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Science for Citizenship.

FACILE criticism will always find vulnerable points of attack in any educational system. Only a short time ago, much was heard in the popular press of the views of prominent business men on the deficiencies of their office boys. Our educational system was therefore condemned *in toto*; our vast expenditure on education was adjudged complete waste. While such hasty judgments, based only on partial observation and imperfect evidence, may be set aside as carrying little weight, those who come most closely into contact with the products of the elementary school may still feel that all is not entirely well with education in England to-day. It may be granted that as compared with twenty-five years ago, when the Education Act of 1902 came into force, vast strides have been made. A higher standard is attained, a greater degree of accuracy and a stronger grip of the facts is to be observed, together with less tendency to a parrot-like repetition of the form in which the subject matter has been received. On the other hand, knowledge and inference which depend on that elusive quality, the intellectual flexibility and adaptability which for lack of a better term examiners connote by 'general intelligence,' seem rarely to show an advance commensurate with the improvement in specific branches of learning.

It may perhaps seem at first sight unfair that any educational system should be judged by the product of its lower grades—a product, too, of which the raw material is drawn in a large number of cases from sources which in all their conditions—intellectual, social, and moral—are unfavourable and sometimes entirely inimical to the aims and influence of the school. But it must be remembered that, since the beginning of the present century, what is almost a social revolution—still, however, incomplete—has taken place in the personnel of the elementary school staff. No longer do they proceed by the treadmill of elementary school, pupil-teacher centre, elementary training college, and back to the elementary school. The throwing open of the secondary school to the elementary school class, and the extension of university studies in the training colleges, have brought back to the work of teaching in the schools of elementary grade, men and women whose intellectual and social outlook have been broadened by intimate contact with other minds of varied culture, interests, and social antecedents, which in former conditions, as a general rule, they might never have

encountered while in the formative stage of their career.

It is not necessarily a mark of carping criticism to hold—indeed it would be idle to deny—that the qualifications of the elementary branch of the profession are still open to improvement in certain directions; but a great step forward has been taken towards the ideal of those who long ago hoped that the majority of teachers in the elementary school would one day hold a degree, not as a *cachet* in an already honoured profession, but as the outward sign of certain qualities and cultural attainment. What they looked toward in their staff of the future was not a band of specialists, each highly trained in his own subject, but of men and women of wide culture who might introduce into the elementary school a wider outlook and cultivate in the material on which they had to work an intelligence trained to alertness in appreciating the varied aspects of life and knowledge as a function of existence as members of an economic, social, and political community. To this end the secondary school and university courses then seemed the obvious avenue of approach.

It must, however, be admitted that the trend of events has by no means justified expectation. It is not intended here to enter into a detailed criticism of the system of training teachers, but merely to use certain features in that system as illustrating some present tendencies in education as a whole. Those of the older school saw as their ideal a training college in which ultimately a majority if not all of the students would be working towards a degree, in which arts and science would be fairly well balanced, in which different interests, different studies might meet as in a common pool to their mutual intellectual advantage and understanding. The narrowness of the training college, its seminary atmosphere, would thus be alleviated. Circumstances, however, have decreed otherwise, and instead of the numbers being fairly well balanced, science has as a general rule become preponderant. While the Board of Education has continued to examine the greater proportion of the students this has been of less moment. Those who were responsible for the general lines of the examination were well acquainted with conditions in the schools. Inspection by the Board of both colleges and schools secured that training should be carried on with a view to the need of schools for certain qualities and capacities in their teachers. When in the near future the Board will no longer be responsible for the examination of students in training colleges, however logical its decision may be, and even though it may continue to inspect and take part in the examination of the technical side of training, the divorce between the examining body and the elementary schools will be complete, while, having in view the character of university courses as they are regulated at present, it may aggravate a tendency towards specialisation which is part a symptom, part a cause of the defects of our educational system as a whole.

For many years the training college stood to the elementary school in a relation analogous to that of the university and the public school. For long it was for the brilliant boy or girl in the elementary school practically the only avenue of intellectual advancement. Theoretically, it is true, it led to one profession only, but in practice some made it only a means to an end, taking advantage of t › general rather than the professional education, and after a few years left the profession to attain eminence in other walks in life. The academic side of the training college, from being subservient to the technical as it was when training was first instituted, became more and more important, and with the introduction and extension of university work it has tended, and tends increasingly, to overshadow the function of a training college as an institution of which the aim was not primarily academic. It must in fairness be recognised that this has been forced on the training colleges by the educational antecedents of the students, and no one would deprecate that the academic education of the intending teacher should be carried to the utmost limit that his capacity and opportunity allow. But it is a fact that the student who passes from the elementary school through the secondary school to the training college, if he takes up university work, tends to elect for a science degree. It is more than a moot point whether a course leading to a science degree, as at present laid down along highly specialised lines, constitutes the most suitable preparation for the career of an elementary school teacher.

It may perhaps appear that in considering the case of the teacher too great stress has been laid upon what is relatively a small proportion of those who come under a part only of the whole system. But the teacher is a crucial example; in his case the effect is cumulative, and with present changes the tendency of which he is characteristic is increasing. Turn to the secondary school, and the same trend towards highly specialised courses in science is perceptible. In the Report of the

Board of Education for 1926, in dealing with the examination of grant-aided secondary schools, it is stated that while Latin holds its own and Greek shows a decrease, the number of candidates taking chemistry and physics is increasing. Of the number of candidates taking the First Examination in 1926, 40·2 per cent. offered chemistry and 24·7 per cent. physics. In elementary and experimental science the figure was 5·7 only, and in general science 2·5. In the same way, of the 437 advanced courses recognised in 309 schools, 210 were in science and mathematics, 179 in modern subjects, and 37 in classics. It must not be supposed, of course, that we regard the growth of science teaching in comparison with other subjects as unsatisfactory; what we object to is the virtual limitation of science in secondary schools to chemistry and physics, or to botany in girls' schools. Science, up to the standard of the First School Examination, should be of a more cultural, and less specialised, scope: it should be science for all, and not science as preliminary training for a university course.

In training colleges where students are working towards a degree, and in secondary schools, courses are framed with a view to the requirements of a university. Indeed, in some secondary schools the work is of a sufficiently advanced character to justify representations to the university that many students under existing regulations do no more than mark time in their first year of residence. Such an organisation of courses is justifiable only in so far as the aim of the university, the training college, and the secondary school is entirely identical. The university in its science courses aims at turning out men, especially those who seek honours, who have attained a more or less high degree of specialisation. But the aim of the secondary school in framing its courses, save for the exceptionally gifted intellectually or the favoured few whose means allow, should be to turn out pupils who are fitted to take their place as citizens intellectually equipped for the average life of the community. Still more does this apply to the elementary school. *A fortiori*, the teachers should be fitted by their own training to educate their pupils to that end. It is by no means clear that such highly specialised courses as chemistry and physics, still less perhaps biology or physiology, framed with a view to the requirements of a still more highly specialised university course, are the best media through which school and training institution can best perform their function. With teachers themselves trained in highly specialised courses, we are in danger of a circle as narrow in its way as that of the older type of training.

Of the importance of science in any modern system of education there can here be no question: but there is danger of a certain confusion of thought. The value of the practical application of science was fully brought out during the War; it has been apparent in many of the problems which have arisen since the War; while scientific men have repeatedly and justifiably urged upon the public and the Government the fundamental importance of the promotion of scientific research for all departments of the administration and life of the community and the British Empire. This insistence upon the value of science, aided by a confusion between instruction in science and a technical training, has obscured its true function as an element in the training of the average individual in preparation for his duties as a member of the community. Now that science enters so widely and so intimately into every department of life, especially in all questions relating to health and well-being, it is essential that both the individual who ultimately through the vote will control policy, as well as those by whom that policy will be framed and carried out, should have a general knowledge of the scope and aims of science, as well as of scientific method and the mode in which science envisages and attacks its problems. It is, however, beyond question that it should be a general knowledge on broad lines: a specialised training in some highly technical branch of science is neither needed, nor indeed is it desirable. The educationist need feel no alarm.

As a medium of culture, the history of scientific discovery opens up to the imagination vistas of man's endeavour which place it in the front rank of humanistic studies. Through a general familiarity with the methods of scientific observation and experiment in the various branches of research, may be developed a critical attitude in judgment, a power of observation, and a capacity for orderly arrangement; while a knowledge of the questions with which science as a whole is concerned in the past, present, and the future, fosters the broad outlook which, in combination with these qualities, is essential in successful dealing with the problems of life. We doubt, however, whether much of the science teaching in schools, either primary or secondary, could be regarded as science for citizenship instead of science for specialists; and we should welcome a movement which would broaden its scope and change its character.

Musical Stimulus and Response.

