

In his "Everyday Botany" (see NATURE, **134**, 918 ; 1934), Mr. Brimble showed that the human element can and should find its proper place in a general treatment of botany ; in his "Intermediate Botany" he proves that a human interest can usefully be introduced into a text-book for students.

It is not necessary to follow the author's effort in this direction throughout the various chapters, which are well arranged, full of information, always up to date and well illustrated, largely by clear and diagrammatic drawings by the author himself. As botany is largely a practical subject, the author gives at the end of each chapter some hints for practical work, and in dealing with the various plant associations some information concerning the methods of field work in plant ecology. In an appendix, students will find a number of questions and exercises taken from Higher Certificate and Intermediate Examinations of various universities. Thus everything is done to help the student, who will be duly grateful for this clearly written and very attractive text-book.

Structure of the Atom

Modern Views of Atomic Structure

By Dr. Karl Rast. Translated from the German by Dr. W. O. Kermack. Pp. x+156. (London : Frederick Muller, Ltd., 1935.) 7*s*. 6*d*. net.

SO long ago as 1919, Prof. Stock was invited to deliver a series of lectures at the colour works of Fr. Bayer and Co. at Leverkusen, and these were translated into English by Prof. S. Sugden and published in 1923 under the title "The Structure of Atoms". In 1932 and 1933, Dr. Karl Rast of Leverkusen delivered two lectures on a similar subject, and these have now been translated into English by Dr. W. O. Kermack and published under the title "Modern Views of Atomic Structure", together with an appendix in which twelve additional points are discussed. Both books are largely concerned with the basis which underlies the periodic classification of the elements ; but whereas in the first volume this is interpreted mainly with the help of the nucleus atom and Moseley's determinations of atomic numbers, the later volume gives the place of honour to Pauli's 'exclusion principle', as the basis for the Rydberg series, in which the periodic classification finds a simple and exact algebraical expression.

The author must have been very hard-pressed to cover in two lectures a syllabus which occupies not less than half a dozen lectures in the Tripos course at Cambridge ; but he has wasted a couple of pages in a description (which he himself describes as "long-winded") of an illustration of Pauli's principle in terms of soldiers guarding bags of gold ; and in associating the second quantum number with the *minor axis* of an elliptical orbit, he is certainly not following Sommerfeld ; but as a rule his illustrations are vivid and helpful, and he has evidently enjoyed the task of "making things plain, which before were so confusing".

The reviewer would particularly welcome (because they were unfamiliar to him) the description of Cantor's experiment, in which the linear paths of the molecules were demonstrated by a shadow-pattern of mercury on a copper plate, and the demonstration that the K, L and M series of X-ray spectra do in fact merge into the Lyman, Balmer and Paschen series of hydrogen. On the other hand, there is one small point in which the reviewer can claim to have anticipated the author, when he refers to members of the transitional series of elements as "iron-like" and then adds rather recklessly, "You will not find the idea in

any text-book", since even in the first edition of the reviewer's "Inorganic Chemistry" (1922) these metals are grouped together as "steel-forming elements".

In a book such as this, there are, of course, many points where improvements could easily be made; and the lectures would obviously develop and change if the author were asked to repeat them year by year; but they are already good enough to be commended, especially to chemical readers who learn modern physics only with difficulty.

T. M. Lowry.

Laboratory Teaching

The Science Masters' Book, Series 2
Part 1: Physics. Pp. xvi+273+xv. 7*s*. 6*d*. net. Part 2: Biology, Chemistry, Experiments for Receptions. Pp. xvi+252+xv. 7*s*. 6*d*. net. Being Experiments selected from the *School Science Review* by a Committee of the Science Masters' Association, edited and arranged by G. H. J. Adlam. (London: John Murray, 1936.)

ONE of the most troublesome of the problems that confront the teacher in the laboratory is that of evoking the interest of generation after generation of students (and indeed, of preserving his own interest, and interests). The succession of familiar experiments on the law of moments, the simple pendulum, the refractive index of a prism and the like is, as usually presented, dreary and deadening enough in all conscience, and the present writer has never seen a determination of the latent heat of steam (and he must have seen some hundreds) which has aroused in the breast of a junior student of to-day any trace of the emotions (possibly) experienced by a student of Black. The truth is that the stereotyping of an experiment for laboratory use and the mechanical handing-out of a schedule and a mass of the relevant apparatus take half the life out of the exercise.

Even if the experiment is standard and standardised, it has some chance of fulfilling its purpose if it is presented with the living voice of a teacher who has not lost all his enthusiasms, who can suggest some little variant, or give some touch of colour to the story which may serve as a focus of interest. Was it Searle who said that small corrections are the fun of physics? They may very well be; but they must be put forward in Searleian fashion, or there is a danger that they will appeal only to the already converted.

It is one of the encouraging signs of the elementary teaching of to-day that science teachers are alive to the necessity for keeping out of the rut of the standardised experiment, and we cannot be too grateful to Mr. Adlam (who could worthily say of the *School Science Review*, *pars magna sum*) and to his colleagues of the Science Masters' Association for the production of these valuable volumes, and above all for the spirit which has resulted in their production.

It is impossible to analyse in detail the contents of the work. It might be called "The Odds and Ends Book", for, far more than a studied logical presentation, it presents those original variations and applications of the old stories (some of them new) which assist so much in giving colour and zest to experimental work. Simple and novel forms of apparatus are proposed for experiments of all types; variants of old favourites appear; laboratory devices and tricks of all kinds abound; the possibilities of *cork-wax-pfennig* physics are demonstrated time and again; the products of our sixpenny stores are put to high uses never dreamt of by their purveyors; and through all the pages there runs a genuine spirit of enthusiasm most encouraging to those who believe that a knowledge of scientific principles, properly imparted, has a cultural value second to none.

The work is divided between physics, chemistry and biology. Physics, as is natural—and by 'natural', the writer means no more than "as is natural in view of the manner of evolution of science teaching and the scope of the subject"—is the favoured sister; out of some 520 pages of text, 270 are allotted to physics, 110 to chemistry, 90 to biology; and a section of 50 pages, which will be hailed enthusiastically by those unfortunates who are threatened with impending conversaziones, is devoted to what is termed, with eighteenth-century particularity, "Experiments suitable for Receptions, Speech Days and General Occasions".

The experiments are well distributed between the different branches of the subject. It is interesting to come across an account of a model of an illumination photometer; it would be well if more attention were directed to this side of photometry. Pickering, of the Massachusetts Institute of Technology, who was one of the pioneers in the art of laboratory teaching, wrote, sometime in the late 'sixties or early 'seventies, a manual of physical laboratory practice which is a model of

its kind. In an institute of technology pure physics was something of a Cinderella, and the author had to limit severely his laboratory course. Two experiments were chosen to illustrate photometry—a simple comparison of candle powers, and an example of the use of a primitive type of illumination photometer. The fact that the candle-power experiment has always held its place and that, until recently, the far more important quantity, the foot-candle, was relegated to the obscurity of of an arithmetical problem, provides an interesting comment on the trend of teaching practice. The effects were odd ; students were obsessed with the necessity for having two (more-or-less) point-sources of light from which to measure ; and the question, "Given a standard candle, how would you measure the illumination at a point in a room?" not infrequently elicited two types of answer, one of which involved the closing of the window shutters and making measurements from a hole bored therein, whereas the other assumed a knowledge of the sun's distance, thereby providing a *terminus a quo* for the purpose of measurement.

But this is by the way, and is merely intended to illustrate the desirability of providing simple types of illumination photometer and exercises in the measurement of illumination. Mr. Adlam and his colleagues have, we trust, given their sails to favouring breezes ; and no reader of their work can fail to hope that, amid the major adventures of modern physics, the little bark of the Science Masters' Association may indeed

"Pursue the triumph and partake the gale".

A. F.

Planck's Philosophy of Physics

The Philosophy of Physics

By Max Planck. Translated by W. H. Johnston. Pp. 118. (London : George Allen and Unwin, Ltd., 1936.) 4*s*. 6*d*. net.

IT is certainly an interesting, almost a sensational, thing that the discoverer of the quantum, which has done more than any other new theory in science to shake the old determinist philosophy, should be himself one of the stoutest to restate it in more guarded and acceptable terms. That is the gist of this small volume of essays by Max Planck, very carefully and clearly translated by Mr. W. H. Johnston. It is well worth reading for the calm and good judgment with which one of the acknowledged masters of modern science reviews both this determinist question and the other great cognate problems in contemporary scientific philosophy.

Knowing the facts profoundly, Planck admits all that can be said on the indeterminist side, that absolute precision is unattainable in the prediction of minute events or indeed in any scientific prediction, because the means of observation and of measurement themselves introduce a fresh disturbing element into the phenomenon under observation. But the substance of the determinist position remains unshaken. There could be no fruitful action at all, unless we could reckon on a regular and predictable sequence of events.

This predictable sequence is the essence of the notion of causality, either in human action or in the ordinary processes of Nature. Thus in the case of the individual, although to himself he appears to be free to do what he pleases—and this appearance to one's self is the capital fact—yet, to an observing, knowing and calculating mind, prediction of what he actually *will* do becomes more and more certain as that mind approaches omniscience.

Max Planck makes good use of this ideal of the omniscient mind and finds it in the background, or at the limit, both of all science and of all morality. He has some stirring words towards the end as to the need of faith in the future as the bedrock of scientific progress, as it is of any other. His counsel as to the sort of science, and the method to be used, in schools is highly sensible, and should be pondered by teachers and others, not only in regard to science but also to the subject matter of all education. It is a mistake, he holds, to think that we need to indoctrinate the pupils with the very latest results of research.

"The public is favourably impressed if the curriculum of an intermediate school (=something 'intermediate' between the ordinary schools and the university) already contains modern problems of scientific investigation. Yet such a practice is exceedingly dangerous. The problems cannot possibly be dealt with thoroughly and the consequence may easily be to induce a certain intellectual superficiality and empty pride in knowledge. I should think it extremely dangerous if the intermediate schools were to deal with the

theory of relativity or the quantum theory. . . . I would definitely condemn any attempt to take such a question as that of the universal validity of the principle of the preservation of energy (questioned to-day in nuclear physics), and treat it as debatable, before pupils who cannot have properly grasped the meaning of the principle involved, still less its potential scope."

The principle has obviously other sound applications than to latest theories in physics.

F. S. MARVIN.

Interplanetary Travel

Rockets through Space:
or the Dawn of Interplanetary Travel. By P. E. Cleator. Pp. 246+22 plates. (London: George Allen and Unwin, Ltd., 1936.) 7*s*. 6*d*. net.

EVEN the man of science, devoted as he is to the open-minded examination of the facts of Nature as he finds them revealed by experiment, completely free as he should be of dogma and preconceived ideas when these do not agree with new facts, finds himself occasionally the target of abuse, accused of obscurantism, prejudice and an unwillingness to abandon orthodox ideas. On these occasions he should be meticulously careful to give the advocate of unorthodoxy a fair hearing, and in this spirit we approach Mr. Cleator's book, although the prospect of travelling through space to the other planets and returning safely again seems very remote.

It must be said at once that the whole procedure sketched in the present volume presents difficulties of so fundamental a nature that we are forced to dismiss the notion as essentially unpractical, in spite of the author's insistent appeals to put aside prejudice and to recollect the supposed impossibility of heavier-than-air flight before it was actually accomplished. An analogy such as this may be misleading, and we believe it to be so in this case. To begin with, the most powerful chemical reaction is unable to lift its own mass outside the earth's gravitational field: while the ejection of the burnt fuel decreases the load automatically, the comparative weakness of the fuel compels a mass ratio of fuel carried initially to working load which would deter all but the paper-bold, who do not flinch from the notion of a twenty million ton rocket required to project a twenty ton mass to Venus and back. We do not see how a small party of passengers, whose equipment is limited to ten tons, could hope to erect their return rocket, of mass two million tons, on the surface of an alien planet where they would be handicapped by an unnatural temperature and the necessity for wearing gas masks.

Mr. Cleator recognises the inadequacy of known fuels, and suggests the use of sub-atomic energy. If we ever discover how to release this safely, the position will indeed be changed, although in any event mass must be carried to generate momentum by ejection; but another suggestion, the annulment of gravity by electrical means, is without the experimental foundation which the author thinks it has. Then there are the difficulties connected with braking the descent on to a planet of the earth. There is no fuel to waste in braking by reverse rocket action; if there is no atmosphere, as on the moon, a parachute cannot work; in the case of the earth, would any parachute stand the strain, and would not the whole contrivance, rocket and parachute, burst into incandescence like a meteor? The incandescence might do no more than pit the surface of a thick-walled rocket, but must damage a light parachute structure.

Starting with the most open mind in the world, one must remain convinced that the time is not yet ripe for organising 'interplanetary societies' to discuss projects such as these. On the credit side, the societies have accomplished advances in the technique of rocket projection. One might suggest something that is possibly within their reach, and which would add materially to astrophysical knowledge. The spectrum of the sun in the far ultra-violet is inaccessible on earth on account of absorption in the atmosphere: it would appear possible to project a rocket to a height of a hundred miles above the earth's surface, carrying a spectrograph to secure the ultra-violet solar spectrum. A single exposure would decide whether the Lyman series is really so enormously strong as our present theories suppose it to be.

Returning to the 'sciences' of astronautics (a tolerable word) and astrogation (a terrible portmanteau word for astronautical-navigation), we are compelled to join the ranks of those whom Mr. Cleator stigmatises as visionless reactionaries, and to 'throw cold water' on the idea of interplanetary travel under present conditions. Let those who find themselves fascinated by this idea go quietly about the business of improving rocket design, rather than drum up publicity and complain of neglect. Mr. Cleator thinks it a pity that the Air Ministry evinced not the slightest interest in his ideas; provided that an equal indifference is shown by other Ministries elsewhere, we all ought to be profoundly thankful. R. v. d. R. W.

Short Notices

Agriculture and Horticulture

The Use of Fertilizers :
a Guide to the Manuring of Crops in Great Britain. By A. S. Barker. Pp. x+204. (London : Oxford University Press, 1935.) 7*s*. 6*d*. net.

"Agriculturists may feel that an addition to the numerous books dealing with fertilizers requires some vindication", says the author in his preface. We agree. The author proceeds to disarm criticism by limiting the primary scope of his book to farmers, fertiliser sellers and agricultural students. The reviewer would place fertiliser sellers first in this grouping, for the needs of the farmer and student are met elsewhere. "The Use of Fertilizers" is not, however, to be dismissed as superfluous. The mixing of fertilisers on the farm, the importance of 'condition' in fertiliser mixtures, and the use of 'concentrated' mixtures, are subjects dealt with authoritatively and helpfully. It is pleasant to see repeated emphasis laid on the absence of justification for trivial differences in the composition of mixtures. Valuation and the economics of fertiliser application are, as might be expected from the author's connexion with the fertiliser trade, exhaustively handled.

A noteworthy section of the book is that on the manuring of market garden crops. Much less experimental information is available about this than about the manuring of field crops. Indeed, fertiliser experiments have not infrequently given negative results, as though the high 'condition' in which market garden soils are maintained leaves little room for further response to artificials. In this section one would, therefore, have been particularly glad of experimental backing for the recommendations made. Possibly they are largely presented, in the author's phrase, "In the light of the experience of farmers and growers". At all events, this portion of the book fills, as well as can be in the absence of elaborate field experiments, a distinct gap in the literature on the use of fertilisers.

Biological Processes in Tropical Soils :
with Special Reference to Malaysia. By Dr. A. Steven Corbet. Pp. xiv+156+16 plates. (Cambridge : W. Heffer and Sons, Ltd., 1935.) 7*s*. 6*d*. net.

Many interesting facts are introduced into this book, but they are so loosely knit together that the reviewer feels sorrow for the missed opportunity. The basis of the book is a graph, after E. C. J. Mohr, consisting of two curves with temperature as abscissa but no quantitative ordinate : from consideration of these curves the author deduces a perspective of tropical soil processes. It does not often happen that such an extended argument is based upon so unsubstantial a foundation. Upon nitrification the author has done experimental work, but his exposition of it is not lucid : it is not clear whether Fig. 7 refers to bacterial or purely chemical change, under insolation or not. Most of the matter is similarly imprecise, with an irritating semblance of precision, as when the equation $B = R$ is allotted a line. Mr. H. Gunnery's sixteen magnificent photographs, skilfully sited and accurately focused, add considerably to the value of the text. The book is well produced and not expensive ; it deserves the welcome due to a pioneer, but it is to be hoped that its successors will be more thorough. H. N.

Anthropology and Ethnology

Naskapi :
the Savage Hunters of the Labrador Peninsula. By Frank G. Speck. Pp. 248+20 plates. (Norman, Okla. : University of Oklahoma Press, 1935.) 3.50 dollars.

Mr. Speck's investigations have shown that the Naskapi-Montagnais are well worthy of study. Owing to the conditions of their environment the margin between existence and extinction is extremely narrow—in fact so narrow, that on occasion they have been forced to resort to cannibalism. Like the Eskimo, they appear to have established a state of equilibrium between environment and mode of life which has enabled them to survive, though precariously. Hence their culture, that of a purely hunting people, affords evidence of having been static over a long period. Variation would tend to extinction rather than survival and advance. Probably this state of equilibrium was attained very soon after their migration and settlement in their present location. This would account for the tenacity with which the people cling to their all-important animal cults, notwithstanding their ready acceptance, superficially, of the tenets of Christianity. In the character of these animal cults, in which the bear figures prominently, they show, more perhaps than any other Amerindian group, affinities with north-east Asia.

Mr. Speck has written a valuable account of certain aspects of Naskapi culture, and his further reports will be awaited with keen interest.

The Cassubian Civilization
By Dr. Fr. Lorentz, Dr. Adam Fischer and Dr. Tadeusz Lehr-Spławiński. Pp. xxvi+400+8 plates. (London : Faber and Faber, Ltd., 1935.) 21*s*. net.

In this volume a German and two Polish ethnographers have collaborated in the examination of the ethnological affinities of the Cassubians, an ancient and peculiar tribe inhabiting the seashore on each side of the German-Polish frontier line. For

reasons which will be obvious, the nationality of the authors is by no means entirely irrelevant.

In the first section of the book, Dr. Lorentz definitely establishes the fact that in the historical sense the Cassubians are of Sclavonic origin, and maintains that notwithstanding their adoption of the fruits of German culture they have remained in all essentials a Sclavonic people. This position is further substantiated by Dr. Fischer, who describes the salient features of Cassubian culture, beliefs, customs, occupations and institutions, as it exists to-day. He finds that in no way does it differ from that of the Poles.