The Influence of Music on Behavior. By Prof. Charles M. Diserens. Pp. v+224. (Princeton: Princeton University Press; London: Oxford University Press, 1926.) 11*s.* 6*d.* net.

THIS book covers so wide a field that a review of it is far from easy. From the title-page we learn that it was "presented as part of the requirements for the degree of Doctor of Philosophy in the Department of Psychology of the University of Cincinnati." The last chapter perhaps provides the key to the book's construction; it consists of a report of the writer's own experiments on the subject carried out during the year 1921–22 in that University. In the conduct of this research the author must have found it necessary to acquaint himself with the accounts of previously published work; the penultimate chapter, entitled "The History of Experimental Work on Reactions to Musical Stimuli," embodies the results of his extensive reading. Having proceeded thus far, he began to collect the published material concerning the influence of music on work and on the sick, the use of music in magic and in myth, and the reactions of animals to music. These (in reverse order), together with a lengthy introduction, are the titles of the remaining six chapters of the volume.

The core of the book—the record of the author's own experiments on the physiological effects of music—is as unsatisfactory as might be anticipated from a young tyro's attempt to deal with so extremely difficult a subject. One might have felt tempted to regard these early efforts as prolegomena to more mature research to be expected from him in the future. But Dr. Diserens is now (so we learn from the title-page) assistant professor of psychology in his old University; and, *more Americano*, it seems only too likely that he will be fully occupied henceforth in giving lecture courses, taking practical classes, and supervising crude research work, similar to his own, conducted by future aspirants for the doctorate in philosophy.

Yet Dr. Diserens has done good service in publishing the results of his wide reading. It may be objected that the data on which he draws are of very different value—good, bad, and indifferent—and that they might well have been supplemented with more adequate criticism than is here given them. On the other hand, there is not in existence any book containing so extensive a bibliography as this on the subject. The author, therefore, deserves our gratitude alike for his attractive literary style, and for having collated the results of previous workers, many of them from somewhat inaccessible sources, which had not previously been brought together in one volume.

When we read Dr. Diserens' review of the long line of experiments which have been attempted to determine the influence of music on such animals as the cobra, rattlesnake, lizard, pigeon, quail, pelican, mouse, rat, hare, squirrel, antelope, elephant, lion, tiger, coyote, monkey—not to mention many others—we are struck with the lack of previous training among the investigators in the methods of experimental psychology. The experiments might have been devised by the 'man in the street,' without any attempt to distinguish between the effects of music and those, say, of strangeness of the sound, wonder as to its source, curiosity in the movements of the performer, etc. But even if these precautions had been taken, it is doubtful whether a more satisfactory result than that reached would have been attained, namely, that animals vary widely in their response, according to their species and according to the kind of music to which they are subjected.

Substitute 'individual' for 'species,' and this is precisely the result of the many, often equally uncritical, experiments that have been performed on man. All that can be said in the case both of animals and of man is that music may act as a sedative, or as an excitant, or as a stimulant to uncongenial work. Dr. Diserens shows how in primitive magic music usefully serves to enhance bodily energy and to give the magician a feeling of increased power. He brings forward evidence which indicates the semi-magical nature of many work-songs in primitive people. He also rightly distinguishes in such music the different functions of rhythm, melody, and words, the first eliminating, he believes, "the strain of voluntary attention," and encouraging synchronous regular movements, the second releasing reserves of energy, and the third giving relief by reference to the desires and conflicts of the worker.

"At present," Dr. Diserens concludes, "we only know that music does influence the reactions belonging to work, but we cannot as yet control such effects with such certainty as to warrant general industrial use." But here, again, the few experiments which can be adduced have not been carried out under sufficiently stringent conditions. The data quoted in regard to the results of sorting the mail to music at the Minneapolis Post Office are not in themselves adequate to convince the trained psychologist that, as Dr. Diserens maintains, they show "that music will cause ordinary

mail sorters to do more work and make fewer errors than usual." The influence of foreknowledge, suggestion by the investigator, and many other sources of error need to be eliminated in order to produce conviction. Nor is the author's acquaintance with modern statistical methods assuring when he concludes, from the data published by him on the effects of bicycle-racing with and without the accompaniment of music, that "the results seem to indicate a distinct stimulation of the athlete by musical stimuli."

The truth is that music exerts so many different responses—by its direct physiological effects, its arousal of imagery and association, its acceptance as purely musical meaning, as having a personified character, etc.—that different kinds of music cannot fail to produce different effects in different individuals, and that the same music may produce different effects at different times in the same individual.

This brings us to the problem—what *is* music? Dr. Diserens maintains that intervals and chords do not present "genuinely musical situations," and that children and savages "delight in sound or colour combinations which pain the cultivated ear." Both these statements may be questioned, so far as the æsthetic attitude—regard for beauty—is concerned. Among the phonographic records employed by the author in his own experiments occur "Rosy Cheeks Fox Trot," "Dixey Medley" (banjo solo), and "Infanta March" (banjo). We wonder whether even the very highest powers of adaptation (the lack of which caused the works of Beethoven and Mozart, as well as Wagner and more modern innovators, to be characterised as unmusical when first they appeared) would enable "the cultivated ear" to designate these as æsthetically musical!

We may illustrate this difficulty by reference to the author's own experiments on the influence of music on the rate of respiration. He concludes that music, whether fast or slow, "accelerates respiration." But when we find that of the four records of 'fast' music which he uses, two—both banjo records—were disliked by three of the eight subjects and were by other subjects termed distracting, we may well ask, How, then, can we be sure that the influence of such records on respiratory rate is due to their *musical* character?

The whole subject—the effect of music on behaviour—needs to be attacked in a more thoroughgoing, systematic way. Yet, for the reasons already given, the psychologist is grateful to Dr. Diserens for his book.

The Structure of Metals.

Metallographic Researches: Based on a Course of Lectures delivered in the United States in 1925. By Prof. Carl Benedicks. Pp. xi+307. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 20*s*. net.

THE practice which has been developed of late years in the United States of inducing a European metallurgist of standing to give courses of lectures on his own researches at various centres is certainly an excellent one. Not only does it bring American metallurgists and students of the subject into personal touch with men who would otherwise remain nothing but names to them, but it also brings the trans-Atlantic visitor into touch with American affairs and institutions and sometimes engenders a higher degree of respect for them than had previously been entertained. Most of the lecturers thus brought to America have been British, but recently Dr. Carl Benedicks of Sweden and the German metallurgist, Dr. Guertler, have been included in the list. In the case of Dr. Benedicks, the subject matter of the lectures given has been put into book form under the title at the head of this notice.

Dr. Benedicks is of course a metallurgist and physicist of high standing, and the subject matter of his lectures accordingly attains a high level, although that level varies considerably between the different lectures reproduced in this book. Some of these—such as that dealing with the improvement of high-power photo-micrography of metals by means of the 'epiphragm'—have already been published in Great Britain, and so has much of his work on the 'homogeneous thermo-electric effect.' Another of his chapters is purely historical, and while we may understand his desire to secure recognition for a hitherto obscure Swedish metallurgist as the first observer of the *Ac* points in steel, this is not a matter of very wide interest. More directly important is the account of an attempt to determine the specific gravity of molten iron, an attempt which has met with a degree of success which is highly creditable when the extreme difficulties surrounding such experiments are considered.

Of much more general interest are the two chapters dealing respectively with a kinetic theory of the constitution of solid matter and with the hardening of steel and other alloys. In the first of these Dr. Benedicks puts forward a kinetic theory of the space-lattice which is of essentially

physical rather than purely metallurgical interest. Indeed, it appears to have been evolved in part at least in order to account for the thermo-electric effects which the author claims to have established. It does not seem, however, that Dr. Benedicks' views really take us much forward. He objects to the suggestion that in addition to an attractive force-field surrounding an atom there should also be a repulsive field. He suggests that no repulsive field is needed to account for the properties of gases and liquids on a kinetic theory, and that its introduction in the case of solids is equally unnecessary. According to this view, the atoms have no equilibrium position on a space-lattice, but merely a mean position which results from continual mutual collisions. That collision and rebound imply repulsive forces is, of course, obvious, but the suggestion is that these repulsive forces come into action only on actual contact. What, however, is really meant by 'contact' in the case of such a system as an atom is believed to be? Presumably, repulsion results from some sort of deformation produced in the atoms by their mutual forces, but it is difficult to believe that such deformation only becomes sensible at the instant when the outer electron orbits overlap or touch.

Perhaps the most interesting deduction drawn by Dr. Benedicks from his kinetic theory is that of the 'phoretic electron' mechanism of electric conduction. According to this view, electrons pass freely from atom to atom only when the outer electron orbits are in contact, and since the amplitude of atomic vibrations increases with rising temperature, there is a decrease of conductivity with rise of temperature. One difficulty of this theory, however, is that there does not appear to be any reason why this effect should not be of the same order in alloys as in pure metals, so that the low temperature coefficient of resistivity of solid solution alloys is not explained. Dr. Benedicks also attempts to explain super-conductivity at very low temperatures by the suggestion that at those temperatures the atoms become 'agglomerated,' *i.e.* remain in continuous contact, and therefore electrons can pass from atom to atom without resistance. This would be an excellent explanation if all metals and alloys became super-conducting when at temperatures near the absolute zero, but in fact the phenomenon is confined to a few metals only.

These somewhat important examples of the failure of Dr. Benedicks' theory suggest that it requires much further consideration before it can be seriously put forward, and it seems rather a pity that it should have been made the subject of an educative lecture in America—at least in its present form.

Criticisms of a similarly serious nature can be brought against Dr. Benedicks' treatment of the theory of hardening of steel and other alloys. The view of the nature of hardening by the breakdown of a super-saturated solid solution and the resulting formation of finely dispersed particles of a 'precipitate' in the solid matrix is dismissed by the Swedish metallurgist on the ground of certain measurements of the electrical resistance changes in alloys during the course of hardening. It is a well-known fact that an element present in solid solution causes a far greater increase in electrical resistivity than the same substance present in the form of separate crystals. It is argued, therefore, that the breakdown of a solid solution by the formation of minute 'suspended' particles should be accompanied by a decrease in resistance. In fact, measurement shows that resistance increases up to the point where maximum hardness is attained and only then decreases.

The argument just cited, however, is based on a fallacious assumption, namely, that the resistivity of a substance A in which particles of B are suspended is independent of the dimensions of the particles. Actually, we have no experimental basis for that assumption, and there is, on the contrary, good reason to suppose that the presence of very minute suspended particles may produce a higher resistivity than the same material in atomic dispersion, in solid solution. According to the lattice distortion theory put forward by the writer some years ago, the high resistivity of a solid solution is due to the distortion of the lattice caused by the presence on it of the solute atoms. This also causes a certain moderate amount of hardening. But when such a composite lattice begins to break down, the first effect—which must in fact increase until all the solute atoms have begun to travel towards a state of separate aggregation—must be a partial breakdown of the parent lattice, and it is this further disturbance of the parent lattice which will produce both mechanical and electrical hardening, *i.e.* increase of resistivity.

On this view, resistivity and hardness should attain their maximum at about the same stage and should then decline together, as experiment actually shows. Now, what is Dr. Benedicks' alternative? He draws an interesting distinction between a 'super-cooled' and a 'super-saturated' solid solution, although it seems doubtful whether such a distinction has any real meaning. He

further suggests that, in a freshly quenched alloy or an austenitic steel, we have a super-cooled but not a super-saturated solid solution, and that age-hardening in the alloys or the corresponding process in austenitic steel results from a transformation *from the super-cooled to the super-saturated solution.* Now it is well known that by rapid cooling and other means a super-saturated solution can be maintained without crystallisation, but it is quite another matter to suppose, as Dr. Benedicks does, that a super-saturated solution can be *formed* by transformation. The writer respectfully suggests that if a super-cooled solution, whether solid or liquid, is caused to undergo transformation, the result will never be the formation of a super-saturated solution, but a separation into two phases.

Somewhat similar criticism can be applied to Dr. Benedicks' remarks on hardening by cold work. This he ascribes to the production of multiple twinning, in spite of the facts that in copper and copper alloys the existence of twinned crystals confers no sign of hardness, while observation shows that twin lamellæ offer no obstacle to crystalline slip. Further, mechanical twinning is unknown in alpha-iron, yet that metal hardens vigorously under cold work. It would thus seem particularly unfortunate that Dr. Benedicks should have put before his American hearers a series of views so markedly at variance with those held by British and American metallurgists, while leaving his views open to such obvious and, in the writer's opinion, fatal objections. This is the more the pity, since Dr. Benedicks' contributions to metallurgy are so important that he should have had no difficulty in providing his audience with sound, well-established material, such as is to be found in his chapter on meteoric iron and invar, on a 'rational' section for ingots intended for cold-working, and on the 'hot wall' effect in corrosion.

W. ROSENHAIN.

The Suppression of Mosquitoes.

Principles and Practice of Mosquito Control: being a Handbook to the British Mosquito Control Institute. By John F. Marshall. Pp. viii + 39 + 20 plates. (Hayling Island, Hants.: British Mosquito Control Institute, 1927.) 2*s.* 6*d.*

FROM the British Mosquito Control Institute at Hayling Island, Hampshire, has been recently issued this handbook on the principles and practice of mosquito control, which includes also a brief account of the inception of the Institute and of the results of its work. The Institute owes its existence to the success of an anti-mosquito campaign which was initiated at Hayling Island in 1920 to deal with the local mosquito nuisance which had become so intolerable that the inhabitants of the central residential district found it impossible to sit in their gardens in the late afternoons or in the evenings. Mr. F. W. Edwards, of the British Museum (Natural History), expressed the opinion that the trouble was probably due to the salt-marsh species *Aedes* (*Ochlerotatus*) *caspius* and *A.* (*O.*) *detritus*, and examination of some thousands of adult mosquitoes captured in the residential area during September and October proved that the latter species was almost entirely responsible. To Mr. John F. Marshall belongs the credit of beginning in 1920 investigations preliminary to the inauguration of methods of control. In April 1921, at a meeting of some seventy inhabitants, it was decided to institute a systematic campaign against the mosquitoes; committees were elected to deal with the various branches of the work, and a circular was issued to every householder on the island explaining the objects of the campaign and appealing for the assistance of voluntary workers and for financial support. A laboratory was improvised by Mr. Marshall, where mosquitoes could be examined and investigations on their breeding habits carried out.

Larvæ of *Aedes detritus* were found in 1921 in enormous numbers in certain accumulations of stagnating and partly salt water about a mile and a half from the centre of the residential district, and in the summer and autumn of that year several of these breeding places were permanently abolished, while a large number of others were treated with paraffin or with larvicides. During the next three years the work of abolishing or controlling the mosquito breeding areas was continued, and the nuisance progressively decreased and eventually disappeared. Evidence of this was furnished by a postcard 'canvass' of the residential district in October 1924, as well as by the fact that residents were able, for the first time in many years, to sleep out of doors. The inconvenience due to insufficient accommodation for the work in progress was severely felt, and Mr. Marshall generously erected at his own expense a separate building in which the various branches of the work could be adequately developed.

This building—the Institute—which was formally opened by Sir Ronald Ross in August 1925—contains eleven working rooms, and cost with its equipment about £4200. It is hoped that a scheme for establishing the organisation upon a permanent

basis may eventually be devised, and in preparation therefor the Institute has been incorporated. Up to the present the Institute has not received financial assistance from official bodies or local authorities—excepting a grant of £100 from the Ministry of Health in 1923 towards the cost of labour employed in certain experimental work—but has had to rely on voluntary contributions. An appeal is now issued for subscriptions—life members' and annual—and for donations to provide an annual income which will enable the work of the Institute to be carried on efficiently.

The success of the work on Hayling Island directs attention to the desirability of suppressing mosquitoes which, when present in numbers, cause general annoyance by their bites, which are frequently followed by the development of sores and sometimes by even more serious consequences. These effects may be produced by Culicine as well as by Anopheline mosquitoes. This aspect of mosquito control is emphasised by the recent decision in the 'Paisley Case' (see NATURE, June 25, p. 934), the first of its kind under the Public Health Acts in Great Britain, in which the sheriff found that certain ditches had become so encumbered with silt and vegetation as to be ineffective as water courses and that the ditches and the adjacent overflowed ground had become a breeding place for large numbers of mosquitoes, and he ordained that the owners should clear the ditches and maintain them clear.

Communities which may decide or be compelled to undertake mosquito control would do well to consult this handbook for the sequence and nature of the operations and to base their methods, as at the Hayling Institute, on a true scientific foundation. For example, there are twenty-five species of mosquitoes in Britain which differ considerably in their habits, and in the period of hatching out, so that it is necessary to discover first the species which are prevalent in the district, to estimate which is the most important and should therefore be first attacked, and to see that waste of effort is avoided, for example, by treating with larvicide only the water in which larvæ have been actually observed. Useful suggestions are given for inspecting possible breeding places, for applying larvicides, for 'unstagnating' the water, and for recording progress in a central institute.

There will always be, as is pointed out in the handbook, a certain section of the public who will refuse to assist in the work of mosquito control, maintaining that the task is hopeless. This attitude of mind should be dealt with, as in the first year or two at Hayling Island, by the education of public opinion by means of demonstrations of living and preserved specimens of the local mosquitoes and of diagrams illustrating the progress of the campaign.