In the third section Dr. Spławiński examines the linguistic affinities of the Cassubians, and with the reservations inseparable from the application of linguistic studies to racial questions, confirms the conclusions of his two colleagues.

At the present juncture, racial studies, especially in Central Europe, labour under a disadvantage, especially in the eyes of the general public, who view them with some mistrust. In the present instance this is allayed, or should be allayed, by an introduction from Prof. B. Malinowski, who has some pregnant observations to offer on the relation of race, national culture and political allegiance. This introduction adds a crowning touch to what is both a valuable scientific study and an instructive document for all who are interested in national questions in Europe to-day.

Ubena of the Rivers

By A. T. and G. M. Culwick. With a Chapter by Mtema Towegale Kiwanga. Pp. 444+5 plates. (London: George Allen and Unwin, Ltd., 1935.) 16*s*. net.

Not the least remarkable feature in this excellent account of the Wabena of Tanganyika is the fact that it was in part inspired by the desire of the people themselves that an account of their traditional customs and tribal records should be embodied in some permanent form before it was too late. Hence not only is the book based on material, in the collection of which the authors had the co-operation of Wabena of all grades and standing, but also it actually incorporates a history of the people written by Chief Towegale Kiwanga.

The tribal story, like that of a number of other Bantu peoples, is a record of gradual consolidation, which, according to the Wabene account, began about the middle of the eighteenth century and apparently is only now approaching completion. In this the introduction of British rule has proved a stabilising, rather than a disturbing, factor.

In the picture of tribal life and organisation given by Mr. and Mrs. Culwick, the account of magical and religious belief is a good example of the difficulties which confront anyone who hopes to evoke consistency in, or to systematise, Bantu beliefs. In the description of family life, Mrs. Culwick's share has been fruitful in material illustrating the activities and point of view of the women, while the record of how the puberty ceremonial for girls is performed is in the highest degree instructive.

Biology

The Structure and Composition of Foods

By Dr. Andrew L. Winton and Dr. Kate Barber Winton. Vol. 2: Vegetables, Legumes, Fruits. Pp. xiv+904. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 75*s*. net.

The first volume of this book was reviewed in Nature some three years ago (Nature, March 4, 1933, p. 316). This second volume consists of an equally comprehensive survey of vegetables, including mushrooms, roots and tubers, leaves and stems, flowers, fruit and seeds (other than those already covered by vol. 1 in the sections on cereals and nuts). The two volumes together make an extremely useful survey of almost the whole of vegetable food sources.

Vol. 2 contains a very interesting introductory chapter "designed to cover the salient chemical features common to the two parts of this volume, Vegetables and Fruits" and intended to supplement the brief statements made in the introduction to vol. 1. Although this introductory chapter only occupies 24 pages, it covers an extremely wide field, but it is curious to note that some of the information therein is of much more recent date than other. For example, Williams's proposed formula for vitamin B_1, published in 1935, is followed on the next page by two alternative formulæ for ascorbic acid, that of Haworth, universally accepted two years ago, and that of Karrer, actually abandoned by Karrer at that time. Again, the information about vitamin D would bear revision; the account of the work of Askew and others is only brought up to 1931, and consequently contains a quite incorrect description of calciferol, though Waddell's recent work on irradiated cholesterol, published in 1934, is mentioned. No attempt is made, in the descriptions of individual food substances, to indicate their content of vitamins, but the minor mineral constituents receive specific mention in many places.

The description of every plant is accompanied by its systematic name, which will help chemists and botanists to identify some that are differently described on the two sides of the Atlantic. The general production of the book, the authors' admirable illustrations and the full index, nearly 50 pages long, contribute to its usefulness, and it is difficult to imagine that many properly equipped food laboratories or agronomic institutions will be able to dispense with it. A. L. B.

How to see Nature:

(1) Birds, Beasts and Pond Life. Pp. x+102+x+110+x+108. (2) Plants, Flowers and Insects. Pp. xii+112+x+142+x+114. Written and illustrated by Eric Fitch Daglish. (London and Toronto: J. M. Dent and Sons, Ltd., 1935.) 6*s*. net each.

These books form two further attractive additions to the prolific publications of Dr. Daglish. Both are beautifully illustrated chiefly by the woodcuts for which the author is well known. In fact, one may fairly say that the text is merely a vehicle for the pictures, because the explanatory diagrams are crude

and in some cases misleading. Dr. Daglish is first an artist and enthusiastic natural historian, for neither book will bear close scrutiny for its biological truths. As examples chosen at random, we read that a corm is "an underground stem which differs from a bulb in being solid and showing no leaves" and that an ovary is "the lower part of the pistil containing the seeds". Tendrils are loosely described as "growths from the stem which enable plants to climb", and transpiration as "the process whereby water and gases are given off through the stomata". The dahlia tuber is a modified root, not a stem as Dr. Daglish states.

It is a pity that the text of these books does not conform more to the exactitude demanded by science, because the author has a charming style of writing which undoubtedly goes far in stimulating the enthusiasm of the lay reader; besides, the books are beautifully produced. But neither of them can be recommended without reserve to the discriminating reader.

Some American Trees:

an Intimate Study of Native Ohio Trees. By William B. Werthner. Pp. xvi+398. (New York: The Macmillan Co., 1935.) 21*s*. net.

THE preface and foreword, both very brief, indicate that this attractive book is the work of a life-long lover of trees: a work he unfortunately did not live to finish, but it has been completed by his widow. Although dealing with the trees of a comparatively small area, the book is of wide general interest. The quotation from Kingsley which faces Mrs. Werthner's preface that "He is a thoroughly good naturalist who knows his own parish thoroughly" is very apt.

Two introductory chapters deal with trees in general and the forests of Montgomery County. The richness of the United States in native trees—more than 700 compared with 85 in Europe (exclusive of the U.S.S.R.) is discussed and reasons for it given.

The main part of the book deals with the 89 trees of Montgomery County. Each is described fully, but in non-technical language, and information given concerning distribution, soil preferences, uses of its wood and also any other parts of economic value, historical associations, etc. The author was evidently not merely a skilled but also an artistic photographer; the book containing 302 excellent illustrations of habit, bark, foliage, flowers and fruit of the trees he studied so closely.

Applied Entomology:

an Introductory Text-Book of Insects in their relations to Man. By Prof. H. T. Fernald. (McGraw-Hill Publications in the Zoölogical Sciences.) Third edition. Pp. x+405. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 21*s*. net.

NINE years have elapsed since the appearance of the second edition of this text-book. In its present edition the work has been re-written in places in order to bring it up to date, while a certain amount of new matter has been incorporated. Great advances have been made in knowledge of pest control, certain new pests have appeared in the United States and sundry other problems in applied entomology have come into prominence. The chief facts respecting these and other subjects are referred to in the text, but the important subject of the insect transmission of plant viruses seems to have been almost overlooked. Of the introductory chapters, those on pest control provide a good elementary statement of the position. In the rest of the book, the method of dealing with the chief pests, order by order, is followed as in the previous editions. The book is a useful elementary treatise for North American students, in that it provides the essential facts and thereby paves the way for more detailed study.

South African Butterflies:

a Monograph of the Family Lycaenidae; with a Description and Illustration of every Species and Figures of many of the Larvae. Edited and drawn by Desmond P. Murray. Pp. viii+195+18 plates. (London: John Bale, Sons and Danielsson, Ltd., 1935.) 25*s*. net.

THE usefulness of the volume under review rests on the additions to our knowledge of the life-histories of the Lycaenidae, and the excellent and beautifully reproduced illustrations. The inadequacy of references detracts from its value as a systematic work, and the manner in which many of the author's statements are presented leaves much to be desired. There are too many misprints for a treatise of this size, and had the author taken the trouble to consult a taxonomist he would have avoided committing himself to such unfortunate solecisms as: No. 49a. *Phasis clavum* var. nov.; and No. 131a. *N. Major* var. nov.

Chemistry

A Comprehensive Treatise on Inorganic and Theoretical Chemistry

By Dr. J. W. Mellor. Vol. 14: Fe (Part 3), Co. Pp. viii+892. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 63*s*. net.

THIS new volume completes the chapter on iron and includes also a chapter on the element cobalt. Two more volumes, already in the Press, will complete the series. The concluding portion of the chapter on iron includes the halides, sulphides, sulphates, nitrates and phosphates. It is characteristic of the author's method that, although the space-lattice of iron pyrites is reproduced, and its structure as a ferrous disulphide is thereby demonstrated in the most convincing way, more than a page is given up to the speculations of an earlier period, most of which depend on the hypothesis of "highly polymerised molecules". Indeed, the conclusion finally reached by modern workers is stated so briefly, in less than four lines of text, and is wedged so tightly between the purely speculative formulæ Fe=S=S and S=Fe=S, that the casual reader who did not know the correct answer would be unlikely to discover it, or even to recognise its correctness when reading through the text.

The chapter on cobalt is of the usual detailed character, but is largely occupied with co-ordination compounds. These are discussed under the simple salts from which they are derived, for example, $CoCl_3$, $CoBr_3$, CoI_3, etc., with the result that the different salts of a complex ion such as the hexammine $[Co.6NH_3]^{+++}$ must be looked for in different sections. The red and blue colours of cobalt chloride are discussed in paragraphs extending over several pages; but in this case the author has given a clear lead by interpolating his own conclusions in paragraphs printed in smaller type. The structure of the anhydrous blue crystals is also discussed.

The well-established characteristics of the "Treatise" are retained in the present volume, and no further approbation is needed to commend it to those who are already familiar with the earlier volumes.

A Systematic Handbook of Volumetric Analysis : or the Quantitative Determination of Chemical Substances by Measure, applied to Liquids, Solids and Gases. By Francis Sutton. Twelfth edition, revised throughout, with numerous additions, by Dr. A. D. Mitchell. Pp. xvi+631. (London : J. and A. Churchill, Ltd., 1935.) 35*s*.

"THE energies of scientific men have been taxed to devise new and rapid methods of chemical analysis to meet the wants of these high pressure times"—so wrote Francis Sutton seventy years ago : it might have been written by Dr. Mitchell to-day with equal truth. The output of analytical methods is more numerous than ever, and personal experience of all those described is no longer possible; but Dr. Mitchell's reputation is such as to ensure that all the methods described are trustworthy.

Readers may be reminded that the scope of the work is a wide one : it includes volumetric methods applied to inorganic and organic substances, to urine, blood and water and to gas. Many of the old methods are still practised, some new ones are creeping in, for example, potentiometric titration. The last "Sutton" is eleven years old, and must in most laboratories be very nearly worn out by constant use; there will be many who hasten to put the new volume in its place.

The Chemistry of Synthetic Resins By Carleton Ellis. Vol. 1. Pp. 829. Vol. 2. Pp. iii+830–1615. (New York : Reinhold Publishing Corporation; London : Chapman and Hall, Ltd., 1935.) 2 vols., £4 17*s*. 6*d*. net.

DR. CARLETON ELLIS is an indefatigable worker : his text-books in other fields of chemical technology are indispensable to the workers therein and the same will undoubtedly apply to these volumes which, although labelled second edition of a work which appeared twelve years ago, have, like the subject treated, grown from infancy to adolescence. To-day there is no end to the uses or importance of the various synthetic resins or plastics as they are also called.

It is perhaps opportune to summarise the development, for it is a striking one. To be able to make constant products, often with very special properties, from semi-solid complex mixtures of amorphous organic substances, is no mean achievement. The original phenol formaldehyde condensation patents have now expired, with the result that such resins are made at less cost to the public and in greater diversity, including forms which have the property of dissolving in drying oils and yielding varnishes which dry with rapidity.

A second, now universal, type of resin is that made from a polybasic acid such as phthalic anhydride and a polyhydric alcohol such as glycerol, which produces durable plastic lacquers. A third type are the vinyl resins, and a fourth those represented by chlorinated rubber. Finally, there are the urea resins which are to-day developing so rapidly. The work deals exhaustively with these and many others in seventy chapters, in which the scientific and technical aspects of the subject are given equal weight.

Organic Solvents : Physical Constants and Methods of Purification. By Arnold Weissberger and Erich Proskauer. Translated from the German Manuscript by Randal G. A. New. Pp. vi+212. (Oxford : Clarendon Press; London : Oxford University Press, 1935.) 15*s*. net.

ALL sorts of organic solvents are now in use in the laboratory as well as in industry. The users often require to know something about their properties, and they will welcome the fact that, thanks to the collaboration of an organic and a physical chemist, a collection has been made of the physical constants in handy tabular form, separate for each substance, of 157 different solvents selected in an arbitrary fashion but covering a wide variety of requirements.

In addition, about half the book is devoted to a summary of the best methods of purification and often of preparation of the solvents, with copious references to the original literature—in all, 1,406 citations are given.

A very valuable book is thus put in the hands of the scientific worker, who will be able in future to make even better use of this large variety of solvents. In passing, it is to be hoped that efforts will be made by the chemical manufacturers to supply many of them in Great Britain at prices comparable with those charged in the United States and Germany.

Handbook of Chemistry and Physics : a Ready-Reference Book of Chemical and Physical Data. Editor-in-Chief : Prof. Charles D. Hodgman. Twentieth edition. Pp. xiv+1951. (Cleveland, Ohio : Chemical Rubber Publishing Co.; London : A. Harvey, 1935.) 6 dollars; 25*s*.

THIS volume, now in its twentieth edition, really needs little introduction to readers of NATURE. It gives in a most convenient form an excellent set of mathematical tables and mathematical aids to chemists and physicists. The data concerning the physical and chemical properties of the elements are well set forth, and the arrangement of data in connexion with inorganic compounds is most helpful.

Considerable pains have been taken with the nomenclature of organic compounds, and an extensive summary of the rules laid down by the Committee on Organic Nomenclature of the International Union of Chemistry is given. The section on X-ray spectra has been revised by Prof. Cork, and much valuable data included. The magnetic data have also been enlarged, additions in magneto-optics being particularly noticeable; the magnetic susceptibility of liquid mercury is, however, incorrect, and it is suggested that data on the magnetic anisotropy might be included in later editions. On the whole, teachers and research workers will find that the possession of this volume will relieve them of much searching for scattered data, and it is strongly recommended.

Thorpe's Dictionary of Applied Chemistry

Supplement. By Prof. Jocelyn Field Thorpe and Dr. M. A. Whiteley. Vol. 3: Glossary and Index. Pp. vii+166. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 21*s*. net.

THE third supplementary volume of Thorpe's "Dictionary" contains the index to the supplement; but a hundred pages are devoted to a glossary of terms used in the dictionary, ranging from A-acid and Abderhalden's reagent to the Zeeman effect, Zeisel's method, zero-point energy and the Zwitterion hypothesis. This glossary provides a guide to the meaning of a large number of important terms, which do not happen to form the subject of independent entries either in the original or in the supplementary volumes. In some cases, but not in all, the index gives a reference to a passage in the text in which these terms are used or discussed.

Geography and Travel

Men and Gods in Mongolia (Zayagan)

By Henning Haslund. Translated from the Swedish by Elizabeth Sprigge and Claude Napier. Pp. xvi+358+40 plates. (London: Kegan Paul and Co., Ltd., 1935.) 15*s*. net.

IN "Men and Gods in Mongolia" Henning Haslund, author of "Tents in Mongolia", carries further the story of his wanderings in central Asia. Of this narrative the detail in part will already be known to those who follow the literature of Asiatic travel. In 1927 he joined the famous expedition of exploration to Sinkiang (then Chinese Turkestan) led by Sven Hedin, in the capacity of assistant in charge of transport. This is the point at which the present narrative opens, and thenceforward a breezy style carries the reader rapidly through a varied scene. The story includes a description of a Madarai devil dance festival which led to a friendship with that incarnation of the Buddha, Yolros Lama, to Etsingol, to Lop Nor, across the Black Gobi, to arrest in Hami and detention at Urumchi and, finally, to the home of the Western Turguts, where a prolonged stay was made for the study of this little-known people and their culture.

Südsee: Travels in the South Seas

By Hugo Adolf Bernatzik. Translated from the German by Vivian Ogilvie. Pp. xvi+158+80 plates. (London: Constable and Co., Ltd., 1935.) 10*s*. 6*d*. net.

DR. BERNATZIK is an explorer who has been in turn big game hunter, photographer and ethnologist, completing his anthropological studies and taking his doctorate at the University of Vienna with a thesis on a West African tribe. In 1932–33 he visited the Solomon Islands, New Guinea and the Island of Bali, and while he promises that the scientific results of his observations will appear elsewhere—the *Geographical Magazine* of December contains an account by him of a stone age tribe in New Guinea—he here gives his readers a foretaste of his quality in a series of sketches dealing with the natives and incidents of travel in the localities visited. They make lively and interesting reading, and give some informative glimpses of plantation as well as native life, especially in the Solomons. Anthropologists will probably find the remarkable series of very fine photographs, more than a hundred in number, of greater interest than the text.

Moved On! from Kashgar to Kashmir

By P. S. Nazaroff. Rendered into English from the Russian Manuscript of the Author by Dr. Malcolm Burr. Pp. 317+24 plates. (London: George Allen and Unwin, Ltd., 1935.) 12*s*. 6*d*. net.

"MOVED ON! FROM KASHGAR TO KASHMIR" is the story of a refugee, but none the less a keen observer of lands and peoples on the way. The author, P. S. Nazaroff, in a sequel to an earlier volume, writes first of the people of Kashgar and then of his travels and adventures when, after finding sanctuary in Kashgar for four years, he was compelled to move on once more, owing to the recognition of the Soviets by the Chinese authorities. In the second part of his book he tells of his journey and the peoples he encountered when he crossed the Karakorum to Srinagar in Kashmir, where he was succoured by the British Resident.

Geology

The Triassic Fishes of Brookvale, New South Wales

By the Rev. R. T. Wade. Pp. xiv+110+10 plates. (London: British Museum (Natural History), 1935.) 10*s*.

THIS small octavo volume of some eighty pages, ten plates and forty-seven text figures is in effect a catalogue *raisonné* of the known fish fauna of the locality. The fauna is of interest and importance in that it is intermediate in age between the well-known Hawkesbury and Gosford formations. A considerable number of new species and genera is described, adequately figured, and the present situation of the type specimens recorded, so that the work will be of definite use to other workers in similar fields of research.

The Keeper of the Department of Geology of the British Museum (Natural History) states that the bulk of the material was purchased by the Trustees and that "it was considered advisable that a systematic account should be published by the Museum as an aid to further studies on the fishes of this formation". This policy of the Trustees in publishing accounts of the faunas of definite localities such as, in addition to the present one, the excellent account of the vertebrate faunas of the English Eocene by Dr. White, in a handy and, comparatively speaking, inexpensive form is very much to be commended. It is to be hoped that as time and opportunity occur it will be continued and the field extended.