The handbook is illustrated by excellent photographs prepared by Mr. Marshall, and by useful diagrams which help the reader to recognise the more important larvæ and adults. But its principal value is as a record of the means by which the serious nuisance due to mosquitoes was overcome within four years in a somewhat difficult terrain—a noteworthy achievement on which the director and his collaborators are to be warmly congratulated.

Climatic Changes: their Causes and Influences.

(1) *The Pulse of Progress: including a Sketch of Jewish History.* By Ellsworth Huntington. With a Chapter on Climatic Changes, by G. C. Simpson. Pp. x+341. (New York and London: Charles Scribner's Sons, 1926.) 21*s.* net.

(2) *Climate through the Ages: a Study of the Climatic Factors and their Variations.* By C. E. P. Brooks. Pp. 439. (London: Ernest Benn, Ltd., 1926.) 15*s.* net.

(1) MR. ELLSWORTH HUNTINGTON, of the Geographical Department of Yale University, in a series of thirteen interesting volumes, besides numerous papers, has ingeniously and eloquently advocated the view that in the environment of which man is the creature, climate is the most powerful factor. As a corollary to this view he holds that climatic changes are the main cause of the rise and fall and of the migrations of civilisation. In the present work he puts his theory in a more attractive form as he limits the climatic pulse in historic times to a comparatively narrow beat, as he explains the vicissitudes of ancient Greece by climatic influences of the order of a change of mean temperature of the year from 62° F. to 63·1° F., with a variation of humidity of 10 per cent. To determine the mean annual temperature within 1·1° F. is practicable for few countries only; and it would be impossible to prove or disprove so slight a change for any country except within recent times. That climate is an important factor in human welfare, and that people's working efficiency varies with weather, is universally recognised; and these facts are confirmed by the interesting statistics brought forward by Mr. Huntington from American industrial and

educational records. It may nevertheless be doubted whether the climatic changes in historic times have been the main factor in the migration of races and civilisations.

Mr. Ellsworth Huntington's books are always interesting, for he is graphic and collects striking examples from a wide range of evidence. His information is obviously of very unequal value, but he consoles himself with the reflection, "Perhaps your answer is wrong, never mind." Perhaps on that principle he retains the generally rejected explanation by Dr. W. H. S. Jones that the decay of Greece and Rome was due to an increase of malaria owing to a decrease in rainfall.

The new ground covered in the "Pulse of Progress" is the application of Mr. Huntington's principles to the natural history of the Jews. He has restudied the Bible and its newer criticism, and has re-written the Bible story in accordance with the geographical control of physical agents. His version is like that of the "Darkie Sunday-school":

"Bring yer sticks o' chewey gum and sit upon de floor
And I'll tell yer Bible stories dat yer never heard before."

His account of Jewish history is not likely to be reprinted in Great Britain by the Sunday School Union, but is in accordance with the general trend of advanced Biblical criticism. He points out, for example, that the plagues were the natural result of a succession of low Niles. His account, however, shows that the climate of Palestine and Egypt has been practically unchanged throughout historic times, except for the minor fluctuations that are inevitable owing to the complexity of the factors that control weather. The volume includes an interesting chapter on what Mr. Huntington describes as the suicide of Russia by the expulsion of its aristocracy and the massacre of more than a million of the more intelligent citizens. Australia he describes, on the other hand, as having "evolved a social and political system which is pre-eminent as one of the important recent contributions to human progress."

One of Mr. Huntington's most striking contributions to climatic variations within historic times has been deduced from the variations in rate of growth of the big trees of California; their evidence is complex, as different trees did not vary in the same way simultaneously, and their records require a lot of interpretation to make them tell the same tale. Their restricted distribution, as pointed out by Dr. G. C. Simpson in a weighty article reprinted by Mr. Huntington, proves that there has been no serious change in the climate of the belt occupied by these trees during the past 2800 years. Mr. Huntington has introduced one correction on the interpretation of the big tree records, based on evidence from the Caspian. This correction is rejected by Dr. C. E. P. Brooks in (2) "Climate through the Ages," although he supports Mr. Huntington's main thesis by accepting important changes of climate within the historic period. Dr. Brooks holds that major climatic changes are due to the interaction of many geographical causes and that former glaciations and warmer periods were the result of the different distribution of land and water; but as there has been no appreciable change therein during the past 2000 years, he assigns the climatic variations during historic times to solar activity. According to his view, climate is under solar control when land and water are stationary.

Dr. Brooks compares the evidence of the big trees with the variations of the nearest salt lakes. The country in which they occur must have had a wet climate during the glacial period, which was followed by a dry warm interval, before another cold wet episode. The evidence is not altogether harmonious, for the lakes indicate a maximum rainfall at 1000 B.C. (p. 393), which was followed by a dry period until A.D. 800; according to the big trees, the wettest time was between 480 and 250 B.C., and it was followed by drought until A.D. 850. Toward the end of this time the climate was so warm that, according to Dr. Brooks, there was no perennial ice in the Arctic Ocean in the seventh century and none at all in the Greenland seas. Since then, the Norse colonies have been frozen out by increasing cold. Dr. Brooks connects this change with the end of a warm dry period in Britain in the ninth century and the final deterioration of the British climate about A.D. 1000. That the climate of Greenland has become more severe in recent times is indicated by weighty evidence; but a change of this extent in the Arctic Ocean would surely have been accompanied by greater changes in the British climate, and it is contradicted by the evidence of the Sagas. The frequent assertion that the British weather has become milder instead of more severe during the past eighteen centuries is opposed to any fundamental change in the Arctic Ocean.

The effect of geographical changes in climate naturally leads to a discussion of the Wegener theory of continental drift, which has received most support from the meteorologists; and it is interesting to note that Dr. Brooks emphatically rejects it as unnecessary. J. W. GREGORY.

Our Bookshelf.

Condensing Plant: a Complete Treatise on the Principles and Details of Construction of Modern Steam Condensing Apparatus; for Designers, Users, and Students. By R. J. Kaula and I. V. Robinson. (The Specialists' Series.) Pp. xiii + 400. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 30*s*. net.

A MODERN steam power plant can be divided into three main sections: the boilers and their accessories, the turbines, and the condensing plant. Most text-books on steam machinery deal partially with the three sections, but the multiplication of types of machinery in power houses and the increasing complexity of the systems tend to make specialisation desirable. Many engineers therefore will welcome this book, which is devoted entirely to the condensers, air pumps, feed pumps, and feed systems. All the earliest steam engines were condensing engines, and the patent of Savery introduced the practice of surface condensation. Newcomen led the injection water into the steam cylinder, and Watt made the capital improvement of a separate condenser. Of other inventors, one of the least known is Samuel Hall, whose patent for surface condensers for steam vessels, taken out in 1836, is a most interesting one. With the introduction of high-pressure steam the jet condensers gave place to surface condensers, and with the coming of the steam turbine a new chapter in the history of the condenser opened. An immense amount of investigation has been carried out on the design of condensers, the corrosion of the tubes, new forms of air pumps, and improved systems of feeding the boilers, and all these matters are admirably treated by Messrs. Kaula and Robinson in the work under notice.

Industry and the State: a Conservative View. By Robert Boothby, John de V. Loder, Harold Macmillan, Hon. Oliver Stanley. Pp. viii + 269. (London: Macmillan and Co., Ltd., 1927.) 6*s*. net.

THIS book is an interesting expression of the views held by what may be termed the left wing of the British Conservative Party. Opposed on one hand to *laissez-faire* as on the other to socialism, it seeks a *via media* between these conflicting extremes. The authors are convinced that an advance in the economic status of the wage-earning classes is the necessary corollary of their advance in political status, and they seek the means whereby the improvement may be effected. Their suggestions do not partake of novelty, but they are urged with some force and ardent conviction. For the planning of economic policy they would have an Economic General Staff. Industrial Councils and Wage Boards would be created with increased powers; and co-partnership would be made an essential part of industrial organisation. The writers have read widely, and there is throughout an air of attractive goodwill about their proposals. How far they are likely to attract attention is another matter. Much, for example, of the recent legislation they quote in support of their views is open to a different interpretation from what they place upon it. Their account of the characteristics of industrial ownership follows that of an American, Mr. Robert Brookings; but if they had considered the arguments of Prof. Henry Clay, they would have seen that most of the inferences they draw are quite misleading. Their insistence that there is an incompatibility between socialism and private property is contradicted by the work of Mr. and Mrs. Webb and Mr. R. H. Tawney; they do not seem to grasp the distinction made by most socialists of authority between property as use and property as control. But their book is doubtless meant to be no more than a tentative sketch; and as such it is an interesting expression of a significant tendency which is not unlikely to grow.

Engineering Metallurgy: a Textbook for Users of Metals. By Prof. Bradley Stoughton and Prof. Allison Butts. (Metallurgical Texts.) Pp. xi + 441. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 20*s*. net.

As the range of steels and non-ferrous alloys is extended it becomes more and more necessary for the engineer to have some metallurgical knowledge, at least sufficient to enable him to make use of metallurgical literature. It is becoming common to include some training in metallurgy in the university and technical college courses for engineering students, and the need for suitable text-books has arisen. The manual compiled with this object by Profs. Stoughton and Butts is not quite successful in approaching the subject from the point of view of the engineer, which is distinctly different from that of the student of metallurgy. It is rather a condensed text-book of metallurgy, in which each section is treated in brief outline, without undue detail. Short sections on fuel questions, on heat losses, and on pyrometry are included, and the reader can obtain from it a general survey of metallurgical practice, from the treatment of ores to that of castings and forgings.

It is on the physical and metallographic side that the book is weakest, and there are inaccuracies on certain points, whilst the discussion of a subject of such importance to the engineer as the heat treatment of steel is very sketchy. Surely, also, since photo-micrographs are freely introduced, some short account should have been given of the use of the microscope in the engineering works. It is quite possible to make the young engineer familiar with the processes of preparing sections for micro- and macro-examination, and with the general characteristics of such materials as he may have occasion to use, although years of experience may be needed before he can interpret unusual appearances in a critical manner. The authors have had to bear in mind the curriculum in American colleges, and this has no doubt restricted them in their treatment, but a different method of approach is needed in an engineering course on scientific principles.

Handbook for Prospectors. By M. W. von Bernewitz. Pp. ix + 319. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s.* net.

IT may be very gravely doubted whether it is possible to write a handbook for prospectors which is of any use to the men for whom it is intended. Modern prospecting expeditions, equipped and sent out by important syndicates, are usually under the charge of trained mining geologists, who require no information upon elementary crystallography or geology. On the other hand, the rough practical prospector, who has in the past been responsible for the discovery of many of the world's most important mineral deposits, neither knows nor cares, nor wants to know anything about the "dodecahedron of the isometric system"; his phraseology is of quite another type. It is difficult to imagine what kind of a prospector would be benefited in the slightest degree by such drawings as the author's Fig. 28, which shows a hand drill and hammer; it surely ought to be obvious that a man who does not know what these are had better leave prospecting alone; incidentally, it is probably impossible to imagine a hammer shaft worse shaped than that shown in the figure in question; it is quite certain that no practical prospector would ever attempt to use such an obviously futile appliance. Again, the detailed instructions given for such things as tying packs and arranging and priming a dynamite cartridge are surely unnecessary and can never be learnt from books. It would also be interesting to know how many prospectors the author thinks would be benefited by his table of the atomic weights of the elements as determined by the International Committee. There may be one or two things in the book, particularly in the first twenty-three pages, which may be of use to the prospector; the remainder would probably be useless to him even if he could understand it.

Monograph of the Sea-Snakes (Hydrophiidæ). By Malcolm Smith. Pp. xviii + 130 + 2 plates. (London: British Museum (Natural History), 1926.) 10*s.*

THIS work in its scope and arrangement follows the lines of the British Museum Catalogues; the greater part of the text is purely systematic in nature, but the author's views on the relationships of the group and some notes on habits are included in the introduction. The list of references under each specific heading is not supposed to be exhaustive, but an attempt has been made to include all those of any importance from which the student may obtain any additional information he may require. The book will be welcomed by all systematic herpetologists as the first complete account of the Sea-snakes since the publication of Boulenger's "Catalogue of Snakes" (1896); based on the largest collection of these animals that has yet been brought together, the author's views carry weight and conviction. The most important proposed change is the recognition of two sub-families, the Laticaudinæ of Australian origin and the Hydrophiinæ of Indo-Malayan seas; these two sub-families are established chiefly on osteological features of the skull and are regarded as two separate evolutionary lines. The author's conception of the genera agrees closely with that of Boulenger, but he finds that many of the species recognised by the latter are untenable; the names used are for the first time brought into line with the International Rules of Zoological Nomenclature.

The Theory of Equations and the Complex Variable. By Prof. Rai Charan Biswas. Pp. viii + 269. (Calcutta: Chuckervertty, Chatterjee and Co., Ltd., 1926.) 3.8 rupees.

THIS volume contains an introduction to the theory of algebraic equations as the subject was known to mathematicians of half a century ago. It gives the usual theory of cubic and biquadratic equations, Fourier's and Sturm's methods of separating the real roots, also chapters on symmetric functions of the roots, determinants, and elimination. The only methods of numerical solution considered are those of Newton, Lagrange (by continued fractions), and Horner. Great advances in this branch of the subject have been made in the last twenty years, so the book is distinctly out-of-date on the numerical side. Its only novel feature lies in the inclusion of the equations satisfied by the sum and difference of two roots of an equation.

The author gives an account of the geometrical representation of complex numbers, with some applications to the theory of equations. Cauchy's method of locating the complex roots of an equation is explained, but the book is in no sense an introduction to the theory of a complex variable. Many of the problems are interesting, and none of them involves much theoretical difficulty.

W. E. H. B.

The Mind and the Film: a Treatise on the Psychological Factors in the Film. By Gerard Fort Buckle. Pp. xiv + 119. (London: George Routledge and Sons, Ltd., 1926.) 5*s.* net.

IN "The Mind and the Film" the advance in technique in kinematography is related to the way in which a 'story' should be presented so as to secure its full psychological effect. The 'story' itself, the mode of its expression, and its angle of conception and balance, are considered in the first part of this little book; while the second part is devoted to a brief but practical discussion of the uses of photographic 'aids to the mind.' Suggestive hints, linked up with more or less obvious physiological and psychological principles, are given to the producers of films throughout; and the ordinary reader who enjoys the 'pictures' will find not a little interest in reading of the devices by which his understanding is helped, and his emotions stirred, while he follows them. The book is written in non-technical language so far as psychology is concerned, but abounds in the somewhat uncouth vocabulary of the motion picture camera.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Constitution of Ordinary Lead.

AFTER repeated failures I have at last succeeded in obtaining the mass-spectrum of ordinary lead. This has been done by the use of its tetramethyl compound, a pure specimen of which was kindly supplied me by Mr. C. S. Piggot, of the Geophysical Laboratory, Washington. The vapour was first used diluted with carbon dioxide but later was admitted pure into the discharge tube. It works smoothly, but very long exposures are required. The three principal lines are 206 (4), 207 (3), 208 (7). The figures in brackets indicate roughly the relative intensities and are in good agreement with the atomic weight 207·2. This group is beautifully confirmed by its repetition 15, 30, and 45 units higher, corresponding with the mono-, di-, and trimethyl molecules. Comparator measurements show that all three of these lines are integral with those of mercury to an accuracy of 1 or 2 parts in 10,000.

There are indications that many other isotopes may be present in small proportions. An exceedingly faint line at 209 occurs in the atomic group, and on one plate is visible on the $PbCH_3$ group. This is almost certainly an isotope. Search for lighter mass numbers in the atomic group is unfortunately impossible owing to the mercury group and its penumbra. It was hoped that definite information would be available from the $PbCH_3$ group, but the unexpected appearance of lines certainly due to $HgCH_3$ complicates this region too. The evidence suggests the possibility that 203, 204, and 205 are all present in small proportion, but certain proof will only be available when mercury can be eliminated from the discharge.

The mercury lines in these experiments were more intense than any previously obtained, and indicate with certainty the presence of a seventh isotope Hg^{196}. Comparative exposures show that this is present to the minute extent of 0·04 per cent.

F. W. ASTON.

Cavendish Laboratory, Cambridge.
July 30.

Helium Compound.

IT has been shown by Paneth and his co-workers in Berlin that any element which stands in the periodic table from one to four places before a noble gas will form an easily volatile hydride; such is the case with lead and bismuth, the hydrides being gaseous at ordinary temperatures. If, as is generally supposed, orthohelium has one electron relatively far removed from the nucleus with respect to the other, it is possible that in this state the helium atom might exhibit properties similar to, though less pronounced than, those of hydrogen; that is, it might be expected to combine with such an element as bismuth, and the resulting compound would in all probability be a gas.

The point can be investigated by the use of the radioactive isotopes of lead and bismuth, and a series of experiments has been made with this object in view. The results seem to indicate that such a gaseous compound does exist. Helium and other gases, at from 0·5 to 1 mm. pressure, were passed over a strong radioactive source of radium B and radium C, then, through a U-tube partially filled with glass wool, into a bulb containing a zinc sulphide screen; the gases could be excited in the tube surrounding the source by means of an electrodeless discharge. The relative amounts of radioactive gas formed were estimated by the number of scintillations appearing on the screen.