Problems of Petroleum Geology :

a Sequel to Structure of Typical American Oil Fields. Edited by W. E. Wrather and F. H. Lahee. (Sidney Powers Memorial Volume.) Pp. xii+1073. (Tulsa, Okla. : American Association of Petroleum Geologists ; London : Thomas Murby and Co., 1934.) 6 dollars ; 25*s*. 6*d*.

Few industries are now more closely allied to science than that of petroleum, both in regard to its geology and its chemistry. This volume deals with the problems of the former, and is a compilation of forty-three papers specially prepared by forty-seven authors.

After a historical introduction, the essential parts deal with the origin and evolution of petroleum, its migration and accumulation, and particularly the relation of its accumulation to structure : there are some papers dealing with oil-field waters. The book is a veritable mine of information, and it will be very helpful to petroleum geologists ; it should indeed aid considerably in future progress.

Mathematics

Interpolatory Function Theory

By Prof. J. M. Whittaker. Pp. vi+107. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 33.) (Cambridge : At the University Press, 1935.) 6*s*. 6*d*. net.

Interpolation by finite differences is an old subject, going back to the time of Newton, but Prof. Whittaker's treatment will come as a surprise to those familiar with the usual treatises. His object is to deal with new and little-known aspects of the interpolation series, and to discuss them in the light of the modern theory of integral and meromorphic functions (which is briefly summarised in the introduction). After three chapters dealing respectively with series of polynomials, differences and summation, and successive derivates, we come to two chapters concerning what is called the cardinal series. It was discovered by J. F. Steffenson and E. T. Whittaker (the author's father) that this series is closely connected with the well-known Newton-Gauss interpolation series, although at first sight it seems to be quite different. The cardinal series is also related to the theory of Fourier series and integrals, and to Hardy's 'm-functions' ; its interesting properties have been studied by Ferrar, Copson, Pólya, Miss Cartwright and others.

The final chapter deals with asymptotic periods, and the 'tract' concludes with a bibliography of important original work. Most of the contents have not appeared in any other book, and some parts of it, founded on the author's own researches, have not been published before in any form. H. T. H. P.

Analytical and Applied Mechanics

By Prof. Guy Roger Clements and Prof. Levi Thomas Wilson. Pp. ix+420. (New York and London : McGraw-Hill Book Co., Inc., 1935.) 21*s*. net.

This work provides a thorough elementary introduction to applied mechanics with a strong practical and engineering bias. On the statical side the usual general theorems are developed lucidly and in order, and adequate discussions are given of the theory of frame-structures, cables and the bending of beams. In the dynamical section the kinematics and kinetics of particle motion are treated in detail, and the work concludes with chapters on energy methods in the solution of problems (including problems of fluid motion) and on uniplanar rigid dynamics. A large number of carefully graduated exercises is provided.

The book, which is, as usual, excellently produced, may be strongly recommended as an introductory course to a student in the final grade. A. F.

Miscellany

Janus-Man in Starry Night

By Colin Tolly. Pp. viii+101. (Oxford : Basil Blackwell, 1935.) 5*s*.

Mr. Colin Tolly's budget of sonnets calls for notice in these pages, as poetry inspired or influenced by science will become more and more common as the ideas of science are gradually absorbed and form part of our ordinary mental equipment. This process is going on all the time, and we have often noticed it before. At the moment the due expression of these ideas is peculiarly difficult for two main reasons. One is the extraordinary spate of new discoveries and theories ; the other, the prevailing unrest and dissatisfaction with the general state of the world in which these ideas are shooting up. Both these contemporary features find a striking demonstration in Mr. Tolly's verse. He is at grips with all kinds of problems and mysteries as well as the simpler but dominating thoughts of evolution and death which haunt him throughout. Often there are quite moving and common human emotions ; more often one is tortured by doubts and mystical longings for a state of joyous peace beyond the whirl of atoms and of bewildering problems.

This attitude of mind inclines the author, as so many others in our day, to a deep, but rather inarticulate, sympathy with Eastern thought as in "God-Seeking : Vedânta", where "into the Ocean of Space within he plunged ; and Nature, Man and God

did win". This idea and its expression are typical of the general tone of the poems, face to face with ultimate questions. It cannot be said to be satisfying or even encouraging to the further clear and steady pursuit of truth. But it stirs one to a world of rather conflicting thoughts and ideals. At one time the thinker is led to picture the Golden Age of peace and happiness in the remote and purely imaginary past before "Man the Arch-Slayer" arose in his might. Nowhere does he lead our thoughts to a future earthly ideal built up by science. For poets of that temper we must, it seems, wait a little longer, until more of the present tempest is overpast.

F. S. M.

The Road to Modern Science

By H. A. Reason. Pp. xii+306+24 plates. (London : G. Bell and Sons, Ltd., 1935.) 6*s*. net.

One of the most important needs of the present day is the acquisition by the ordinary citizen and the statesmen alike of an adequate general scientific knowledge as a background for the problems with which they are both confronted and the decisions they are called upon to make in this scientific age. An essential step to that knowledge is an understanding of the way in which science has reached its present position in the sum of human knowledge and culture. In this book, Mr. H. A. Reason gives a very competent account of the way in which the present structure of scientific knowledge has been built up and of the contribution of individual men of science from the times of Thales, Pythagoras and Hippocrates onwards. He has a sense of values, and his account of the development of the individual sciences from the time of Newton, without being superficial, is never unbalanced or too detailed, and his final chapter on the present day, if brief, is adequate and accurate. Although written primarily for young people, the book is never childish and has equal claims to a place in reading and courses of general science which form an indispensable element in the training of the adolescent for citizenship to-day and in those courses of adult education which endeavour to rectify the gaps in older and more inadequate curricula.

Training in Industry :

a Report embodying the Results of Inquiries conducted between 1931 and 1934 by the Association for Education in Industry and Commerce. Edited by R. W. Ferguson. Pp. xi+156. (London : Sir Isaac Pitman and Sons, Ltd., 1935.) 6*s*. net.

Mr. R. W. Ferguson in "Training for Industry" presents a well-documented account of various training and educational schemes which have been introduced by certain important business concerns. It deals mainly with training facilities provided by the firms themselves, rather than those provided by universities, colleges and technical schools. The book suffers from the defects of the method by which the material has been collected—it is based on the answers to inquiries conducted by the Association for Education in Industry and Commerce. Though its scope is limited to describing those schemes of which particulars were obtained, it should serve a useful purpose in giving some idea of the amount of educational and training work which is being quietly undertaken in Great Britain by industry itself. A valuable feature is the inclusion of fourteen detailed appendixes relating to specific educational schemes which have been introduced by various large firms or industries.

The author shows that industrial training and education is carried out in various ways, including day continuation schools or their equivalent within the works ; evening studies at technical schools coupled perhaps with incentives to encourage regular attendance or steady work ; provision of lectures, group meetings, discussion circles or conferences within the factory ; and trainee or pupilship schemes. Little, however, is said about training for higher administrative posts.

K. G. F.

Handbook of the Heavens

Sponsored by the American Museum of Natural History. Editors : Hubert J. Bernhard, Dorothy A. Bennett, Hugh S. Rice. Pp. xvi+131. (New York and London : McGraw-Hill Book Co., Inc., 1935.) 5*s*. net.

This volume, produced by members of the Junior Astronomy Club at the American Museum of Natural History, is written by enthusiasts for their hobby, and is intended to appeal to equally enthusiastic amateurs.

It is admirably adapted for its purpose. The star maps (for both hemispheres) are not overloaded with detail, and the directions for "Exploring on the Moon" similarly concentrate on the broader features. Other sections deal with the planets, the sun, double and variable stars, nebulæ and clusters, meteors and comets, asteroid hunting, telescope usage and amateur photography.

An interesting feature is a series of maps showing *dated* paths of the planets among the stars. By combining the information given in these charts with that given in the constellation maps, it is easy to locate the position of a planet. Altogether, this is a volume to be recommended.

A. F.

Physics

A Textbook of Physics

By E. Grimsehl. Edited by Dr. R. Tomaschek. Authorized translation from the seventh German edition by Dr. L. A. Woodward. Vol. 5 : Physics of the Atom. Pp. xiii+474. (London, Glasgow and Bombay : Blackie and Son, Ltd., 1935.) 17*s*. 6*d*. net.

This volume, completing a series of text-books, preserves the almost unique character of its complementary numbers in presenting, in a setting usually associated with an advanced treatise, an encyclopædic elementary survey of atomic physics, the experimental side predominating in range rather than in detail, with a limited amount of mathematics simplified to the extreme. The order and scope may be indicated in the broadest terms as an exhaustive subdivision of the general chapter headings : electrical structure of matter ; the nucleus ; light and matter ;

waves and corpuscles ; spectral lines and the structure of atoms ; molecular structure (and spectra) ; structure of solids and liquids ; electrodynamics of moving media ; matter and energy in the universe.

Great attention is paid to securing a clear and understandable presentation of each item of the very wide range covered, and the utmost care is taken to safeguard the interests of those who are not advanced mathematicians. The standard is stated to be that of an ordinary degree. Frequent reference is made to the preceding volumes in which attendant subjects have been developed, and hence the order here followed is somewhat unusual. But insufficient stress is laid on the interrelation of all the vast field of phenomena, and as a result little attention is directed to the efforts of contemporary study to unify the heterogeneous accumulation of facts and theories embraced by modern physics ; there is, indeed, practically no discussion of the formal, abstract and philosophical bases of the science. The recent discoveries of the positron and neutron are briefly described, the Heisenberg mechanics is not attempted, and the work of Dirac is almost unmentioned, but the simplified exposition of the Schrödinger wave equation is extremely good, as are the very numerous photographs of spectra, tracks, patterns, etc. ; the printing and production are of the highest order.

The student who has previously consolidated a reasonable framework of knowledge will have no difficulty in filling in from these pages such details, apart from formal mathematics and abstract theory, as his personal needs and aims dictate ; the book will also provide a valuable source of reference, and the teacher and lecturer will find his requirements supplemented in a concise and accessible form.

N. M. B.

The Structure of Crystals

By Ralph W. G. Wyckoff. Supplement for 1930–1934 to the second edition. (American Chemical Society, Monograph Series No. 19A.) Pp. 240. (New York : Reinhold Publishing Corporation, 1935.) 6 dollars.

THE supplement to the second edition of Wyckoff's book on "The Structure of Crystals" records the progress made in the years 1930–34. The 367 references in the original volume to work done in the year 1930 have now been supplemented by 129 additional references to papers published in the same year, whilst subsequent years are represented as follows : 1931 (509), 1932 (503), 1933 (546), 1934 (362). These additional references occupy about one third of the text, the remaining two thirds being used for abstracts of the new data, classified (with one exception) in the same way as the main volume.

Mention may be made of structures such as the octahedral clusters of six boron atoms in CaB_6, the linear FHF ions in $(NH_4)HF_2$ and the non-linear NO_2 ions in $NaNO_2$. The X-ray analysis of five polymorphic forms of ammonium nitrate is recorded, the form which is stable at highest temperatures having the body-centred cubic structure of cæsium chloride, apparently because both ions are rotating and are therefore spherically symmetrical. It has also been shown that the water remaining in plaster of Paris can be nearly all removed without destroying the crystal form and without altering the diffraction pattern, leading to the conclusion that the water is present in a zeolitic condition, occupying gaps or holes in the crystal structure of the anhydrous salt.

Examples such as these may serve to show the interest and importance of the data now recorded ; but the chief value of the supplement depends on the fact that it is possible to look up the data for all the diverse compounds that have been examined by this method, and to find both a summary of the essential results and references to the original papers.

Infra-Red and Raman Spectra

By Dr. G. B. B. M. Sutherland. (Methuen's Monographs on Physical Subjects.) Pp. xi+112. (London : Methuen and Co., Ltd., 1935.) 3*s*. net.

ONE of the most remarkable features of present-day physics is the rapidity with which a novel phenomenon or effect is absorbed into the body of general doctrine, and may indeed almost immediately become a powerful tool for the investigation of intimate structural details. In the present monograph, the author has restricted himself to the study of infra-red and Raman spectra as a means to the investigation of molecular structure. The hundred and twelve pages of the book are divided between a discussion of experimental methods, of the normal vibrations of a molecule, of vibration-rotation spectra, long wave-length spectra and the correlation of infra-red and Raman spectra. An appendix gives the inter-nuclear distances and fundamental frequencies of some simple molecules as determined from infra-red and Raman spectra. Bibliographies are appended to the various chapters, and include a total of more than seventy references.

The volume begins at the beginning and, though definitely restricted in scope, is none the less an admirable introduction to a more general study of the subject.

A. F.

Fluorescence Analysis in Ultra-Violet Light

By J. A. Radley and Dr. Julius Grant. (Monographs on Applied Chemistry, Vol. 7.) Second edition. Pp. xi+326+29 plates. (London : Chapman and Hall, Ltd., 1935.) 21*s*. net.

ONE welcomes a second edition of this very useful book after a lapse of only two years. The authors have made little change in the scope and arrangement of the information, but they have enlarged it by fifty per cent by interpolating numerous fresh instances of the ever-broadening utility of fluorescence phenomena. The publishers have also been generous in adding fourteen excellent plates descriptive of recent developments.

The present-day craving for applying new scientific methods to criminology finds response in several examples, especially stains on garments caused by various body fluids, and the detection of drugs, etc., in body fluids, which serve as valuable aids in setting out on toxicological inquiries. Under "Medical and

Biological Science", sera fill a gap in the earlier edition.

The present work certainly marks a great advance on its predecessor; but if it is to develop into a standard work, which may well be, its opening chapter should be rewritten, and more attention paid to detail. In several places the text has been corrected or improved, but other opportunities of doing this have not been taken, notably, the more important of those laxities indicated in a review of the first edition (NATURE **133**, 665; 1934). S. J. L.

Philosophy and Psychology

The Origins of Love and Hate

By Dr. Ian D. Suttie. Pp. xvi+275. (London: Kegan Paul and Co., Ltd., 1935.) 10*s*. 6*d*. net.

THE late Dr. Suttie may be said to have belonged to the 'eclectic' school of English medical psychologists who, influenced by the teaching of pioneers like Freud, have nevertheless never followed slavishly his metapsychology or bound themselves strictly to his psychotherapeutic technique. Indeed, from the outset Suttie questioned the strict psychoanalytic theory on both logical and biological grounds, and later came to reject its basic explanatory concepts for clinical reasons as well. "The Origins of Love and Hate", however, is not a mere criticism of Freudian theory. It offers an alternative account of the underlying psychical determinants of culture and character (including those of the psychopathological manifestations of the latter) as a constructive contribution to general and abnormal psychology.

The main points on which Suttie differs radically from Freud are his insistence upon the role of the mother rather than the father in the mental development of the child, the substitution of love (in the sense of tender emotion) for libido (in the sexual sense) and for the primal hatred involved in the œdipus situation, and the tracing back of neurotic disorders to their root cause in disturbances of the mother-child relation.

The book will provoke discussion and criticism as indicating a new orientation in genetic psychology.

The World of Colour

By Dr. David Katz. Translated from the German by Dr. R. B. MacLeod and Dr. C. W. Fox. Pp. xvi+300. (London: Kegan Paul and Co., Ltd., 1935.) 15*s*. net.

"THE WORLD OF COLOUR" deals with colour perception from the purely psychological, as distinguished from the physiological, point of view; and, on the basis of experimental work, much of which is highly original in character, offers new solutions of problems of great theoretical and practical interest. Among these the most outstanding are those of the illumination of empty space, the differences of the appearance of colours according to their contexts, and the apparent constancy of colour in varying conditions of lighting. The problem of sensory constancy comprises a series of questions having to do with the stability of perception in general; and, in the particular case of colours, Katz shows that the way in which we see these in different illuminations approximates in all cases to the 'genuine' colour, which is apprehended in the particular illumination that best reveals the microstructure of the illuminated surface.

While the experimental and theoretical parts of the work will be of the greatest interest to psychologists (incidentally also to physicists, physiologists and even philosophers), the application of the theories made to arts and crafts such as architecture, painting, photography, illuminating technique and the like, will prove to be of no less practical value to the artist and craftsman.

The Attitude of Voltaire to Magic and the Sciences

By Dr. Margaret S. Libby. (Studies in History, Economics and Public Law, Edited by the Faculty of Political Science of Columbia University, No. 408.) Pp. 299. (New York: Columbia University Press; London: P. S. King and Son, Ltd., 1935.) 16*s*. 10*d*.

IN this work, which represents a large amount of research, the originality of Voltaire in the field of the various sciences is rightly shown to be overestimated, though for his skill and importance as a popular exponent of the new scientific ideas, he retains full credit. The views of Voltaire are shown here against a background of the scientific developments of his time. Historians of science and philosophy will thus find in this work ample material for consideration and study. It would remain to be shown, for example, what are the detailed relations between the religious philosophy and the history of science in the eighteenth century.

Philosophy and the Concepts of Modern Science

By Prof. Oliver L. Reiser. Pp. xvii+323. (New York: The Macmillan Co., 1935.) 15*s*. net.

THE conclusions of the sciences, often used uncritically, help the author to build up a rather peculiar vision of the universe. Pleading for a revival of anthropomorphism and for a religion of humanism, he lets his mind roam from a justification of a modified emergent evolutionism to that of a generalised sun worship, the gap between the two being bridged by a novel conception of light as the link between logic and physics, mind and brain, the physical and the spiritual. The book, though very readable and interesting, is one link in that extraordinary chain of American works which points to the imminent birth of a new Western wisdom the esoteric meaning of which is understandable, at least at present, to a selected few. T. G.

The Book of the It:

Psychoanalytic Letters to a Friend. By Dr. Georg Groddeck. Pp. 301. (London: The C. W. Daniel Co., 1935.) 10*s*. 6*d*. net. (Supplied to medical and psychological readers only.)

THIS book consists of letters written by Dr. G. Groddeck to a friend. They are all on a psychoanalytic basis and consist of advice on a variety of matters relating to sex, family life, etc. To those readers who are acquainted with the psychology of sex and its many and varied manifestations in every-

day life, this book will present little if anything that is new, but the book is very readable and states the facts of symbolism, etc., in a clear and interesting manner. Those who are not wholehearted Freudians will find much of the book disagreeable and unacceptable.

I and Me :
a Study of the Self. By E. Graham Howe. Pp. 256. (London : Faber and Faber, Ltd., 1935.) 7*s*. 6*d*. net.

"I AND ME", which is stated to be a study of the self, consists of six lectures delivered for the Home and School Council of Great Britain in 1934. The author compares the pattern of the teaching contained in these lectures to that presented by Tao, 2,500 years ago. There are a number of diagrams which are well executed but convey little or nothing to the reader, whatever symbolic meaning they may contain for the author. The chapters are devoted to the selves, the family, society, science, medicine and religion.

Technology

The Chemistry of Cement and Concrete
By F. M. Lea and Dr. C. H. Desch. Pp. xii+429+10 plates. (London : Edward Arnold and Co., 1935.) 25*s*. net.

FEW materials of construction are more important than cement—indeed some six million tons are made and used in Britain per annum. The cement works are mostly up to date, and the cost of the finished article is continually being reduced, whilst its quality is satisfying increasingly stringent standards. The chemical knowledge of the subject continues to grow, and it is this aspect that is contained in the present book, which is a considerably extended new edition of the work first written by Dr. Desch in 1911 and now long since out of print.

The chief author is on the staff of the Building Research Station, and thus thoroughly *au fait* with the more practical aspect of the subject. The scope includes the chemistry of the changes which the raw materials undergo during conversion into clinker and cement, and covers a very wide field including the properties and behaviour in use of concretes even under such varied conditions as in sea-water and in pipes for the transport of effluents.

The book is likely to become the standard work of reference in this field for both chemists and engineers.

Symposium on the Welding of Iron and Steel
Vol. 1 : Present Day Practice and Problems of Welding in the Engineering Industries. Pp. xx+676+136 plates. Vol. 2 : Welding Practice and Technique, including Welding Apparatus ; the Metallurgy of Welding ; Specification, Inspection, Testing and Safety Aspects of Welding. Pp. vii+974+123 plates. (London : Iron and Steel Institute, 1935.) 2 vols., £2 2*s*. ; to Members, 30*s*.

ON May 2–3, 1935, a symposium on the welding of iron and steel was held by the Iron and Steel Institute in conjunction with a large number of other societies and institutions concerned with this subject. The papers then presented, together with a number received since the meeting, are now available in book form. The number of such contributions has reached the high figure of 150, of which 84 have come from Great Britain, 14 from the United States, 10 from Australia and 9 each from France and Germany. The present volumes, therefore, may truly be claimed to represent an international effort to indicate the present position of the welding industry and the research work which is being done in connexion with it. It will come as a surprise to many people to learn how widespread welding has become and how important are the parts which are joined together by this means.

In addition to the papers themselves, the volumes contain summaries of each section, the discussions and correspondence on the papers, together with both name and subject indexes. In view of the large amount of material to be presented it has been thought well to subdivide the papers into four groups, of which the first deals with present day practice and problems of welding in the engineering industries, the second, welding practice and technique including apparatus, the third, the metallurgy of welding, and finally, specification, inspection, testing and safety.

The papers contained in these reports form by far the most substantial contribution ever made to scientific and technical advance in the welding industry. Even those concerned solely with the welding of non-ferrous materials will find in the present volumes an enormous amount of information which is directly applicable to their own work.

F. C. T.

Boiler Feed Water Treatment
By F. J. Matthews. Pp. 256+9 plates. (London : Hutchinson's Scientific and Technical Publications, n.d.) 12*s*. 6*d*.

THIS should prove to be a most useful book. The problem of feed water treatment is a very real one, and a great variety of treatments are now prescribed so that the ordinary operator requires assistance in his choice. The super-pressure boilers require special consideration and treatment, for which skilled chemical assistance is an essential. Water supplies are always changing and periods of drought or excessive rainfall also bring about changes. The author has put together a very readable compendium under the headings of scale formation, corrosion, foaming and priming.

A Textbook of Pharmacognosy
By J. W. Cooper and T. C. Denston. With Illustrations and Drawing Notes by M. Riley and D. W. Shaw. Second edition. Pp. xiii+522. (London : Sir Isaac Pitman and Sons, Ltd., 1935.) 18*s*. net.

IN the second edition of this well-established book, more information of a theoretical nature has been added. Accounts of the geographical distribution, collection and preparation for the market of drugs have also been included. The subject matter is very comprehensive, and satisfies the syllabus in pharmacognosy for the Chemist and Druggist Qualifying Examination, and to those candidates the book can be earnestly recommended.

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Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 461.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Hooke as Geologist

Two comments on Mr. W. N. Edwards's article on Robert Hooke published in NATURE of January 18 seem worth making. The first concerns the date of Hooke's really important geological work, the second the interpretation of a passage which Mr. Edwards has, I think, taken on trust from earlier authorities. My points are condensed from an article on "The First English Geologist" published in the *Durham University Journal* of June 1935, in which Hooke's evolutionary doctrine was also examined.

(i) Hooke's earliest papers date between June 1667 and September 1668 ("Posthumous Works" 1705, pp. 279–345): that is, they were delivered before Steno's "De Solido" (1669) was published. The third paper connects with the fourth, dated February 1686–87: after which all the papers are later. But all the important theories will be found in the two papers of 1667–68 (for example, Mr. Edwards's citations from those of 1694 and 1699 will be found earlier, on pp. 312–14, and especially p. 314). The later papers only repeat the earlier, under the influence of Pythagorean theories and Burnet's "Theoria Sacra" (1681) or "Sacred Theory of the Earth" (1684), which converted Hooke, and geology with him, to cosmology, to the grave detriment of science. This earlier dating of all Hooke's important geological thinking gives him a claim to be regarded as among the greatest of the early workers in this science, as Mr. Edwards suggests; but his genius suffers if the later papers are confused with the earlier.

(ii) There seems to be no real evidence that Hooke anticipated William Smith in recognising "the possibility of identifying strata by their fossils and 'raising a chronology' out of them". If it is, as Mr. Edwards says, "well known", it is because an important passage was misread by Lyell, whose conclusions (and often his italics) have been repeated by von Zittel, H. B. Woodward, and others. This passage, written in 1688, is based on two earlier ones too long for quotation here ("P. W.", pp. 321 and 335), in which the authenticity of fossils as "Monuments of Nature" is argued by a parallel with antiquarian relics. In 1688 ("P. W.", p. 411), repeating the parallel he says:

"And though it must be granted, that it is very difficult to read them, and to raise a *Chronology* out of them, and to state the intervals of the Times wherein such or such Catastrophies and Mutations have happened; yet 'tis not impossible, but that, by the help of those joined to other means and assistances of Information, much may be done even in that part of Information also."

Lyell quotes as far as "impossible", where he puts a full-stop and leaves it at that ("Principles", 1840, i, p. 48), thereby altering the sense considerably. His "*raise a Chronology*" in italics makes everyone think of Smith, but there seems to be no evidence that Hooke ever thought of fossils as guides to the identification of strata. All that he seems to have had in mind was a modest hint that the "chronologies" of the "scripturists" might need revision. The reference on p. 412 to "the ingenious author that has lately writ of that subject" (the Flood) shows that this passage was written with Burnet's "Sacred Theory" in mind, and that his intention was no more than to carry terrestrial history beyond the then accepted date of the Deluge (*c.* 4000 B.C.). He undoubtedly saw the possibility of extending history further back in time, for he said these "greatest and most lasting Monuments of Antiquity" might "far antidate all the most ancient Monuments of the World" (p. 335); but his main concern, like that of Woodward, Ray, Burnet, Whiston, and lesser men, was with the Flood. (See p. 341 and the repetition of his doubts in 1687–88 on p. 408.) In other words, Hooke's "chronology" has been misinterpreted, just as his "earthquakes" have; but he himself remarked that words are "ill set marks on very confused Notions".

Hooke was in 1667–68 a very great and original geologist; he was the first uniformitarian; he was a considerable pre-evolutionist; but he was not a stratigrapher. There is something ironical in the repeated attribution of a discovery he did *not* make to one whose lightnings so frequently illuminated others: and I join Mr. Edwards in surprise and regret that his tercentenary has passed with so slight acknowledgment.

A. P. ROSSITER.

University College,
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Jan. 22.

MR. ROSSITER does well to underline the early date of Hooke's geological work, but he might have gone further. For example, Hooke's observations on petrified wood, read before the Royal Society on June 17, 1663, were published in John Evelyn's "Sylva" (1664, pp. 96–7) as well as in "Micrographia" (1665), where Hooke also briefly outlined his views on fossils and refuted Stelluti's opinions on "*lignum fossile*". On p. 439 of the "Posthumous Works", Hooke refers to his "lectures in 1664" on the agency of earthquakes in modifying the earth's surface. In my article I gave the date 1668 for certain passages because they were taken from the first section of the "Discourses of Earthquakes", which concludes (on p. 328) with the words "Ended Sep. 15, 1668". I should be sorry if anyone thought that Hooke's reputation suffered because other passages dated 1694 and 1699 were also quoted.

As for Mr. Rossiter's second comment, no one, so far as I know, has ever regarded Hooke as a stratigrapher; the claim is merely that he foreshadowed a principle which was later re-discovered and applied by others. Hooke wrote ("P. W.", p. 335) that "no one scruples to affirm" that excavated coins and other relics are of such and such nature, "nor that they are Roman, Saxon, Norman, or the like". He then turns to the "medals of nature", fossils, says that there is similarly no reason to doubt their authenticity, and completes the parallel by adding "nor will there be wanting media or criteria of chronology". Taken in conjunction with the other similar passages, it does not seem unreasonable to conclude that Hooke had an inkling of the value of fossils as indexes of age. There certainly seems little doubt that he had in mind an *extensive* revision of the "chronologies of the scripturists". Hooke's belief in the extinction of species and his statement that the fossils of one region differed from those of another should also be remembered.

W. N. EDWARDS.

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Jan. 29.

Scattering of Fast β-Rays

IN two previous notes[1] some results have been described which were obtained with a beam of fast β-rays ($1500 < E < 3000$ ekv.) in a nitrogen-filled expansion chamber. It is clear from the photographs that these β-rays are considerably scattered in the gas. By selection of those cases where there is a perceptible change in the direction of path (whenever the deflection exceeds 20°) and by measurement of the angle of deflection with a Pulfrich stereo-comparator, Curve I in Fig. 1 was obtained for the single scattering in a gas at angles greater than 10°–20°.

The ordinates of Curves I and II represent the number of collisions resulting in a deflection through a given angle δ for the interval of 10°. Curve I gives the statistical distribution of 212 collisions on a total of 180 metres of electron tracks. Curve II gives the same values, calculated for the same length of path (with a velocity of 2,000 ekv.) using the formula given by Mott[2] for scattering at 'relativistic' velocities. The mean error of an observation is of the order of 3°.

Curve I shows a very considerable anomalous excess scattering for angles greater than 20°. On Curve III the ratio of the observed and calculated values has been plotted. Above 30°, the observed values are seen to be very much greater (10–100 times) than those calculated.

If, as is commonly held, the relativistic treatment of the problem, based on Dirac's wave equation, contains no fundamental error, then, in contradiction with current ideas, the above-mentioned facts would imply that, for light elements and high velocities, the scattering is mainly due not to the Coulomb extranuclear field, but to a quite different cause.

The hypothesis that the scattering is due to some radiative forces must also be rejected on theoretical grounds. The effective cross-section for the observed excess scattering is of the order of 2×10^{-22} cm.^{2} for the nitrogen nucleus, whilst according to Bethe and Heitler's theory[3], the effective cross-section of a radiative effect must be certainly less than 5×10^{-24} cm.^{2}.

In the majority of cases, the deflections of the β-rays are not accompanied by a noticeable decrease in energy, but in a few cases non-elastic collisions occur with the loss of a considerable part of the energy. The dotted stepped line in Fig. 1 shows the distribution of fifteen cases where the energy loss exceeds $\frac{1}{2}$ or $\frac{2}{3}$ of the original energy. The full stepped line gives the number of deflections where the loss amounts to 0·9 of the original energy (the instances of almost complete energy loss, mentioned in our previous notes[1], are not included). It may be added that the directions, in this case, appear to be distributed isotropically. The assumption that the non-elastic collisions shown in the diagram are accompanied by the emission of an electro-magnetic radiation would lead to unreasonably large values of the yield (cf. our previous notes).

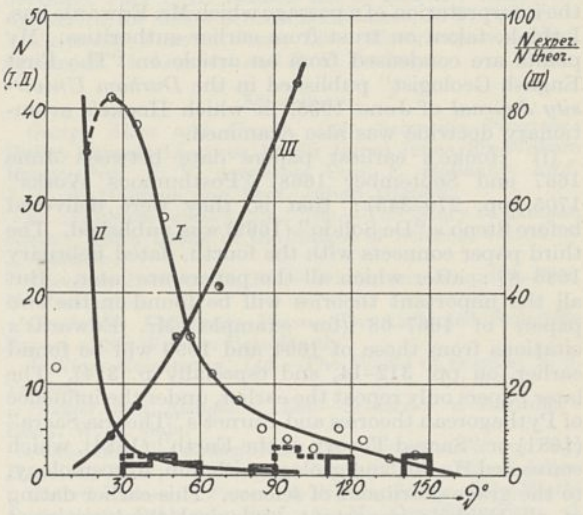

FIG. 1.

In this connexion, it may be of interest to note that in 1929 Henderson[4], when examining much slower β-rays ($\bar{E} = 340$ ekv.), observed an anomalous scattering in the light elements (which in hydrogen amounted to about 80 per cent of the normal effect for angles ranging from 10° to 30°). This he believed to be due to electronic scattering. In our case, however, it would be quite impossible to ascribe the excess scattering to any collisions with electrons. Henderson's interpretation is probably incorrect; he may have been observing an effect similar to ours.

In all probability, we are dealing here with a kind of 'intranuclear' effect. The wave-length of the electrons was of the order of $\lambda = 5 \times 10^{-11}$ cm. From the point of view of quantum mechanics, it seems likely that the effective cross-section is of a higher order than the square of the radius of an atomic nucleus, and will be almost of the order of λ^2 if considerable nuclear interaction takes place.

D. SKOBELTZYN.
E. STEPANOWA.

Physical-Technical Institute,
Leningrad.
Jan. 15.

[1] D. Skobeltzyn and E. Stepanowa, NATURE, [137, 234, 272 (1936)].
[2] N. F. Mott, *Proc. Roy. Soc.*, A, **124**, 425 (1929).
[3] H. Bethe and W. Heitler, *Proc. Roy. Soc.*, A, **146**, 83 (1934).
[4] M. Henderson, *Phil. Mag.*, **8**, 847 (1929).

Induced Radioactivity of Mercury

BY means of a sensitive tube counter outfit in which the effects of penetrating cosmic radiation are partially compensated[1], it was found that mercury (as HgO) could be activated by neutron bombardment, the active product decaying with a period of 40 ± 5 hours. The irradiated mercury oxide was dissolved in nitric acid and the mercury passed through a series of different precipitations. It was also mixed with inactive gold and platinum compounds, and the metals then carefully separated. In every case the activity followed the mercury fraction and is, consequently, probably due to the isotope $_{80}Hg^{205}$.

The nature of the emitted particles has not been investigated. If they are negative electrons, as will probably be the case, the active mercury isotope is transformed into the stable isotope of thallium $_{81}Tl^{205}$. The activity is weak (the isotope Hg^{204} being present in an amount of only 6·85 per cent of the element); the number of impulses per minute from 0·7 gm. of HgO which had been irradiated four days with a radon-beryllium source (initial activity 100 millicuries) was about equal to the natural activity of 0·006 gm. Sm_2O_3 observed under the same conditions.

Some other hitherto unknown active isotopes have been observed and will be described later. From a chemical and biological point of view, it is of special interest that an active isotope of sulphur, decaying with a period of more than two months, can be isolated from carbon tetrachloride which has been irradiated with neutrons.

No measurable activity could be detected after irradiation of bismuth (Bi_2O_3).

E. BUCH ANDERSEN.

Physical Institute,
University, Aarhus,
Denmark. Feb. 12.

[1] *Z. Phys.*, **98**, 597 (1936).

Oxide Films of Some Alloys

BY means of cathode ray diffraction, we have already shown that, at high temperatures, a thin film of γ-Al_2O_3 is superficially formed on aluminium bronzes containing more than 3 per cent of aluminium,

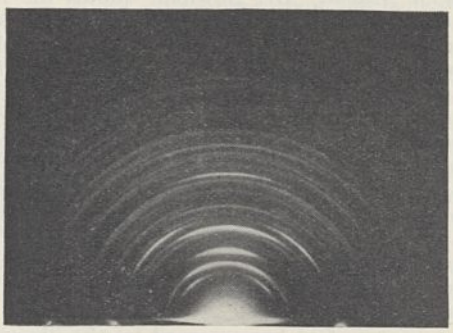

FIG. 1. Diffraction pattern of $NiCr_2O_4$ on nichrome.

and a ZnO-film on brass (Zn 30 per cent, Cu 70 per cent)[1]. These films protect the alloys from further oxidation.

Copper-beryllium alloys also possess a remarkable non-oxidising property at high temperatures. According to our electron diffraction studies, this property seems to be due to a film of BeO (hexagonal, $a_0 = 2{\cdot}70$ A., $c_0 = 4{\cdot}39$ A.), which is formed when the beryllium content exceeds the small quantity of 1 per cent. It is a striking fact that no rings of copper oxide are found in the diffraction pattern when alloys containing such small percentage of beryllium are heated at a red heat.

Nichrome (Ni 80, Cr 20 per cent) is one of the most prominent of non-oxidising alloys. From the heated surface of this alloy we obtained the diffraction pattern due to $NiCr_2O_4$ or $NiO.Cr_2O_3$ (cubic, $a_0 = 8{\cdot}30$ A.) (Fig. 1). The marked non-oxidising property of this alloy may be explained by the formation of this oxide film.

ICHIRÔ IITAKA.
SHIZUO MIYAKE.

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Chemical Research,
Tokyo.

[1] NATURE, **136**, 437 (1935); *Bull. Inst. Phys. Chem. Res.*, **14**, 704 (1935), (in Japanese).

Spin Coupling in the $^3\Sigma$-State of Phosphorus Deuteride

KRAMERS[1] has shown how the fine structure of $^3\Sigma$ molecular energy levels, which is not completely accounted for on Hund's theory by the interaction of the resultant electron spin with the magnetic field arising from the rotation of the nuclei, may be explained by considering the mutual interaction of the individual electron spins.