When a gas was circulated over the source and through the bulb, with no discharge passing, only a negligible number of scintillations was observed. With excited hydrogen a very large number appeared; it is most unlikely that these could have been due to particles of the source carried over in suspension, because similar experiments with oxygen and nitrogen gave no effect. When helium was used a radioactive gas was also found to be carried over into the bulb; the number of scintillations observed was much smaller than with hydrogen, yet much greater than that to be accounted for by hydrogen impurities in the helium or by radium emanation which had been occluded in the source. It thus seems probable that gaseous helides analogous to Paneth's hydrides can be formed.

D. M. MORRISON.

The Cavendish Laboratory,
Cambridge, July 14.

Breeding Places of Sucking-Fish in the North Atlantic.

IN a note in NATURE of Dec. 4, 1926, p. 805, Dr. H. C. Delsman described an attempt to hatch some fish eggs from the Java Sea which, according to his investigations, belong to *Echeneis naucrates* L. Hitherto nothing at all has been known about the propagation of this sucking-fish which is so common in tropical seas. Nor have we been any better acquainted with the breeding places and development of other sucking-fish, in spite of the attention given to these fish since early times.

Through the cruises in the years 1911–1922 of the *Dana* and other Danish ships in the tropical and subtropical northern Atlantic, some material has been collected that will throw a light on the breeding places of a few species of Echeneididæ. In this material we find post-larval stages (from a length of 5·6 mm.) of 3 species, namely, *Echeneis lineata* Menzies, *Remora remora* Linné, and *Remora clypeata* Günther (probably = *R. albescens* Temm. and Schl.). In the thousands of towings not more than the following numbers have been taken: about twenty specimens of *R. remora*, about ten specimens of *E. lineata*, and only one of the last-mentioned species.[1] All these post-larval stages have been taken in pelagic tow nets, working between the surface and a depth of 25-50 metres (one of them was taken at a greater depth, but may have been caught in hauling in the implement). All the post-larvæ were caught in the months April-November, and none of them during the months of the colder season (December-March).

The post-larvæ of *R. remora* have almost all been taken in the months of June-July, and one only in September and November (the most northern and the most southern find). The catchings of *E. lineata* extend over the months of June to November, with only a single find in April. The only specimen of *R. clypeata* was caught in November. So it appears—at least as to *R. remora*—that there is a sharply limited spawning time.

The free pelagic existence of the post-larvæ is evidently of a rather short duration for these species. At a length of 3-4 cm. *R. remora* joins its host, and

[1] In *Comptes rendus de l'Acad. des Sci., Paris*, 1926, t. 182, p. 1293, I have given a short survey of these young stages as to the position and development of the sucking disc during the ontogenesis.

scarcely any more are taken freely pelagic.[2] At any rate, *E. lineata* has obtained the full efficiency of its sucking disc when it has reached a length of 5 cm. (inclusive of the long caudal fin that makes about three-tenths of its total length).

The distribution of the post-larvæ is given on the accompanying map (Fig. 1), from which it will be seen that the two species—particularly *R. remora*—have chiefly been taken in the Sargasso Sea—where most of the fishing was done; very few have been taken north of 30° north latitude, and none at all have been taken in the precincts round the Caribbean islands, where the fishing chiefly was carried out during the months of November-April. The above-mentioned

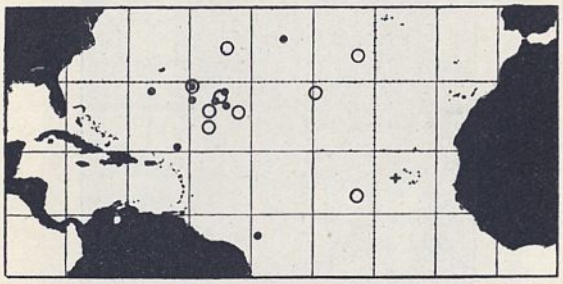

FIG. 1.—Distribution of post-larval stages of sucking-fish in the North Atlantic. ●, *Remora remora* L.; +, *Remora clypeata* Gthr.; ○, *Echeneis lineata* Menzies.

species in this way appear to be typical oceanic spawning species. A very striking fact is the total absence of stages of the most common sucking-fish in the West Indies, *E. naucrates* L. I therefore draw the conclusion that this species, so numerous along the coasts, spawns near these in shallow water and most likely in the warmest season, at which time of the year little fishing has been undertaken by Danish ships in the West Indian seas. The correctness of this conclusion seems to be confirmed by Delsman's find in the Java Sea. In the Atlantic north of the equator we shall surely be able to find this species, particularly in the shallower parts of the Caribbean Sea in high summer.

As to the species inhabiting the Mediterranean, the spawning places, season, etc., is, so far as I know, still quite unknown.

A. VEDEL TÅNING.
Carlsberg Laboratory,
Copenhagen,
June 10.

Chromium-plating and Resistance to Corrosion.

THE statement made by H. C. H. C. in NATURE of July 2, p. 6, on the subject of the protection afforded by electro-deposited chromium, as mentioned in Mr. U. R. Evans's book, "The Corrosion of Metals," seems so definite that, in view of the contrary experience of several workers specialising in electro-deposition for the prevention of corrosion, it seems desirable to direct attention to the fact that, so far, preliminary tests have indicated that electro-deposited chromium cannot be looked upon as a reliable protection of iron and steel from corrosion.

Much depends on the thickness of the deposit: comparatively thin deposits have given disappointing results. Thus, a thickness of 0·0013 cm., which gives ample protection in the case of a zinc deposit and fair results with nickel, is not sufficient in the case of chromium, which rapidly breaks down in the salt-spray corrosion test; but, as I have already pointed out elsewhere, the hygroscopic corrosion product which is formed may have a marked influence in accelerating the corrosion. The salt spray corrosion test may, however, be taken as a particular simulation of marine conditions.

The behaviour of chromium as a corrosion preventive seems to vary, some specimens having been found to resist corrosion far better than others. The explanation is probably to be found in the inherent tendency of chromium to become passive, in which condition it presumably acts cathodically to the iron, actually accelerating the process of rusting.

Further, the statement that chromium does not adhere well when deposited directly on steel is not in accordance with the experience of most workers. On the contrary, it adheres much more readily to iron or steel than is the case when a coat of nickel is first deposited. Certainly, stripping troubles are much more prone to occur in the latter case.

The deposition of chromium has a certain future before it on account both of its hardness and resistance to tarnish, and it is also being applied in certain special processes (for example, fine line engraving). But, so far, its use as a protection of ferrous metals from corrosion has not yet been definitely demonstrated; zinc and cadmium deposits are far superior to chromium in this respect.

S. WERNICK.
Woolwich, S.E.18.

MR. WERNICK has performed a service in stating his experience on the degree of protection to be expected from electro-deposited chromium. Much of what he says is quite true, and indeed there is no disagreement between his experience and the guarded statements on this subject made by Mr. Evans in his book, and in my review of it to which he refers. Thus Mr. Evans states (page 208): "Chromium-plated articles which are now being manufactured in this country are said to withstand sea-water and tarnish"; and again, "The problem has been attended by many difficulties, some of which have not wholly been overcome as yet." In my own review I wrote, "It is stated that plated articles manufactured in this way withstand corrosion. . . ." Mr. Wernick seems to assume that Mr. Evans and I have expressed an opinion in favour of chromium more definite than is actually the case.

It must, however, be emphasised that several workers who have tested chromium-plating have published the view that, if the plating is satisfactorily performed, it does give considerable resistance to corrosion. References to these are given in footnote No. 2, p. 208, of Mr. Evans's book. Some of them may not be entirely unprejudiced, but taken as a whole they cannot be neglected. No doubt the results, as Mr. Wernick says, are somewhat variable. This is true of any new process. In the July issue of *Industrial and Engineering Chemistry*, Killifer has published an article in which he definitely recommends chromium-plating as a means of combating cases of corrosion which are encountered in the chemical, oil, and paper industries. In the course of this he states that the unsatisfactory results obtained with early samples of chromium-plating were due to pin-holes.

With reference to the question of the direct deposition of chromium on steel, Ollard, who has done so much work on the question of the adhesion of many sorts of depositions, stated at the British Association in 1925 that "the best results were obtained if the steel was first coated with nickel or copper." If Mr. Wernick has obtained better adhesion by depositing chromium direct, he has achieved a considerable success, and it is to be hoped that he will publish his method in full, if he has not already done so.

So far as I have been able to ascertain, his statement

[2] A survey of the smallest known adolescent stages of the different species has recently appeared by E. W. Gudger (*Am. Mus. Novitates*, Nov. 17, 1926).

that "the salt-spray corrosion test may . . . be taken as a particular simulation of marine conditions," does not command general acceptance. I have consulted Dr. Bengough, who has had wide experience of this test, and he informs me that it all depends on how it is carried out. It was introduced by the Bureau of Standards, and as carried out by them certainly did not simulate marine conditions, since the articles in question were exposed to salt spray kept permanently moist. If the test is modified so that the articles are alternately wetted with salt spray and dried at intervals, a nearer approximation to marine conditions is obtained. Salt spray, however, is not sea-water spray. The latter contains a variety of salts and some colloidal substances. A still closer approximation is furnished by using sea-water spray with alternate wetting and drying. Even this, however, is not the same as marine conditions themselves. Dr. Bengough's view is that no artificial test of this kind which has yet been devised can really take the place of natural marine conditions.