Interaction of the resultant electron spin with the rotating molecule splits each rotational level into three components given by the term:

$$f(K, J-K) = \tfrac{1}{2}\gamma\,[J(J+1) - K(K+1) - S(S+1)]$$

where $J = K,\ K \pm 1;\ S = 1;\ K = 0, 1, 2 \ldots$ The mutual interaction of the spins gives to these components the additional energies:

$$f_{K+1} = \frac{2\varepsilon K}{2K+3};\quad f_K = 2\varepsilon;\quad f_{K-1} = -\frac{2\varepsilon(K+1)}{2K-1}.$$

Since the publication of Kramers's work, which considered only the O_2 molecule, the constants γ and ε have been evaluated for the following molecules:

Molecule	O_2	N_2	PH	OH^+
γ	− 0·025	− 0·003	− 0·072	− 0·132
ε	+ 0·242	− 0·433	+ 0·713	+ 0·76

We have now succeeded in photographing on the 4th order of the 10-ft. concave grating the band of phosphorus deuteride corresponding to that of phosphorus hydride, and have obtained from it the values $\gamma = -0{\cdot}041$, $\varepsilon = +0{\cdot}74$. The changes produced in the values of the constants on substitution of the isotope of hydrogen are in agreement with the explanation given above; γ, which involves the rotation of the nuclei, is reduced to little more than half its former value, corresponding to the increase in the moment of inertia, while ε is only slightly changed. A full account of the investigation will be published shortly.

R. W. B. PEARSE.
M. ISHAQUE.

Imperial College of Science
and Technology,
London, S.W.7.
Jan. 31.

[1] *Z. Phys.*, **53**, 422 (1929).

Microscopic Observation of the Absorption of Insulin and Protamine-Insulinate

In a recent paper[1] Hagedorn, Norman-Jensen and their co-workers have described new insulin compounds with protamines, which are more or less insoluble in water at a *p*H about 7 and show a prolonged action of the insulin when injected subcutaneously, although the solubility is definitely increased by the blood constituents. Several such compounds with different protamines showing somewhat different solubilities were studied and tested in the treatment of severe diabetes.

Being engaged in a study of vascular reactions in the Sandison-Clark chamber inserted in rabbits' ears, it struck us that it might be possible to observe directly the absorption of precipitates introduced into such chambers. We have tested both unstained precipitates and such that were stained by a dye, and have found 0·1 per cent methylene blue to be suitable. When ordinary insulin is precipitated alone, or with methylene blue, at its isoelectric point, and an infinitesimal quantity injected into a chamber, the particles of precipitate can be seen in the tissue spaces and in lymphatics of 1–2 μ in diameter. They move into slightly larger lymphatics, and all but traces disappear in forty-five minutes.

The protamine-insulinate takes about five hours to disappear. After forty-five minutes, the excess dye injected is completely decolourised, and the particles have to a large extent been aligned in lymphatics of 1 to a few microns. After two hours, the quantity present in the lymphatics is more prominent compared with that in the tissue spaces. After three hours there is definitely fewer particles to be seen. They do not seem to be carried away into larger lymphatics, but to dissolve *in situ*. After five hours, only slight traces remain in tissues and lymphatics.

It would seem that this method of observation might be useful also in other cases where the absorption of precipitates is involved.

H. K. Beecher.
A. Krogh.

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University, Copenhagen.
Feb. 7.

[1] *J. Amer. Med. Ass.*, **106**, 177–180 (1936).

A New Genus of Ants in Britain

While making some observations on the ants that occur in south-east Dorset (as a preliminary to a detailed survey of the ant fauna of South Haven Peninsula), I came across workers of a small reddish species which on closer examination proved to be quite distinct from any known British species. The most obvious characters that differentiate this from other Myrmicines are the shape of the mandibles and the very square head, of which the hind margin is markedly emarginate. The mandibles, instead of broadening to a toothed distal end, narrow to a single point like a pair of curved tusks which when closed just cross at the tip. When the specimens were shown to Mr. O. W. Richards, he immediately referred them to the Continental genus *Strongylognathus*, Mayr, which is well known to be an inquiline or slave-maker associating with *Tetramorium*. A full description of the species will be published elsewhere.

Workers were taken from two loci more than a mile apart, and in both cases were associated with *Tetramorium caespitum*, Linn. On May 5, 1935, when a nest of *Tetramorium* on a sandy heather-covered bank was accidentally disturbed, several were seen to be moving about among the *Tetramorium*. On June 15, 1935, I was watching *Tetramorium* moving about on the surface of a slight sandy slope on which was an open turf of low plants. Several *Strongylognathus* were seen moving on the surface among the *Tetramorium*, not far from the entrance to the latter's nest. One or two of the former were each surrounded by several *Tetramorium* which appeared to be pulling them about. The object of this action was not apparent.

C. Diver.

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Kensington, W.8.
Feb. 11.

Ontogeny of the Angiospermic Carpel

In a recent letter[1], Dr. I. V. Newman has indicated that he has found, from his study of *Acacia* flowers, evidence favourable to the classical foliar interpretation of carpels. The letter is supplementary to an article previously issued[2] in which it is shown by photomicrographs from *A. suaveolens* and *A. longifolia* that, when carpel formation begins, there is still a small residual cone to the floral axis.

The letter states that neither Grégoire, Saunders, Thomas nor I has provided cellular details of carpel primordia supporting our varied interpretations of the legume. The article referred to states it to be significant that no figures in support of our diverse theories are given in our papers showing the cell details of the primordial tissues of the floral axis.

On this point it may suffice to state in reply that the cellular details observed by Grégoire are still unpublished, and that neither Saunders nor Thomas has professed to deal with carpel primordia. In so far as Saunders is concerned, the absence of figures can scarcely be considered significant, and, in addition, cannot of itself vitiate her views, for she has definitely supported the foliar interpretation of carpels to which Dr. Newman adheres. As to Thomas, his cupular view has been based primarily on the study of fossils.

It would, therefore, seem that I alone remain negligent in supporting my view of acarpous angiospermy by illustration of the cellular details from species of *Acacia*. Dr. Newman quotes me in his letter as having stated that the whole of the residual apex gives rise to the legume as, for example, in *A. spadicigera*. In the article referred to, he affirms that I describe the legume as terminal. In reality I have stated that the single sessile legume of *A. spadicigera* is free and terminal in the *mature* flower, that in its ontogeny there is a residual apical cone which comes to be involved in the base of the mature legume, and that the same condition is maintained in ten other species of *Acacia*, for which the full floral ontogeny has been studied, and in each of which the mature legume is terminal, with the arrested floral cone involved in its base.

Thus, no new fact has emerged by the illustration of the residual cone in the young flowers of *A suaveolens* and *A. longifolia*. In addition, I have often observed the residual cone in species of *Inga*, *Calliandra*, *Albizzia*, *Elephantorrhiza*, *Dichrostachys*, *Pentaclethra*, *Desmanthus* and *Mimosa*, to mention but a few, in all of which the floral cone is merged during development in the base of the single legume.

Still further, I have figured leguminous flowers

with multiple legumes, as, for example, *Cassia fistula*, and have recently examined flowers of *Ceratonia siliquastrum* with 8–24 legumes. Such examples may suffice to indicate that even mature legumes need not be terminal.

At the same time, the lateral positions of such multiple legumes lend no obligate support to the classical foliar interpretation of carpels, such as Dr. Newman appears to claim. For it will be evident that lateral position in itself is no more a proof of the foliar nature of a carpel than the lateral origin and position of a branch would be proof of its foliar origin. My views on free carpel formation are detailed in "Publications of the Hartley Botanical Laboratories", No. 12, in which grounds are advanced for the belief that free carpels are emergences of a spore-bearing axis, the apex of which is arrested, and which may or may not come to be involved in any mature carpel.

It will be found on examination of primordial stages of *Acacia* that the single legume is of multiple primordial origin, the primordia being united by toral growth as the apex of the cone is arrested. This simple fact would in itself be sufficient to counter the classical view of carpel origin with each carpel as a fertile leaf, and might be used, if necessary, in support of Saunders' polymorphic view.

It would seem, however, that the time has come to abandon discussions as to what is leaf and what is stem, and to turn attention to the problems of physiology which determine the arrest of floral apices and the subjacent formation of ovuliferous toral growths. It may be stated finally that a legume differs in no material respect from a follicle such as that of *Nigella*, *Aconitum*, *Delphinium* or *Caltha*, in each of which the follicles are of multiple primordial origin.

JOHN MCLEAN THOMPSON.

Hartley Botanical Laboratories,
University of Liverpool.
Feb. 3.

[1] NATURE, **137**, 70 (Jan. 11, 1936).
[2] *Proc. Linn. Soc. New South Wales*, **40**, Pts. 5 and 6 (1935).

Helium Content of the Stratosphere and of the Air at the Earth's Surface

As Prof. F. A. Paneth and Mr. E. Glückauf[1] have mentioned our researches[2] upon the composition of the stratosphere, we think it useful to specify some points concerning the amounts of helium. Our conclusions deal only with the sum helium+neon, these two gases not being separated one from the other. In our researches we have tried to determine especially the content of oxygen, of nitrogen and of argon, and we obtained the contents of helium+neon only incidentally. In fact, as we have previously stated, we have not measured the helium+neon in all our samples, and as we also stated, we have mixed for that measurement samples from near altitudes. It was, therefore, only as an *indication* that we gave our figures.

As, however, our measurements of the air taken at the level of the earth were made under exactly the same conditions and at the same time as the measurements of the air of the stratosphere, we think in the stratosphere *there is a slight increase of the total helium+neon*, but cannot give very accurate proportions. Moreover, Tetens[3] and Wigand[4] had already pointed out an increase of the proportions of the 'light gases' in the higher layers of the troposphere.

In considering the question, a new fact occurred to us as probable. We found that the proportion of helium+neon (multiplied by 10^3), in eight experiments on the air at the ground-level, is successively: 2·8, 2·9, 2·7, 2·4, 2·4, 2·9, 2·45, 2·45, 2·6; for the stratosphere, our figures are: 3·2, 3·5, 3·3, 2·8, 4·6, 2·7, 3·0. When we consider that the air at the earth's surface has been taken in quite different places: Paris, Mont Blanc, Madagascar, Greenland, etc. (parts of investigations not yet published), and that we have made the measurements with exactly the same apparatus, it appears that *the amount of helium+neon is more constant at the level of the earth than in the stratosphere*. The same conclusion seems to follow from the three determinations made by Prof. Paneth and Mr. Glückauf.

Concerning the variation with altitude we think, with Prof. Paneth and Mr. Glückauf, that many more determinations are needed before any certain conclusion is positively established. At present we have no longer the possibility of clearing up these two questions, namely: (1) whether the proportion of 'light gases' of the stratosphere is actually variable; (2) whether this variation depends upon altitude. We hope Prof. Paneth will be able to get many air samples from the stratosphere and determine the helium content by the very ingenious and accurate method he has worked out.

If the increase of helium of the stratosphere be confirmed, we think it may come from extra-terrestrial sources, perhaps from the sun.

ADOLPHE LEPAPE.
GEORGES COLANGE.

Collège de France,
Ecole Polytechnique,
Paris.

[1] NATURE, **136**, 717 (1935).
[2] *C.R.*, **200**, 1340, 1871, 2108 (1935).
[3] *Erg. Obs. Lindenberg*, **6**, 219 (1911).
[4] *Phys. Z.*, **17**, 396 (1916); *idem*, **25**, 684 (1924).

Electric Moments of Solute Molecules

THE well-known method of computing the electric moments of solute molecules due to Debye makes use of the Clausius-Mosotti formula for the dielectric constant of a mixture. Whereas the analogous Lorenz-Lorentz formula for the refractive index of a mixture is probably very accurate[1], the Clausius-Mosotti formula is at the best a rough approximation because it ignores the force on a polar molecule due to the surrounding molecules being polarised by the molecule considered.

When it is desired to determine the electric moment of a molecule by measurements on solutions of the substance, it is advisable and customary to use high dilutions and non-polar solvents. But it is precisely under these conditions that it is possible to avoid the use of the Clausius-Mosotti formula by taking as model of the solute molecule a sphere and as model of the solvent a continuous medium. This model is completely analogous to that used with such conspicuous success by Debye and Hückel in their treatment of interionic energy in solutions of electrolytes.

Using this model, I obtain the very simple formula

$$(\varepsilon - \varepsilon_0 - n^2 + n_0^2)/\varepsilon_0\, C = 4\pi\mu^2/3kT \quad . \quad . \quad . \quad (1)$$

where ε is the dielectric constant of the solution, ε_0 that of the pure solvent, n is the refractive index of the solution, n_0 that of the pure solvent, C is the number of solute molecules in each cubic centimetre of solution, k is Boltzmann's constant, T is the

absolute temperature ; μ is here defined as the total electric moment between the plates of a large parallel plate condenser filled with solvent containing a single solute molecule with its polar axis normal to the plates. In the special case that the solute and solvent molecules occupy equal volumes, there is a simple relation between the value μ_G of μ computed by (1) and the value μ_D given by the usual Debye formula. The ratio μ_G/μ_D is in this case equal to $(\varepsilon_0 + 2)/3\sqrt{\varepsilon_0}$. This is unity when $\varepsilon_0 = 1$ (gaseous state) and when $\varepsilon_0 = 4$; it has a minimum value of 0·943 when $\varepsilon_0 = 2$.

I have applied formula (1) to Hampson's data for the two monochloronaphthalenes and ten dichloronaphthalenes in benzene and to Jenkins's data for nitrobenzene in the six non-polar solvents benzene, carbon tetrachloride, cyclohexane, carbon disulphide, hexane, decahydronaphthalene. In all cases the values obtained for μ are between 3 and 7 per cent lower than those obtained by the usual formula of Debye. The former values are therefore neither more nor less reasonable than the latter. I do, however, find that as the concentration varies there is no trace of any trend in the value of the left side of (1), whereas the analogous quantity $3\,{}_0P_2$ in Debye's treatment in many cases has a considerable trend even at the highest dilutions. I suggest that this trend is not due to mutual interaction of the solute molecules, as usually suggested, but is due to the inaccuracy of the Clausius-Mosotti formula.

According to the model used by me, μ should vary from one solvent to another according to the relation

$$\mu\,(\varepsilon_0 + \tfrac{1}{2}\varepsilon_i) = \text{constant} \quad . \quad . \quad . \quad (2)$$

where $(\varepsilon_i - 1)/4\pi$ is the polarisability (per unit volume) of the solute sphere. This formula does not agree with the experimental dependence of μ on the solvent, nor should we expect agreement, because this effect will certainly depend specifically on how the dipole is situated in the solute molecule, as has been explained semi-quantitatively by Frank[2].

I hope shortly to publish a detailed derivation of formulæ (1) and (2).

E. A. GUGGENHEIM.

Pippin Cottage,
Sonning.
March 5.

[1] C. G. Darwin, *Proc. Roy. Soc.*, A, **146**, 17 (1934).
[2] F. C. Frank, *Proc. Roy. Soc.*, A, **152**, 171 (1935).

Photo-electric Activity of Iron and its Oxides

THE following results, obtained from a photo-electric examination of the oxidised surfaces of metallic iron, render previous results[1] for other metals more complete.

The surface of Fe_2O_3 was found to be almost photo-electrically insensitive, and no spectral distribution curve could be obtained. The photo-electric currents produced from an iron oxide (FeO) surface were so small that a determination of the photo-electric threshold from the spectral distribution curve could not be made with any accuracy. It did appear, however, that the curve possessed a maximum at 2190 A., and that the photo-electric threshold was at a wave-length less than 2500 A. Hughes and Dubridge[2] give a value of 2620 A. for the photo-electric threshold of outgassed *metallic* iron, and I[3] have found the threshold of a turned metallic iron surface to be at 2980 A. ; this latter surface has been shown to give results similar to a partially outgassed metallic surface.

These results, therefore, bring iron into line with the other metals previously examined. They support a theory of gas adsorption rather than instantaneous oxidation as the initial change undergone by a clean metal surface on exposure to the air.

JAMES S. HUNTER.

Physics Laboratory,
University, St. Andrews.
Feb. 3.

[1] J. S. Hunter, *Phil. Mag.*, VII, **19**, 958 (1935).
[2] Hughes and Dubridge, "Photoelectric Phenomena", p. 75.
[3] J. S. Hunter, *Proc. Roy. Soc. Edin.*, **54**, 102 (1934).

Photo-Activation of the Carbonyl Group in Prototropic Reactions

ACCORDING to the theory of the mechanism of the catalysed bromination of ketones advanced by me[1], presented in outline by Nathan Watson and Laurie[2], and more recently extended by Watson Evans and Morgan[3], the function of the catalytic molecule is the introduction of the translational energy of collision specifically into the carbonyl bond through the formation of transient addition complexes, which leave the bond in an electronically activated condition : "the rupture of one link of the double bond, in chemical changes such as the formation of addition compounds, is an asymmetrical process, which can be formulated as depending on the transient formation of a semi-polar double bond in an activated phase of the molecule"[4].

In confirmation of the foregoing theory, preliminary experiments have shown that it is possible to produce such activation by means of ultra-violet light[5], and in this way to catalyse bromination. A study of the photocatalysis of such prototropic reactions is now proceeding.

WILFRED S. NATHAN.

Technical College,
Cardiff.
Feb. 3.

[1] Thesis, University of London (1933).
[2] *J. Chem. Phys.*, **3**, 170 (1935).
[3] *J. Chem. Soc.*, **167**, 1167, 1173 (1935).
[4] Cf. Lowry, *Chem. and Ind.*, 456 (1925).
[5] Cf. Lowry, *J. Chem. Soc.*, 620 (1926).

Alfred Hayes

THE recent death of Alfred Hayes will recall to the minds of many one who was for successive generations associated with the intellectual and social life of Birmingham, not only as Principal and later Secretary of the Midland Institute, but also by reason of his literary activities in various directions. He was recognised as the poet, who held on manfully in surroundings more or less indifferent and even antagonistic to such an immaterial outlook on life. To me his death brought back a particularly striking sonnet, "Pasteur's Grave", which was written in the following circumstances.

At the opening of the session of the Mason College, now the University of Birmingham, in 1895, my husband was asked to give the inaugural address. Pasteur's death had just occurred and Prof. Frankland chose as his subject "Pasteur—his Life and Work". A few days later he received a warm and appreciative letter from Mr. Hayes thanking him for his lecture and enclosing a copy of the afore-mentioned sonnet, which appeared in one of the London evening

papers. When my husband and I were writing the life of Pasteur for the "Century Science Series" (1898), we asked permission to reprint it in our volume. The ingenious way in which some of the many activities of Pasteur are woven together in so delicate and graceful a manner will, I venture to think, make a special appeal to readers of NATURE. Pasteur was buried in the Pasteur Institute in Paris, hence the last lines.

"No cypress-shadowed churchyard nor the gloom
Of haunted cloisters, doth immortalise
The dust of him whose patience proved more wise
To save than Death to slay. The busy loom
Glancing with silk, the teeming herd, the bloom
Of purpling vineyards, and the grateful eyes
Of souls reprieved at Death's most dread assize,
Shall make eternal gladness round his tomb.
Not 'mid the dead should he be laid asleep
Who wageth still with Death triumphant strife,
Who sowed the good that centuries shall reap
And took the terror from the healer's knife.
Defender of the living, he shall keep
His slumber in the arsenal of life."

G. C. FRANKLAND.

Loch Awe,
Argyll.
March 4.

Chinese Planetary Observations

I HAVE just discovered a rather interesting record in the Lü Li Chih ("Memoir on the Musical Tones and the Calendar"), which is an important section of the official history of the Former Han dynasty (first century of the Christian era).

Two series of figures are given, in relation to the five visible planets, termed respectively "Year Number" and "Observed-Mean-Rule", as follows:

	Year number	Obs. mean rule	Ratio
Jupiter	1728	1,583	1·091
Venus	3456	2,161	1·599
Saturn	4320	4,175	1·035
Mars	13824	6,469	2·135
Mercury	9216	29,041	0·317

It will be seen that the ratio of the two numbers is exactly (to the third decimal) equal to the synodic period, in years.

In Ssu-ma Ch'ien's "Historic Memoirs", written about one hundred years earlier, the planetary periods are very inaccurate.

Does this substantiate borrowing from Greece or Babylon during this period, in which Chinese contacts with the West were considerable?

HERBERT CHATLEY.

c/o Whingpoo Conservancy Board,
Shanghai.
Jan. 20.

Points from Foregoing Letters

Prof. D. Skobeltzyn and E. Stepanowa have measured the relative number, and the amount of the deflection of the paths of fast electrons scattered by passage through nitrogen gas. They find deflections of more than 30°, in greater numbers than predicted by theory; in their view the scattering cannot be explained by the extranuclear electrical field of the nitrogen atom or by collision with other electrons, and they suggest that it may be connected with an effect due to the nucleus of the atom.

The formation of a radioactive mercury isotope of mass 205, when mercury is bombarded by neutrons, is reported by Prof. E. B. Andersen. The author further states that a radioactive isotope of sulphur can be isolated from carbon tetrachloride which has been irradiated with neutrons.

Copper-beryllium alloys (containing more than one per cent of beryllium) are not oxidised at high temperatures. From experiments on electron diffraction, I. Iitaka and S. Miyake conclude that this non-oxidising property is due to the formation of a thin film of beryllium oxide. In the case of nickel chrome alloy (80–20), also non-oxidisable, the authors have observed, on heating, a film of nickel chromate.

By comparing the fine structure of certain spectrographic bands obtained with phosphorus deuteride, with the corresponding structure of the spectrum of phosphorus hydride, Dr. R. W. B. Pearse and M. Ishaque find that the change produced by the substitution of the heavy in place of the light hydrogen in the molecule may be explained by the mutual interaction of the individual electron spins, and the interaction of the resultant electron spin with the rotating molecule.

The rate at which insulin combined with protamine (a simple protein, incoagulable by heat) is absorbed into the lymphatic system has been investigated by H. K. Beecher and Prof. A. Krogh, by introducing small quantities of the compound into a Sandison-Clark chamber inserted in rabbits' ears. The authors have followed the distribution of particles of insulin proteinate stained with methylene blue in the lymphatics and in the tissue spaces.

A species of slave-making ants belonging to the genus *Strongylognathus*, hitherto unknown in Britain, has been observed in south-east Dorset by Capt. C. Diver.

Dr. I. V. Newman recently claimed that he had found in *Acacia* flowers evidence supporting the theory that carpels are modified leaves. Prof. J. McLean Thompson states that the lateral position described by Newman is not a new fact and does not necessarily indicate foliar origin. He reaffirms his views that free carpels are emergences of a spore-bearing axis, the apex of which is arrested.

A. Lepape and G. Colange direct attention to the fact that their results, showing a greater amount of helium in the stratosphere (which results were recently quoted by Paneth and Glückauf) are only approximate and refer to the combined helium and neon from mixed samples from several near altitudes. They now point out that the percentage of helium plus neon is more constant at the earth's surface than in the stratosphere and suggest that the helium of the upper regions may come from the sun.

E. A. Guggenheim deduces a new formula for calculating the electric moment of dissolved molecules. The author applies his formula to experimental data obtained by previous investigators and compares the results with those computed by means of the Clausius-Mosotti formula, which he considers less accurate.

Research Items

Early Cultural Distributions in Louisiana, U.S.A.

MR. WINSLOW M. WALKER, in describing a Caddo burial site at Natchitoches, Louisiana (*Smithsonian Misc. Collect.*, 94, 14), points out the importance for American archæology in the southern States, more especially in relation to the problem of the mounds of the lower Mississippi Valley, of investigation of sites that can be proved to have been inhabited by known historic tribes. The site now described was laid bare in the summer of 1931, when land was being prepared for a new fish hatchery on Cane River Lake near the town of Natchitoches. This body of water was formerly a bend of the Red River, which has now been cut off. No mounds are known to have existed on the site and it was evidently a burial ground. Bones were discovered here about 1916. Of several burials that were uncovered in 1931 only one was examined untouched. It contained the skeleton of a woman, about two feet below the surface, lying on the back with head to the north-east and arms by the sides. With it were two vessels of plain ware heavily tempered with shell. The head was an example of extreme fronto-occipital deformation. This site is probably that visited by Henri de Tonti in 1690. A number of fragments of pottery were obtained from the burials, of a shell-tempered greyish paste tinted with red. Both decorated and undecorated forms were found, the latter incised and engraved, four elements usually being worked into the pattern of the design, as, for example, four spiral arms radiating from a disc. A few stone axes and points were found by the workmen. It would appear that the pottery is of a type found on sites along the Red River, its most northerly point being in Arkansas. None, except as an intrusion, is reported from mounds. The burials probably belong to the early half of the eighteenth century, and afford a valuable clue to the interpretation of many of the archæological remains of north-western Louisiana.

Diatoms and Whales

ONE of the more curious plant habitats is that of the diatoms growing on the skins of whales in the Antarctic. These have recently been studied and described by T. J. Hart (*Discovery Rep.*, 10, 247, 1935). The chief diatom is *Cocconeis ceticola*, a form confined to this peculiar habitat and possibly at times saprophytic on the skin. Other diatoms are, however, also present in some cases, and among these is a new species, *C. Wheeleri*. These diatoms prove to be of considerable practical importance, for when abundant they form a yellowish film on the skin which is easily visible at a little distance. Whales carrying such a marked film have been in the Antarctic for some time, and are found to be in much better condition than whales without a film, which are recent arrivals from warmer seas. The diatoms seem to spread themselves by forming microspores at the beginning and the end of the Antarctic summer. Their survival through the winter months seems to be assisted by the fact that some whales remain in the Antarctic through the winter and these alone possess a diatom film in the beginning of the succeeding summer.

Growth of *Mya arenaria* in the Fundy Bay Region

AN interesting paper by Curtis L. Newcombe (*Canad. J. Res.*, 13, Sec. D., No. 6, Dec. 1935) shows that the rings of growth in *Mya arenaria* are of value as age determinants, and that in controlled experiments, conducted under natural conditions by planting specimens in boxes, the standard error of the differences between mean annual increments obtained by 'annual ring' measurements and those based on field growth experiments is insignificant. A relatively rapid growth is depicted for the first four years, after which there is a pronounced decrease. Relatively little variation has been found in the rate of growth characterising the widely separated parts of the Bay studied. The length of the growing season during 1931 was approximately four months—May–August. During 1930, growth continued until December 1. Such a late growth is considered unusual in the Bay of Fundy region. It is shown that variations in seasonal growth rates during the same and different years correspond with abundance of diatoms and not with temperature, diatoms being the chief food of this species. In a letter to NATURE of February 1, the author discusses the validity of concentric rings in *Mya arenaria*, L. for determining age, in which he mentions the statement of Mead and Barnes (34th Rep. Comm. Inland Fish. Rhode Island, 1904) that their specimens from Rhode Island do not possess 'annual rings' suitable for age determination. The explanation apparently lies in the fact that the *Mya arenaria* from some localities do not form rings of sufficient significance for them to be used in age determinations, whilst in others they are well formed. In a study of this species from Chesapeake Bay the author failed to find rings that might be considered annual in character.

Light and Nitrogen Fixation in the Soil

THE current view is that the vicissitudes of the nitrogen cycle in the soil are mainly, if not entirely, to be interpreted in the light of the varying proportions and activities of the living soil population, both plant and animal. Under English conditions this may well be true; none the less, these views would seem to deserve critical reconsideration in view of the evidence produced by Dr. N. R. Dhar of the significance of the action of light on the soil, under Indian conditions. With sterile conditions he has shown, in comparison between soils in light and dark, that the sunlight alone profoundly modifies photochemical oxidation of ammonia to nitrites and nitrates, the amount of production of nitric nitrogen in the air and therefore in the rain water, and the production of ammoniacal nitrogen in sterile soils containing such carbohydrates as cane sugar. Dr. Dhar in his enthusiasm may be swinging to the other extreme, but his experimental evidence is very striking, and the work deserves very full consideration both by biologists and soil chemists. He has given a very full summary of his work in a publication under the ægis of the Society of Biological Chemists, India, issued in 1935 under the title "Influence of Light on some Biochemical Processes" (Bangalore: Indian Institute of Science. 1 rupee).

Plant Virus Problems

AN address on this subject was given by Dr. Kenneth Smith before Section K at the Norwich meeting of the British Association and is published in *Science Progress*, 30, No. 119, January 1936. Dr. Kenneth Smith, referring to the 'breaking' or variegation of self-coloured tulips, which has been shown to be due to an insect propagated virus disease, makes the very interesting suggestion that virus infection may be widespread as a cause of flower variegation. Inoculation from the petals of variegated violas has produced virulent mosaic diseases in healthy tobacco plants; there is obviously an enormous field of work opening here of exceptional interest to the horticulturist, who may yet be found inoculating flower strains to obtain interesting variegated forms. The insect transmission of virus diseases is discussed. Their transmission is often closely linked with the sap-sucking Hemiptera, and the relation of the virus to the insect carrier raises many points of interest. Dr. Storey's observation of the existence of two strains of leafhopper in East Africa, indistinguishable to the eye but one transmitting the streak disease, the other not, is full of interest, and notably his further observation that the inactive strain will transmit the virus after the wall of the gut has been punctured. The mechanism of movement of the virus is discussed and its slow propagation in living parenchyma and comparatively rapid propagation in living phloem emphasised. A comparative diagram of sizes of virus organisms and of protein molecules, based upon ultra-filtration through specially prepared collodion membranes, lends emphasis to the recent claim of Dr. Stanley of the Rockefeller Institute to have crystallised out the virus of tobacco mosaic, which he therefore concludes is an autocatalytic protein. Certainly autocatalytic production of the virus organism would be a natural assumption to explain the extraordinarily interesting production of a special virus in the roots of tobacco plants, which are quite healthy in the seedlings and yet, grown in sterile soil, later develop a virus which remains located in the roots until it develops symptoms in some of the lower leaves.

South Orkney Islands

THESE islands on the edge of the Antarctic are heavily glaciated, and not easy of access on account of the pack-ice and heavy seas. Discovered more than a century ago, they had been rarely visited and were almost unexplored when Dr. W. S. Bruce chose them for the winter quarters of his *Scotia* expedition in 1903. This resulted in a thorough exploration of Laurie Island and the discovery of the strong probability of its relationship to the Andean folding. In January 1933, the R.R.S. *Discovery II* visited the group and surveyed the coasts of Coronation Island. Mr. J. W. S. Marr has now produced a monograph on the group (Discovery Reports, **10**, 283–382. Cambridge University Press. 15*s*. net). He surveys the history, adding a little to the meagre details, and goes on to a finely illustrated description of the islands with some account of the seals and the scanty plant life. Further evidence is adduced for the existence of the South Antillean arc, now fitly termed the Scotia arc, encompassing the north, east and south of the Scotia Sea, thus supporting Suess's suggestion of Andean connexion with Antarctica. The soundings of the *Discovery II*, added to those of the *Scotia* and *Meteor*, confirm the suggestion. There is, however, a possibility of a gap or deep col in the submarine ridge between lat. 33° and 34° W. on the southern arm. The volume contains a reproduction of the charts of the islands, in which unfortunately there are a few misprints in the names of Laurie Island.

Motor Transport in the Arctic

THE use of mechanical transport is a new feature in arctic travel, although unsuccessful attempts in this direction were made a quarter of a century ago in the Antarctic. In the January number of the *Polar Record*, four writers give their experience of various types of mechanical transport in different parts of arctic regions and discuss its usefulness. The German Greenland expedition of 1930–31 used motor sledges on the ice cap where the surface was smooth, but found them useless near the edge of the ice on account of crevasses, steep slopes, slush and hard snowdrifts. Mr. N. Urvantsev, writing on the use of caterpillar tractors in the Soviet Arctic, claims that they bid fair to revolutionise transport in that region and that they move equally well on sea-ice, snow and snow-free stony surfaces. The Hudson's Bay Company reports on the whole the success of tractors, but a difficulty in high cost of operating and danger of mechanical breakdowns. Lastly, tractors have been found very useful in northern Ontario, provided different types of 'tread' are available for different surfaces. None of the writers finds that the mechanical difficulties are now considerable in this form of transport, but carriage of fuel may be a consideration.

Theory of Excitation

VARIOUS attempts have been made to formulate the laws governing the excitation of living tissues by electric currents. Prof. A. V. Hill's new mathematical treatment (*Proc. Roy. Soc.*, B, **119**, 305; 1935) takes more of the facts into account than previous theories have done, and agrees closely with the results of numerous experiments of different kinds. Excitation occurs when the 'local potential', V, rises above the 'threshold', U. The passage of current for an infinitesimal time produces an increase in V which is proportional to the current. On the other hand, V has a spontaneous tendency to decay exponentially with time-constant k. Lapicque's chronaxie is $k \log_e 2$. The new feature of the theory is that it takes into account the tendency of the threshold to be affected by the passage of currents during finite times. This tendency is 'accommodation'. The rate of change of threshold is given by the following formula:

$$\frac{dU}{dt} = \frac{V-V_0}{\beta} - \frac{U-U_0}{\lambda},$$

where U_0 and V_0 are the initial values and β and λ are constants. The problem is simplified by taking the case (which actually occurs under special conditions) where the original threshold is equal to the threshold after a current has passed for an infinite time. This allows the elimination of β. Several methods of determining λ, the time constant of accommodation, give consistent results. It varies independently of k. Accommodation is accelerated by increasing the concentration of calcium or potassium, or the temperature. It is greatly slowed by decreasing the calcium ion concentration.

Iron and the Origin of Life

IN a series of papers[1] published during the last few years, W. D. Francis, assistant Government botanist in the Botanic Museum and Herbarium, Botanic Garden, Brisbane, offers theoretical reasons and experimental evidence for a connexion between iron compounds and the origin of life. In 1925, he suggested that oxidation of ferrous compounds in soils and waters, or of native or meteoric iron, could provide energy for primitive organisms in a manner analogous to that whereby the oxidation of ferrous carbonate has been shown to provide energy for *Spirophyllum*.

In order to test the validity of such theories, Francis carried out series of experiments in which iron wires were suspended in dilute nutrient media, containing, for example, ammonium sulphate, potassium chloride, magnesium sulphate, potassium phosphate and calcium nitrate. The solution and the iron wires were, it is said, rigorously sterilised before the experiments began, and were protected from contamination as long as they lasted. After the lapse of several days, the ferruginous material on the wire was found to contain microscopic "protein" bodies of "irregular and crystalline shapes". If the atmosphere was freed from carbon dioxide, these particles did not appear, but the presence or absence of light had no effect. The protein was identified as "chromatin" after "the application of seventeen different microchemical tests".

Francis concluded that the particles observed were closely related to the iron bacteria *Leptothrix* and *Gallionella*. He considers that "the iron bacterium *Leptothrix* is derived from inorganic material through the operation of four fundamental factors: (1) the arrangement of iron atoms in ferrous hydroxide, (2) the processes of aggregation and crystallisation of ferrous hydroxide, (3) the chemical affinities of ferrous hydroxide for the groups of compounds containing the protein elements, (4) the ability of ferrous hydroxide to function in oxidation-reduction processes".

These conclusions can scarcely be regarded as substantiated until similar experiments leading to confirmatory results have been carried out in other laboratories throughout the world. In the meantime, it is permissible to make certain comments. *If* the precautions regarding sterility were really adequate, and *if* the colour tests, as used, prove the presence of protein, the work may be of significance. But besides this, it should not be forgotten that traces of silicon in the iron used might during corrosion give rise to a stainable colourless product insoluble in acids and swelling up in alkali. It is known that carbon dioxide enormously accelerates the corrosion of iron in air. Colloidal silica may thus be misleading investigators just as it did fifty years ago, and the spontaneously generated *Leptothrix* now described from Australia may have the same short-lived fame as the celebrated *Bathybius* of Huxley's day.

[1] Francis, W. D., *Proc. Roy. Soc. Queensland*, **37**, 98 (1926). *Bot. Archiv* (German translation), **15**, 377 (1926). *Proc. Roy. Soc. Queensland*, **44**, 23 (1933). Also three papers privately published, 1933, 1934 and 1935.

Recent Rumanian Work on the Absorption and Movement of Mineral Elements in Plants

DURING the last few years, under the able leadership of Prof. Deleano, much valuable information has been added to our knowledge of the absorption and movement of mineral elements in plants.

A note directing attention to new evidence for the negative migration of mineral elements, particularly in connexion with the work of Bossie on wheat, was published in NATURE last year[1]. Since then, further papers dealing with the work of Prof. Deleano and his colleagues have been received, and it is with these that the present note is concerned.