Mr. Wernick's statement that chromium may act as a cathode against iron is very probably true. Certain chromium alloys do behave in this way. Chromium-plating is therefore comparable to nickel-plating rather than to zinc-plating. The question is, is it better to plate with a cathodic material such as nickel or an anodic material such as zinc? The cathodic material will only protect if it is non-porous. Most electrolytic deposits are porous, but if they are hard the porosity can be greatly reduced by polishing. A view widely held by those with a practical experience of plating is that the protective qualities of nickel are largely connected with the fact that it can be well polished. Chromium deposits should have the same character. Anodic coverings such as zinc will protect iron even if porous, but only at the expense of the zinc. The protection will continue until the zinc is used up by the anodic corrosion. It is not difficult to understand why salt-spray tests give good results with zinc-covered articles, but it does not follow that these would have a long life in a marine atmosphere, because the rate of attack of zinc by sodium chloride solution in the presence of oxygen is very rapid, as is well known. H. C. H. C.

A Relic of Sir Edward Frankland.

In "Sketches from the Life of Edward Frankland," printed in 1902 for private circulation (Spottiswoode and Co., 1902), and which for the greater part is his autobiography, reference is made to his apprenticeship days in Lancaster.

Frankland mentions a "delightful occupation devised to prevent my idle hands from finding 'some mischief still'; . . . this was the making of mercurial ointment.

"In a room on the first floor there was a very large marble or serpentine mortar, about 2 feet internal diameter. The pestle was about nine inches in diameter and one foot long, with a wooden shaft about six feet long securely fixed into it, its other end working loosely in an iron ring fixed to a beam in the ceiling. Thus the pestle could be worked round and round and backwards and forwards in the mortar.

"For the preparation of mercurial ointment, about fourteen pounds of hog's lard and five or six pounds of quicksilver were placed in this mortar and had to be triturated until a magnifying glass failed to show any globules of mercury. This blending of mercury with lard is an exceedingly tedious operation; working, in the aggregate, two full days a week, it required about three months to complete it. Moreover, the resistance to the motion of the pestle in the lard is very great, making the labour very hard and the arms ache."

Owing to a rumour that a relic of Sir Edward Frankland might still exist in Lancaster, the writer called on the present owner of the premises at which Frankland served his apprenticeship (Mr. A. H. Robertson) and was shown the mortar and pestle situated exactly as described above, covered with

FIG. 1.—Room at Lancaster with pestle and mortar used by Sir Edward Frankland.

the dust of ages, in the semi-darkness of a small upper room where one could visualise the apprentice and his successors grinding in the true 'Mantalini' spirit of submission.

Mr. Robertson has generously presented the mortar and pestle to the Lancaster Museum, where it will shortly find a permanent home.

The accompanying photograph (Fig. 1) showing the old mortar and pestle *in situ* was taken by Mr. Wynespeare Herbert of Lancaster. W. F.

Unusual Microstructure in Iron and Tungsten.

In the *Metallurgist* for June 24, 1927, page 88, F. S. Tritton describes some unusual microstructures in iron. One of these, originally described by Andrews in 1895, is found in pure re-melted electrolytic iron in the cast condition. The large crystals of which it is composed appear to be broken up by numerous sub-boundaries, but the etching tints indicate that these secondary grains have nearly a uniform orientation within the boundaries of the main crystal. Tritton has confirmed this by the appearance of the slip planes when the metal is strained.

Some years ago we observed a similar structure in tungsten which had been quickly cooled from the molten state. The appearance of an etched section ($\times 200$) is shown in Fig. 1 and is identical with the structure shown by Tritton. The difficulty of developing the sub-boundaries by etching is greater when the longer axis of the small grains, which have a columnar shape, is in the plane of the specimen, as in the case of iron. As the large crystals in our specimen are several millimetres in diameter, it has been possible to determine the orientation of the small grains within the boundaries of one crystal. A beam of X-rays was directed upon the polished

and etched surface of one of these crystals whilst the specimen was rocked through a small angle. The diffraction pattern obtained is practically the same as that given by a true single crystal, but the spots are slightly more spread. This indicates that the small grains formed by the sub-boundaries have a

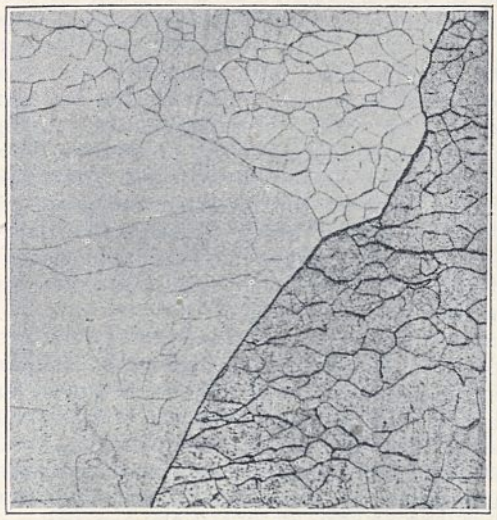

FIG. 1.

nearly, but not quite, uniform orientation in each crystal.

We suggest that the sub-boundaries are formed under the influence of stresses set up during the rapid cooling of the metal. A somewhat similar break-up has been observed by us (*Journal of the Institute of Metals*, **107**, 36; 1926) when tungsten rods are mechanically deformed by swaging.

C. J. SMITHELLS.
H. P. ROOKSBY.

Research Laboratories,
General Electric Co., Ltd.,
Wembley.

Dug-out Canoe in Algoa Bay.

MR. FITZSIMONS, in his letter published in NATURE of May 21 (vol. 119, p. 746), gives an account of a derelict canoe that was washed ashore in Algoa Bay, South Africa, in February of this year. A study of the photograph which accompanies his letter indicates that he is mistaken in attributing the canoe to the 'Mawken' or, as they are usually known in this country, the Salons of the Mergui Archipelago. The Salon canoe has a 'step' in both bow- and stern-end, and there is no trace of anything of this kind in the canoe at Algoa Bay. On the other hand, the high-curved prow, broken off short at the base, and the flat but narrow stern-end clearly indicate that the canoe originally came from the Nicobar Islands. The side blocks shown in Mr. FitzSimons's photograph are for the attachment of the thwarts, made of split bamboo, and for the support for the outrigger. In some cases the canoes are fitted with one or more short masts, which are stepped on the thwarts, but in others they have a single mast fitted with a large square sail. The canoes are steered by a paddle.

The Nicobarese travel long distances from island to island across open sea in these canoes, and I have myself seen a convoy of some eight making for one of the islands in the central group. Canoes from Car Nicobar to reach this group have to cross a stretch of some forty miles of open sea with only the small island of Batti Malv situated about half-way, and it is by no means uncommon for them to be lost at sea. If caught in the north-east monsoon such canoes would be driven towards the south-west, and being caught in the Equatorial Current would be swept to the west and might easily reach the South African coast.

R. B. SEYMOUR SEWELL.

Indian Museum, Calcutta,
June 21.

[Mr. C. Boden Kloss, director of the Raffles Museum and Library, Singapore, also writes to suggest that the canoe came from the Nicobar Islands and should be compared with the plates opposite pp. 80 and 154 of his book "In the Andamans and Nicobars" (London: John Murray, 1903).—EDITOR, NATURE.]

The Magnetic Disturbance of July 21, 1927.

IN the Astronomical Column of NATURE of July 30 the suggestion is thrown out that the magnetic disturbance recorded on July 21-22 may, in the absence of any striking spot display, be attributed to an unusually active region on the sun not represented by a spot, etc.

I submit that the following observation which I made in the late afternoon of July 15 may indeed provide this evidence. At position-angle 130°, that is, for that date near 35° latitude south-east, an immense eruptive prominence rose, splitting at about 15,000 miles altitude into a huge forked formation, each prong reaching ultimately a visible altitude of fully 220,000 miles. Of these two prongs, the more northern one dissolved fairly quickly into invisibility, whereas its southern companion endured a considerable time, showing violent fluctuations of waning and reviving brightness in portions, at varying altitudes. The apparent orifice of the stupendous eruption was fully one day's angle within the sun's disc; and if this is taken into consideration, the longitude occupied by this eruption would just be well past the central meridian on the dates when the magnetic disturbance occurred. From my notes it is also clear that the area from which the prominence rose was before then, *and* after, much agitated so far as the spectroscope revealed, and showed in its western front a very rough photospheric area, beset with little spots.