In 1931, Deleano and Andreesco[2,3], studying the accumulation of mineral and organic substances during the course of development of the leaves of *Salix fragilis*, showed that the total vegetative activity of the leaves can be divided into three periods: (1) At the commencement of vegetative activity mineral and organic substances accumulate in the leaf; this is called the period of growth. (2) The quantities of mineral and organic substances are then maintained constant for a considerable time, during which the leaves transform them into more elaborated forms; this is the period of assimilation proper, or, as Deleano calls it, "constant protoplasm", because the total quantity of nitrogen in the leaves remains unchanged. (3) Towards the end of this period the mineral and organic substances begin to be eliminated from the leaves to other parts of the plant or to the soil; thus giving the third, or period of negative migration. At the onset of this period, it is suggested that the permeability of the cells increases and assimilatory activity declines, resulting in the loss of soluble materials; protein nitrogen decreases in quantity, being converted into more soluble forms such as amino acids and ammonia nitrogen, in which form it is eliminated; fifty per cent of the total nitrogen is lost in this way.

The duration of the three periods in the case of *Salix fragilis* is: period of growth, 25 per cent of the growing season; period of constant protoplasm, 50 per cent; and period of negative migration, 25 per cent.

Analyses of *Aesculus Hippocastanum* material by Deleano and Bordeiano[4] gave substantially similar results, except that the duration of the three periods was in this case 75, 12, and 13 per cent, respectively, of the total vegetative period.

During the third period it was found that non-combined water content commenced to decrease in quantity some time before elimination of the mineral

substances was evident; suggesting that the migration of the latter may be independent of the movement of water. In all the investigations the results are expressed in absolute quantities per hundred leaves, etc., a method now generally used in this kind of work, so that a more correct impression of the movement of the substances in question is being obtained than would be the case if results were expressed on a dry-weight basis.

In a later series of papers[5], similar work on *Populus pyramidalis* and *Robinia pseudacacia*[6]; *Juglans regia*, *Quercus Robur* and *Zea Mais*[7]; *Triticum vulgare*[8]; *Nicotiana Tabacum*[9]; is recorded by Deleano's colleagues. In all cases the three periods of vegetative growth are recognisable, although the duration of the individual periods, and the percentages of materials eliminated during Period (3), naturally show differences in each plant. For example, in *Nicotiana* there are two well-marked phases of development; during the first, maximum accumulation of organic and mineral substances coincides with maturity of the main axis and its members, that is, leaves and fruits; then negative migration sets in. But this is arrested by the development of the axillary shoots, and a second period of absorption and assimilation follows, succeeded still later by a second negative migration.

The work of Deleano and his colleagues shows quite clearly that in annual plants the direction of the negative migration in the third period of vegetative activity is from the leaves and stem back into the soil, very little if any being retained in the roots. In biennials, during the second year, the roots act merely as regulators allowing the passage of considerable quantities of mineral substances, so that throughout the whole period during which the aerial portions show the three stages of development, and movement of materials already outlined, the initial content of mineral and total nitrogenous substance in the root itself remains unchanged.

In perennials it is shown that during any one vegetative (leafy) season, nitrogenous and other materials decrease in the stem during the first period of growth of the leaves, accumulate again to their initial value and then remain constant during the second period of protoplasmic stability in the leaves, and remain constant also during the period of negative migration from the leaves. That is, there is no evidence of a further accumulation of these substances in the stem while they are being passed out of the leaves at the end of their vegetative activity. The natural conclusion is, therefore, that in perennials as well as annuals and biennials, most of the substances migrating out of the leaves are returned to the soil, and not stored in either the stem or the root; and that this state of affairs cannot be shown when results are expressed on a dry-weight basis, but only when they are recorded in absolute quantities per hundred plants or parts of plants.

N. L. PENSTON.

[1] NATURE, **136**, 268 (1935).
[2] Deleano, N. T., and Andreesco, M., *Bul. Soc. Sci. Cluj. Roumanie*, **6**, 209–220 (1931).
[3] Deleano, N. T., and Andreesco, M., *Sonderabdruck Bietrage Biol. Pflan.*, **19**, Hft. 3 (1932).
[4] Deleano, N. T., and Bordeiano, C., *Acad. Roma mem. Sect. Stiint Ser.* (III), **9**, Mem. 10 (1934).
[5] Series Title: "Contributiuni la Studiul Rolului si Functiunii Substantelor Minerali si Organici in Viata Plantei".
[6] No. 2, Polovrageano, I., *Univ. de Bucharest Fac. Farm.*, May 1933.
[7] No. 3, Trandafiresco, E., ibid., June 1934.
[8] No. 4, Bossie, V. G., *Lab. Chim. Anal. Fac. de Farm.*, 1934.
[9] No. 5, Vladesco, I. D., *Univ. de Bucharest Lab. de Chim. Anal.*, 1934.

Developments in Cathode Ray Oscillographs

AT a meeting of the Wireless Section of the Institution of Electrical Engineers held on March 4, two papers dealing with cathode ray oscillograph tubes were presented, experimental demonstrations being given in each case.

The first paper, by Dr. L. Levy and Mr. D. W. West, was entitled "Fluorescent Screens for Cathode-Ray Tubes for Television and other Purposes". This paper contains an account of investigations carried out with various materials employed for the screens in cathode ray tubes. The fluorescent and phosphorescent phenomena displayed by a variety of materials are described in detail, and the results of photometric measurements of the illumination of screens of these materials under different conditions of excitation are given. The results show that it has been possible to obtain a zinc sulphide giving approximately white fluorescence, while a mixture of zinc sulphide and zinc cadmium sulphide giving a brilliant white fluorescence of high intensity has also been prepared. The intense fluorescence of these materials is usually accompanied by considerable phosphorescence, which renders them unsuitable for many practical purposes. The authors have made the discovery, however, that the phosphorescence of zinc sulphide can be prevented by adding a minute trace of nickel—about one part in two million—at the expense of only a very slight reduction of fluorescence.

The second paper, entitled "The Comparative Performance of Gas-Focused and Electron-Lens-Focused Oscillographs at Very High Frequencies", was read by Mr. L. S. Piggott. This paper describes an experimental investigation of the relative properties of the gas-focused cathode ray tube and that employing an electron-lens system for focusing purposes, at various frequencies up to 1,400 megacycles per second (wavelength about 21 cm.). It appears from the results that the latter type of tube is likely to prove a most useful instrument at very high radio frequencies.

A third paper, "A Cathode-Ray Oscillograph for the Direct Measurement of High-Voltage Transients", by A. K. Nuttall, was published in the February number of the *Journal of the Institution of Electrical Engineers*. This paper describes a high-speed continuously evacuated cathode ray oscillograph for the recording of high voltage transients, a distinctive feature of the instrument being that impulses of 100 kv. can be applied to the deflecting plates without the use of a potential-divider. The possibilities of the instrument are illustrated by the results of a brief investigation of the characteristics of a sphere-gap when sparking over on the application of a steep-fronted wave.

Very Low Temperatures

Exhibition at the Science Museum

"THE function of a science museum does not end with the record of the achievements of thought and invention of the past; it is also its duty to show the continuous progress of the present". These words were spoken by Sir William Bragg, when he opened the Exhibition of Very Low Temperatures at the Science Museum on March 4. Before a distinguished audience he recalled that one hundred and forty years ago Benjamin Thompson, Count Rumford, wrote a description of what he considered the ideal science museum should be. He was ahead of his time, however, and an attempt to found such a museum at the Royal Institution was a failure.

The Royal Institution has fulfilled another role, and in the Science Museum at South Kensington Rumford's ideals have been achieved. The valuable historical material which is housed there has taken more than three-quarters of a century to collect, but it is only in comparatively recent years, under the stimulus of the late director, Sir Henry Lyons, and of his successor, Colonel E. E. B. Mackintosh, that its second duty, that of showing the "continuous progress of the present", has been attempted, and of this the present exhibition is an outstanding example.

Lord Rayleigh presided at the opening ceremony. In seconding a vote of thanks proposed by Mr. H. T. Tizard (chairman of the Exhibition Committee), Colonel Mackintosh referred to the fact that it was Prof. P. Kapitza who, during the preparation of the Refrigeration Exhibition held in the Museum two years ago, suggested that the very low temperature section should be omitted and treated some day as a separate exhibition. Mr. T. C. Crawhall, an officer of the Museum, has had charge of the arrangements for both exhibitions and has also acted as secretary of the Exhibition Committee. Among those present were Dr. J. Donald Pollock, by whose personal generosity many of the exhibits have been acquired.

The exhibition, which will be on view until May 31, is unique in conception and ambitious in character, the exhibits having been devised in most cases so that they can be operated by the visitor. Some of them have been made for the exhibition by industrial firms, all of whom have contributed anonymously, while others have been made in the Museum to the designs of Dr. O. Kantorowicz, who has been specially engaged for the duration of the exhibition. The difficulties of constructing apparatus which will demonstrate physical principles in as simple a manner as possible are well enough appreciated, but to make these in such a way that they can be operated continuously by visitors to a museum, which has been so successfully achieved in this exhibition, is worthy of great praise.

The exhibits are grouped under the following headings: temperature reduction, temperature and pressure measurement, liquefaction and solidification, storage and transport, applications, properties and historical. Demonstrations involving the use of solid carbon dioxide and liquid air are given at intervals throughout the day by attendants, while a series of lectures, which will include demonstrations at the very low temperatures, is being arranged. Details of the lectures will be published as soon as possible.

For those who want to make a study of the achievements of the past a collection of apparatus from several places in Great Britain and the Continent is available. These illustrate the work of Andrews, Claude, Dewar, de Haas, Faraday, Joule, Kamerlingh Onnes, Keesom, Linde, Olszewski, Wroblewski, Ramsay and Travers, the Continental exhibits having come from Cracow, Leyden, Munich and Paris, while the others have been received from the Royal Institution and the Manchester College of Technology, in addition to those transferred from other sections of the Science Museum.

A small handbook entitled "Very Low Temperatures", giving a brief survey of the physical principles underlying the attainment of very low temperatures and of their uses, has been prepared by Mr. Crawhall and is on sale at the Museum, price 6*d*. net (7*d*. including postage).

Educational Topics and Events

CAMBRIDGE.—Smith's Prizes have been awarded to A. E. Green, of Jesus College, and A. M. Turing, of King's College.

Rayleigh Prizes have been awarded to S. W. Shiveshwarkar, of Sidney Sussex College, E. T. Goodwin, of Peterhouse and D. M. A. Leggett, of Trinity College.

At St. John's College a research studentship and research exhibitions are offered for competition in July. One Strathcona research studentship of the annual value of £200 is offered for competition among research students who are (*a*) graduates of any university other than Cambridge or (*b*) graduates of Cambridge who are not already members of St. John's College. Two Strathcona exhibitions of the annual value of £40 are also offered for competition under the same conditions as the studentship. In special circumstances a supplementary payment may be made to exhibitioners. The election of a candidate is subject to his being accepted by the University as a research student proceeding to the Ph.D. degree, and if he is not yet a member of the College, to his beginning residence at the College in October 1936.

Dr. J. A. Venn, president of Queen's College, has issued an appeal in connexion with the publication of "Alumni Cantabrigienses". The four volumes of Part 1, containing biographies (nearly 80,000 in number) of all recorded members of this University from the earliest times up to 1751, were published by the Cambridge University Press in the years that immediately followed the Great War. Part 2, covering entrants from 1752 until 1900, will be passing through the Press during the next four or five years, and in order that this section may be as complete as possible, an appeal is being made to biographers, genealogists, historians and also old Cambridge men themselves, for biographical facts relating to any man who matriculated at the University or was admitted to any College between January 1, 1752, and December 31, 1900. All information should be sent direct to Dr. Venn.

LONDON.—The Graham Legacy Committee has, under the regulations for the administration of the Charles Graham Medical Research Fund, awarded a Gold Medal of the value of £20 to Sir Thomas

Lewis, physician in charge of the Department of Clinical Research at University College Hospital, for research work in connexion with the treatment of cardiac disease.

The following have been appointed fellows of King's College: Prof. Gilbert Cook, professor of mechanical engineering since 1921 and now head of the Department of Civil and Mechanical Engineering; Sir Halley Stewart, who is chairman of the Halley Stewart Trust, which has greatly enhanced the facilities for research in physics by placing 30 Chesterford Gardens at the disposal of the College and by the endowment of the research carried on therein; Dr. J. W. Pickering, formerly a student of the College and since 1923 honorary lecturer in physiology; Mr. C. K. Bird, a student in the Faculty of Engineering in 1904–8 and who, since the War, has achieved a distinguished position in another profession under the *nom de plume* of "Fougasse".

The following have been appointed fellows of University College, London: Prof. N. H. Baynes, professor of Byzantine history in the University; Prof. F. G. Donnan, professor of chemistry in the University; Dr. H. P. Himsworth, deputy director of the Medical Unit at University College Hospital Medical School; Dr. R. J. Ludford, honorary lecturer in cytology at University College; Dr. A. S. MacNalty, Chief Medical Officer, Ministry of Health; Mr. F. Norman, reader in German at University College and King's College; Mr. Julian Taylor, assistant surgeon, University College Hospital; Dr. F. C. Toy, deputy director of the British Cotton Industry Research Association.

APPLICATIONS, which must be received not later than April 15, are invited for the following scholarships awarded by the Institution of Electrical Engineers: Duddell Scholarship (value £150 per annum, tenable for three years), open to British subjects less than nineteen years of age on July 1, 1936, who have passed the matriculation examination of a British university. Ferranti Scholarship (value £250 per annum, tenable for two years), open to British subjects less than twenty-six years of age on July 1, 1936, who are students or graduates of the Institution and have been such for not less than two years. Swan Memorial Scholarship (value £120, for one year), open to British subjects less than twenty-seven years of age on July 1, 1936, who have completed a recognised course in electrical engineering or science of at least three years, and who desire to carry out whole-time research or post-graduate work of an electrical engineering nature. Silvanus Thompson Scholarship (value £100 per annum and tuition fees, tenable for two years), for works employees who are the sons of parents of limited means, open to British subjects less than twenty-two years of age on July 1, 1936. William Beedie Esson Scholarship (value £120 per annum, tenable for two years, renewable in approved cases for a third year), open to British subjects who are less than twenty-two years of age on July 1, 1936, have served a minimum apprenticeship (or its equivalent) of three years at an approved electrical engineering works, and desire to take up a whole-time day course in electrical engineering at an approved university or technical college. Further particulars can be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Science News a Century Ago

Steam Navigation in the Red Sea

IN a paper by Lieut. Wellsted "On the West Coast of Arabia, from Ras Mohammed to Jidda", read on March 14, 1836, before the Royal Geographical Society, reference was made to the reefs which lie off the coast and extend considerable distances with navigable channels inside them. Writing at a time when steam navigation to India was frequently being discussed, Lieut. Wellsted said: "It has sometimes been debated whether, if a small steam boat were employed, the mails might not be conveyed up and down the Red Sea inside these reefs, more easily than without them; especially as their influence in destroying any wind, however strong, blowing against them was very remarkable. The passages inside the reefs were very numerous but it would be necessary to anchor each night. But both coal and other wear and tear would be saved and the route is unquestionably practicable".

The Statistical Society

AT the anniversary meeting of the Statistical Society held on March 15, 1836, Henry Hallam, the honorary treasurer, being in the chair, the report of the Council said the Society had 392 members. It was also remarked that "the early progress of a society, which has for its object, not the establishment of a particular theory or the development of any particular science but an enquiry into the various and innumerable relations existing among men and nations, must necessarily be slow—that the usefulness of such a Society cannot be estimated by the apparent amount of its labours or the number of its publications—that its fruits will become visible in an awakened spirit of research".

Royal Asiatic Society and Indian Agriculture

AT a general meeting of the Royal Asiatic Society held on March 19, 1836, the Right Hon. H. Mackenzie and Mr. J. F. Royle made the suggestion that a committee on trade and agriculture should be appointed to inquire into the capabilities of the various soils and climates of India with the view of stimulating production. Mr. Royle exhibited a collection of vegetable and mineral products from India, and in the course of his remarks said that by the application of science, especially of botany and meteorology, much might be done to increase the comforts and resources of the natives of India. That such views were not chimerical might be seen by looking at the rise and progress of the trade in indigo, opium, lac, cotton and more recently catechu, safflower, linseed and rapeseed. In proposing that the Society should investigate the production and inquire into the processes of cultivation of the East, and apply to their improvement the science of the West, he considered he was taking the only satisfactory and legitimate means of attaining the object in view—the improvement of the resources of India.

Herschel's Supposed Discoveries in the Moon

The extraordinary hoax perpetrated by Richard Adams Locke in the newly-founded New York *Sun* regarding the discoveries said to have been made by Sir John Herschel at the Cape, to which reference was made in NATURE of January 13, 1934, p. 73, found an echo in *The Times* of March 21, 1836,

which quoting from *Galignani's Messenger* said: "The Lyons papers, and after them the *Gazette de France* and many of the departmental journals, have been relating wonderful stories of discoveries in the moon by Mr. Herschel, who is represented as giving, by means of an immense telescope he had constructed, a complete geographical description of that planet, its rivers and lakes, its mountains and vallies, its vegetation and animals, together with measurements of hills, plains, etc., the composition of the strata of the lunar soil, and many other very interesting things. We abstained from repeating these fables till we should have at least some plausible authority for their publication, and our circumspection has been justified." The account of the pretended discoveries, *The Times* added, appeared first in an American paper, and was evidently a hoax, though the French papers did not see through it. Another note appeared in *The Times* of March 29, saying that a French paper had attributed the hoax to "M. Nicolet, a Frenchman by birth, but settled in the United States".

Societies and Academies

LONDON

Royal Society, March 5. G. C. ULLYETT: Host selection by *Microplectron fuscipennis*, Zett. (Chalcididæ, Hymenoptera). *Microplectron* was able to discriminate with ease between true and false hosts even where the latter resemble the normal host in everything except the presence of the living larva within the cocoon. The evidence seems to suggest that the acceptance of a host depends, to a large extent, upon the presence of larval movement. A new technique was developed, during these studies, which removed a number of objections present in previous methods. The selection within the host species as represented by choice between parasitised and healthy individuals and also between the latter and unsuitable hosts was investigated. A high degree of discrimination existed between healthy material and hosts containing parasite larvæ which were well grown. The presence of parasite eggs, on the other hand, did not deter females from ovipositing in the host. A wholly mechanistic view of host selection is untenable; the underlying basis of behaviour is of a psychological nature. I. W. ROWLANDS and A. S. PARKES: A study of anti-thyrotropic activity. Inhibition of the effect of thyrotropic extract on the weight of the thyroid of the immature guinea-pig has been used as a test for anti-thyrotropic activity. The normal blood serum of the goat, horse, sheep, cow, and rabbit was not found to possess appreciable anti-thyrotropic activity, nor was that of a castrated ram injected with thyrotropic extract for four weeks. Anti-thyrotropic activity was induced in the blood of rabbits injected daily with thyrotropic extract over a long period. The activity began to appear after four weeks' injection and rose to a maximum at 10 weeks. 2 c.c. of serum obtained at this time completely inhibited the activity of an amount of thyrotropic extract otherwise sufficient to double the weight of the thyroid of the immature guinea-pig. A technique is described for the assay of anti-thyrotropic activity. G. A. MILLIKAN: The kinetics of muscle hæmoglobin. The rates of reaction of muscle hæmoglobin with oxygen and carbon monoxide have been measured by means of a micro-photo-electric form of the Hartridge-Roughton streaming fluid apparatus. The approximate velocity constants for extracts of horse heart muscle were compared with those for the blood hæmoglobin from the same animal. The kinetic results indicate that muscle hæmoglobin should be available as a naturally occurring intracellular indicator of oxygen tension, with a time lag of less than 1/100 second. This provides a new tool for studying the time relations of oxygen consumption in muscle. Its oxygen affinity, its concentration in muscle, and its rates of reaction are all such as to fit muscle hæmoglobin for the role of an oxygen store which can tide the muscle over from one contraction to the next. No known property, however, precludes the possibility of its acting catalytically within the cell.

DUBLIN

Royal Irish Academy, February 10. J. M. O'CONNOR: The physiological basis of the sensation of cold. (4) An analysis of the influence of temperature and of thyroid extract on the oxygen consumption of the anæsthetised rabbit. Under urethane anæsthesia and curare, the oxygen consumption is increased by thyroid extract 50 per cent at all temperatures from 22° to 39°. Within this range the influence of temperature follows the Arrhenius equation in three phases. The first, at 22°–29°, has a value for the Arrhenius constant of approximately 20,000; at 29°–32°, the constant of 16,000 approximately holds; at 35°–39°, the constant is approximately 22,000. At the transition points between the phases there is on the average a fall in oxygen consumption with rise in temperature. The additional oxygen consumed during shivering is proportional to the rate of change in oxygen consumption at the prevailing skin temperature less a threshold value. During the third phase there is no shivering. (5) The relation between basal metabolism, the regulation of temperature, and the sensation of cold. Comparison of the data referred to above with data in the literature from unanæsthetised but quiescent, that is, not shivering, rabbits, shows that the anæsthesia decreases the oxygen consumption in the first two phases but not in the third. The transition point between the third and the second phase is marked by an increase of about 90 per cent in the oxygen consumption on a slight fall of temperature. This transition point is situated close to the lower limit of the normal body temperature. The excitability of the human skin by cold stimuli corresponds to the rate of change in oxygen consumption with changing temperature.

EDINBURGH

Royal Society, February 3. H. S. JENNINGS: Inheritance in Protozoa. An account was given of recent work in the laboratories of the Johns Hopkins University, on inheritance after conjugation of diverse stocks in the ciliate Infusoria. The characteristics of the descendants are for a period of time, up to thirty-six days in some cases, partly determined by the nature of the cytoplasmic body. But the conjugation nucleus gradually takes control and the later characteristics are entirely dependent on its nature. The relation of these findings to the inheritance of acquired immunity or resistance was discussed.

PARIS

Academy of Sciences, February 5 (*C.R.*, 202, 361–444). JULIEN COSTANTIN : Two crops collected in the Roquelaire vineyard where the potato is found to have reverted to the wild state. PIERRE LEJAY : New determinations of gravity at Tonkin, Laos and in Annam. Results are given for 52 new stations. JEAN CABANNES and JEAN DUFAY : Can certain radiations of the nocturnal sky be identified with the Schumann-Runge bands of the oxygen molecule ? A discussion of a recent communication of Kaplan on this subject from the point of view of recent (unpublished) work of the authors. These spectra show no intense radiation attributable to the Schumann-Runge system, but on the whole the presence of this system in the light of the night sky is regarded as probable. HENRI DEVAUX : The transformation of a thin pellicle of CuS, under the influence of metallic copper, is of an electrolytic nature. ARNAUD DENJOY : Continued fractions. A. KHINTCHINE and PAUL LÉVY : The stable laws (probability). MAURICE DE NEVE : The transformation of Bäcklund of pseudo-spherical surfaces. FRÉDÉRIC ROGER : The extension to the local structure of the most general Cartesian ensembles of the theorems of Denjoy on the derived numbers of continuous functions. GEORGES GIRAUD : The existence of certain derivatives of Green's functions : consequences for problems of the Dirichlet type. W. STERNBERG : Extended integral equations. HENRI PONCIN : The structure of potentials which lead to stable hydrodynamic configurations. JEAN LOUIS DESTOUCHES : The properties of the spin of a system of corpuscles. JEAN LAGRULA : The correction of the errors due, in photographic photometry, to the heterogeneity of the blackening of the plate. It is known that a given illumination acting during a fixed time does not correspond to the same blackening at all points on the plate, and this effect has been regarded as irremediable. The present note develops a means of correcting for this, capable of reducing the error to the same order as that of the accuracy of the measurements. BERNARD LYOT : Observations of the solar prominences made at the Pic du Midi in 1935. Results of the study of the prominences by means of colour filters and of the movements of the prominences by slow cinematograph films, later viewed at an accelerated rate. The latter method promises interesting results. PIERRE HUMBERT : The discovery of the phases of Mercury. Evidence of the priority of Malapert as regards this discovery. Z. CHRAPLYWY : The equations of motion of the new electrodynamics. PIERRE GIRARD and PAUL ABADIE : Molecular interactions and the structure of liquids. PIERRE JOLIBOIS : The structure of the spark striking the surface of a solution. PIERRE JACQUET : The mechanism of the electrolytic polishing of copper. Diagrams are given showing the changes in the profile of the anode in the course of the electrolysis. CHARLES SADRON : Double refraction produced by mechanical deformation of some pure liquids. Comparing his experimental results on six pure organic liquids with those calculated from the theory of Raman and Krishnan, the author concludes that the latter is not in close agreement with experiment and scarcely gives the order of magnitude of the phenomena. RENÉ AUDUBERT : The mechanism of the emission of light by chemical reactions. MLLE. CÉCILE STORA : The Becquerel effect and photochemical sensibility of some fluorescent colouring matters. JEAN SURUGUE : The radiation of an active deposit of actinon. WITOLD BRONIEWSKI, J. T. JABLONSKI and ST. MAJ : The solidification diagram of the copper-zinc alloys. The alloys were homogenised by prolonged annealing at 400° C., 2,000 hours for the study of the critical points. The experimental results are given as a diagram. GABRIEL VALENSI : Causes of anomaly in the kinetics of the oxidation of metallic powders. Studies of the effects of roughness of the surface of the metal, of porosity and of irregularities of the dimensions. ANDRÉ LÉAUTÉ and THÉODORE VIERFOND : The ageing of tars used for road surfacing as a function of the amount of carbon. The addition of carbon as a filler appeared to be advantageous from experiments in the laboratory. The results of road tests, with subsequent analyses of the exposed material, confirm this view. JEAN HERMAN : The autoxidation of the hydroxides of iron, manganese and cobalt. ADRIEN PERRET and ROGER PERROT : Researches on magnesium cyanamide. Study of the temperature range over which magnesium cyanamide is stable. ARMAND MARIE DE FICQUELMONT : The hydrolysis of phosphorus dichloronitrides and of their amines. HENRI CLÉMENT : The organomagnesium compound of pentamethylbenzene. GEORGES DARZENS and ANDRÉ LÉVY : The synthesis of 1,9-dimethyl-3-carboxy-tetrahydrophenanthrenic acid and of 1,9-dimethylphenanthrene. LOUIS ROYER : New observations on the decrease of a calcite crystal in an active isotropic medium. Remark on the corrosion figures in dolomite. EDMOND SAURIN : The geological constitution of the province of Phu-Yên (South Annam). GÉRARD GAZET DU CHATELIER : A new type of interphase nucleus. MAURICE HOCQUETTE : Remarks on the composition of the secretion of *Primula obconica*. MARCEL CHOPIN : The examination of wheats and flours by means of the extensimeter. MLLE. JEANNE LÉVY : Study of the fixation of alcohol on the encephalus of the rat, experimentally made alkalosic. CH. DHÉRÉ and O. BIERMACHER : The fluorescence spectra of deuteroporphyrin and pyroporphyrin. Fine structure, emission in the near infra-red.

COPENHAGEN

Royal Danish Academy of Sciences and Letters, October 18. ELIS STRÖMGREN and ERIK SINDING : The original orbit of Comet 1904 I (Brooks). ELIS STRÖMGREN and HANS Q. RASMUSEN : The orbit of comet 1929 I (Schwassmann–Wachmann) in the years 1920–36. P. BOYSEN JENSEN : The distribution of the growth substance during the geotropic curvature of stems and roots.

November 1. VALD. HENRIQUES : Investigations on the ability of cations to penetrate the membrane of blood corpuscles. TH. MORTENSEN : Studies on antarctic echinoderms.

November 15. OLUF THOMSEN : Demonstration of small amounts of gonadotropic hormone in the urine of normal subjects (investigations made in collaboration with K. PEDERSEN-BJERGAARD). CARL M. STEENBERG : An anatomical and systematic investigation of the pulmonate gastropod, *Gonidomus pagoda*, Fér., from the Island of Mauritius.

November 29. S. ORLA-JENSEN (in collaboration with AGNETE SNOG-KJÆR) : The vitamin requirements of various bacteria. S. ORLA-JENSEN : Growth factors present in peptones. O. NEUGEBAUER : Mathematical cuneiform texts.

Forthcoming Events

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

Monday, March 16

SOCIETY OF ENGINEERS, at 5.30.—(at the Watt Bicentenary Exhibition at the Science Museum).—H. W. Dickinson: "Watt".

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—T. H. Harrisson: "Living with the People of Malekula".

Tuesday, March 17

EUGENICS SOCIETY, at 5.15.—(at the Linnean Society, Burlington House, Piccadilly, W.1).—D. Caradoc Jones: "Eugenics and the Merseyside Enquiry".*

KING'S COLLEGE, LONDON, at 5.30.—Prof. J. A. Schouten: "The Theory of the Geometric Object".*

INSTITUTION OF CIVIL ENGINEERS, at 6.—Dr. F. S. Sinnatt: "Some Major Problems in the Utilization of Coal".

Wednesday, March 18

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Dr. F. Loewe: "The Greenland Ice-Cap as seen by a Meteorologist" (G. J. Symons Memorial Lecture).

UNIVERSITY OF LONDON ANIMAL WELFARE SOCIETY, at 8.—(at Birkbeck College, University of London).—Prof. W. Garstang: "The Songs of Birds".*

Thursday, March 19

ROYAL SOCIETY, at 4.30.—P. I. Dee: "The Disintegration of Boron into three α-Particles".

D. F. Martyn and O. O. Pulley: "The Temperatures and Constituents of the Upper Atmosphere".

LONDON MATHEMATICAL SOCIETY, at 5.—(at the Royal Astronomical Society, Burlington House, W.1).—Dr. H. S. M. Coxeter: "Regular Skew Polyhedra in Three and Four Dimensions".

CHADWICK PUBLIC LECTURE, at 5.30.—(at the Royal United Service Institution, Whitehall, S.W.1).—Dr. Arthur S. MacNalty: "Epidemic Poliomyelitis".*

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. R. J. Reynolds: "Cineradiography".

Friday, March 20

PHYSICAL SOCIETY, at 5.—Annual General Meeting to be held at the Imperial College of Science and Technology, South Kensington, S.W.7.

ROYAL INSTITUTION, at 9.—Dr. H. Freundlich: "Structures and Forces in Colloidal Systems".

Saturday, March 21

SCIENCE MASTERS' ASSOCIATION and UNIVERSITY OF LONDON INSTITUTE OF EDUCATION, at 10.—(at the Institute of Education).—Conference on "General Science".

Official Publications Received

Great Britain and Ireland

International Institute for Psychical Research, Ltd. Bulletin 2: The Lajos Pap Experiments. By Dr. Nandor Fodor. Pp. 56+2 plates. (London: International Institute for Psychical Research, Ltd.) 5*s*. [202

The Meaning of "Survival": the Frederic W. H. Myers Lecture, 1935. By W. Whately Carington. Pp. iv+36. (London: Society for Psychical Research.) [212

University College of Wales, Aberystwyth. New Varieties and Strains from the Welsh Plant Breeding Station. Leaflet Series S, No. 3: A New Oat Variety for Hill Land, Ceirch Llwyd Cwta (S. 171), and Farmers' Associations for the Growing and Marketing of Seed Oats in Wales. Pp. 14+2 plates. (Aberystwyth: University College of Wales.) 1*s*. [242

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1935. (Twenty-first Report.) Pp. vii+103. (London: H.M. Stationery Office.) 5*s*. net. [222

River Flow Records. River Dee (Aberdeenshire): the Records of Water Level, Flow and Rainfall for the Year 1935 (together with Records of Temperature and Wind). By Capt. W. N. McClean. Pp. 12+6 plates. (London: River Flow Records.) 10*s*. 6*d*. [252

Other Countries

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. Notes on American Mabuyas. By Emmet Reid Dunn. Pp. 533–557. (Philadelphia: Academy of Natural Sciences.) [202

Report of the Danish Biological Station to the Ministry of Shipping and Fisheries. 39, 1934. By Dr. H. Blegvad. Pp. ii+84. 40, 1935. Pp. 44. By Dr. H. Blegvad. Pp. 44. (Copenhagen: C. A. Reitzel.) [202

Iowa Geological Survey. Vol. 36: Annual Reports 1930, 1931, 1932 and 1933, with Accompanying Papers. Pp. 471. (Iowa City: Iowa Geological Survey.) [202

Cooper Ornithological Club. Pacific Coast Avifauna, No. 23: The Birds of Nevada. By Jean M. Linsdale. Pp. 145. (Berkeley, Calif.: Cooper Ornithological Club.) [202

The Carnegie Foundation for the Advancement of Teaching. Thirtieth Annual Report. Pp. iv+208. (New York: Carnegie Foundation.) [202

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 14, No. 2B: Jurassic Stromatoporoids from Japan. By Hisakatsu Yabe and Tishio Sugiyama. Pp. 58+32 plates. (Tôkyô and Sendai: Maruzen Co., Ltd.) [222

Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending 31st August 1935. Pp. iii+192. 2 rupees. Summary Proceedings of the Thirty-first Meeting of the Indian Central Cotton Committee, held on the 19th and 20th August 1935. Pp. 102. (Bombay: Indian Central Cotton Committee.) [242

Transactions of the Academy of Science of Saint Louis. Vol. 28, Nos. 5, 6, 7: Notes on the Behavior of certain Ants of St. Louis County, by Phil Rau; Notes on the Behavior of certain Solitary and Social Bees, by Phil Rau; Observations on the Life History of the "Baltimore Checker-Spot" Butterfly, *Euphydryas phaëton* (Drury), in Missouri, by Harold I. O'Byrne. Pp. 205–230. Vol. 28, No. 8: Biologic Investigations on the Staphylinidæ (Coleoptera). By Ralph Voris. Pp. 231–261. Vol. 29, No. 1: Natural History of the Alligator Lizards. By Henry S. Fitch. Pp. 38. (St. Louis, Mo.: Washington University.) [252

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1935. Pp. iii+121. (Washington, D.C.: Government Printing Office.) 20 cents. [252

Union of South Africa: Department of Commerce and Industries: Fisheries and Marine Biological Survey Division. Fishery Bulletin No. 2: The South African Marine Fishes of Commercial and Angling Importance. By J. M. Marchand. Pp. 160. (Pretoria: Government Printer.) 5*s*. [252

Science Reports of the Tokyo Bunrika Daigaku, Section B. No. 34: Contributions to the Knowledge of the Digestive Enzymes in Marine Invertebrates. 1: Proteolytic Enzymes in *Polypus vulgaris* (Lamarck), Preliminary Reports. By Eishiro Sawano. Pp. 101–126. 35 sen. No. 35: Bryozoa Fauna collected by the *Misago* during the Zoological Survey around Izu Peninsula. By Y. Okada and Sh. Mawatari. Pp. 127–148+plates 10–11. 40 sen. No. 36: Note brève sur un nouveau trématode, *Tetrochetus hamadai*, provenent du *Spheroides spadiceus*. Par Tamao Fukui et Tôji Ogata. Pp. 149–154. 15 sen. (Tokyo: Maruzen Co., Ltd.) [282

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 15, No. 12 (Mathematics No. 15): Über Flächen und Kurven, 15. Von Sôji Matsumura. Pp. 283–294. Vol. 15, No. 13 (Mathematics No. 16): Beiträge zur Geometrie der Kreise und Kugeln, 15. Von Sôji Matsumura. Pp. 295–306. (Taihoku: Taihoku Imperial University.) [282

Smithsonian Miscellaneous Collections. Vol. 91, No. 24: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. Four New Brittlestars from Puerto Rico. By Austin H. Clark. (Publication 3378.) Pp. 8+3 plates. Vol. 94, No. 16: The Genus *Panscopus* Schoenherr (Coleoptera: Curculionidæ). By L. L. Buchanan. (Publication 3376.) Pp. 18. (Washington, D.C.: Smithsonian Institution.) [282

Fifty-second Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1934–1935. Pp. 8. (Washington, D.C.: Government Printing Office.) [282

Columbia University. Bulletin of Information, Thirty-sixth Series, No. 18: Announcements of Professional Courses in Optometry for the Winter and Spring Sessions, 1936–1937. Pp. 36. (New York: Columbia University.) [282

U.S. Department of the Interior: Office of Education. Pamphlet No. 65: Aids in Book Selection for Elementary School Libraries. By Edith A. Lathrop. Pp. iii+39. (Washington, D.C.: Government Printing Office.) 5 cents. [282

Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelser. Serie Plankton, Bind 3, Nr. 1: The Production of Phytoplankton at the Faroe Isles, Iceland, East Greenland and in the Waters Around. By E. Steemann Nielsen. Pp. 93. Serie Fiskeri, Bind 10, Nr. 2: Beiträge zur Ökologie der Wattenfauna auf experimenteller Grundlage. Von H. M. Thamdrup. Pp. 125+9 plates. (København: C. A. Reitzels Forlag.) [282

Catalogues

Van Cittert Double Monochromators with Optical Systems of Glass or Quartz. (Mono 32.) Pp. 4. Constant Deviation Monochromator F/5. (Phot 35.) Pp. 2. (Delft: P. J. Kipp en Zonen.)

B.D.H. Vitamin Products: Avoleum, Radiostol, Radiostoleum, Radio-Malt, Multivite Pellets, Vitamin C Tablets. Pp. 46+4 plates. (London: The British Drug Houses, Ltd.)