ALBERT ALFRED BUSS.

Chorlton-cum-Hardy, Manchester,
Aug. 7.

Fall of Temperature during the Solar Eclipse.

IT was recorded in NATURE for July 23, p. 120, that at Bangor the fall of temperature during the total solar eclipse of June 29 was not more than 0°·5 C. At Stonyhurst it is reported that no fall of temperature was observed. At Southport there was a slight fall like that at Bangor. Observations at a position on the sands opposite the northern end of the promenade gave the following result:

Summer Time	5.55	6.0	6.5	6.11	6.24	6.30	6.38
Temperature C.°	10°·2	10°·0	9°·8	9°·7	Totality	9°·8	10°·0

Thin clouds all the time intercepted the full effect of the sun's rays.

J. R. ASHWORTH.

55 King Street, South, Rochdale.
July 29.

Stephen Hales: Physiologist and Botanist, 1677–1761.[1]

By Dr. A. E. CLARK-KENNEDY.

STEPHEN HALES was born at Bekesbourne in Kent on Sept. 17, 1677. He was admitted a pensioner of Corpus Christi College, Cambridge, in 1696 and elected a fellow in 1703. At the University he studied theology, chemistry, physics, and astronomy. In 1709 he was appointed minister of Teddington in Middlesex. Soon after, he commenced a long series of researches on the physiology of plants and animals, in which he applied his knowledge of physics and mechanics acquired at Cambridge to the problems of biology.

Hales's first scientific endeavour was to make a complete quantitative investigation of the dynamics of the circulation. "Since we are assured," he wrote, "that the animal fluids move by *hydraulic* and *hydrostatical* laws, the likeliest way therefore to succeed in our inquiries into the nature of their motions is by adapting our experiments to those laws." He therefore devised his 'hæmastatical' method, which consisted of the application of the principle of the manometer to animal physiology, and performed a vast number of vivisection experiments of great technical difficulty in the parsonage at Teddington in pre-anæsthetic days. By tying tubes into the arteries and veins of living animals, he was the first man to record blood-pressure. By counting the pulse-rate during life, and then injecting the heart with wax, he computed the circulation rate in horses, cattle, deer, and dogs, showing that in large animals the blood-flow is relatively less than in small. He estimated the actual velocity of the blood-stream in the different arteries and veins. He measured the velocity of the blood in the tissue capillaries by observation with a microscope, and compared it with indirect calculations of the velocity of the blood in those of the lungs. Studying blood-flow in the tissues, he estimated the capillary blood-pressure, and demonstrated vaso-constriction by cold, vaso-dilation by heat. Lastly, by pointing out that the heart responds to increased venous return by increased systolic output, he laid the foundation of the conception now known as 'Starling's Law.'

Hales was essentially a comparative physiologist. Observations on the physiology of plants suggested corresponding experiments on animals. Observations on animals suggested other experiments on the physiology of plants. "About twenty years since," he writes, "I made several hæmastatical experiments on dogs in order to find out the real force of the blood in the arteries: at which times I wished I could have made the like experiments to discover the force of the sap in vegetables; but despaired of ever effecting it, till by mere accident I hit upon it while I was endeavouring to stop the bleeding of an old stem of a vine which was cut too near the bleeding season, which I feared might kill it. Having tied a piece of bladder over the transverse cut of the stem, I found the force of the sap did greatly distend the bladder; whence I concluded, that if a long glass tube were fixed there in the same manner as I had before done to the arteries of several living animals, I should thereby obtain the real ascending force of the sap in that stem, which succeeded according to my expectation: and hence it is that I have been insensibly led on to make farther and farther researches by variety of experiments." Applying this method, he found the sap pressure in the vine in the bleeding season to be "five times greater than the force of the blood in the great crural artery of a horse; seven times greater than the force of the blood in the like artery of a dog; and eight times greater than the blood's force in the same artery of a fallow doe."

In the field of physiological botany Hales was certainly a pioneer, as he made the first proper scientific investigation of the flow of sap in plants and trees. He measured the rate of transpiration of water from unit surface area of leaves, the rate of absorption of water by unit area of root surface, and calculated the rate of flow of sap along the stem and branches. He measured the sap pressure in stems with, and in stems without, their leaves and branches. Finding that the sap pressure was upwards in all circumstances, he argued against the current theory of a circulation of the sap, and attributed its elevation to transpiration by the leaves, aided at certain seasons by a force exerted by the roots. Of this work he wrote: "I have been careful in making, and faithful in relating the results of these experiments; and wish I could be as happy in drawing the proper inferences from them." But his theory is now regarded as correct in its main essentials.

Hales also invented the present-day method of studying the growth of plants; that of marking stems and leaves at equal intervals. These experiments of his led him to perform a fundamental experiment on the growth of the bone. "As in vegetables, so doubtless in animals, the tender ductile bones of young animals are gradually increased in every part that is not hardened and ossified; but it was inconsistent with the motions of the joints to have the ends of the bones soft and ductile, as in vegetables, therefore Nature makes a wonderful provision for this at the glutinous serrated joining of the heads to the shanks of the bones; which joining, while it continues ductile, the animal grows; but when it ossifies, then the animal can no longer grow: as I was assured by the following experiment, viz., I took a half-grown *chick*, whose leg-bone was then two inches long; with a sharp-pointed iron, at half an inch distance, I pierced two small holes through the middle of the scaly covering of the leg and shin-bone; two months after I killed the *chick*, and upon laying the bone bare I found on it obscure remains of the two marks I had made at the same distance of half an inch: so that that part of the bone had not at all distended lengthwise since the time that I had marked it; notwithstanding the bone was in that

[1] From an address delivered at Corpus Christi College, Cambridge, on June 16.

time grown an inch more in length, which growth was mostly at the upper end of the bone, where a wonderful provision is made for its growth at the joining of its head to the shank, called by anatomists *symphysis*." This experiment, usually attributed to John Hunter, born in 1728, was actually performed by Hales some years before that date.

An accidental observation that bubbles of air ascended with the sap was responsible for Hales leaving the comparatively simple problem of the circulation of the blood to attack a much more difficult subject—the chemistry of respiration. Applying his 'statical method,' Hales demonstrated that plants absorb considerable quantities of 'air.' By distilling vegetable substances he showed that plants contained 'air.' He came to the conclusion that 'air' enters into the constitution of plants, and that an important function of the leaves was absorption of this form of nourishment. "It is by this amphibious property of air," he wrote, "that the main and principal operations of Nature are carried on." As Michael Foster pointed out, Hales was the first man to give a clear enunciation of the existence of gases in both a combined and a free state.

True to his comparative physiology again, from absorption of air by plants Hales turned his attention to respiration in man. Mayow had shown that animals absorb a part of the air they breathe, but Hales carried things a step further when he came to the conclusion that respiration in some way modifies the properties of the air left over so as to make it unfit for life and for combustion. Thus he was led to experiment on himself, and to perform the first re-breathing experiment. Taking a well softened bladder, and closing his nostrils, he proceeded to breathe in and out of it. "In less than half a minute," he wrote, "I found a considerable difficulty in breathing, and was forced after that to fetch my breath very fast, and at the end of the minute the suffocating uneasiness was so great that I was forced to take away the bladder from my mouth." Then in an attempt to find "some means to qualify and rebate the deadly noxious quality of these [expired] vapours," he constructed a more complicated form of rebreathing, apparatus with inspiratory and expiratory valves, so arranged that his expired air had to pass through diaphragms of cloth before being inspired again. He could rebreathe the air contained in this apparatus for one and a half minutes only when there were no diaphragms. When, however, these were moistened with a solution of 'sal tartar,' and then replaced, rebreathing could be continued for five to eight minutes. Moreover, the diaphragms increased in weight to a greater extent than he could account for by absorption of water only. If Mayow can be said to have discovered oxygen, surely Hales described carbon dioxide!

Throughout Hales's writings there is no mention of the phlogiston theory. By this silent refusal to follow Stahl, he kept alive the spark of truth that Mayow had lit, to be rekindled more than a century later by Black, Priestly, and Lavoisier. If only he had followed Mayow a little more literally, and conceived, as he had, of different kinds of gases, instead of one 'air' with variable properties, he might well have arrived at a true conception of respiration. Be this as it may, Hales's researches had a great practical outcome in his work on ventilation.

In 1740 troops lay embarked off Spithead for an expedition to America. Hales suddenly conceived the notion that large ventilators would be very serviceable in making the air in ships more wholesome. These ventilators were to take the form of large bellows to be worked by hand, which would suck out the foul air from between decks. But he was not alone in this idea. A few months later, Martin Triewald, Captain of Mechanics and Military Architect to the King of Sweden, devised a similar machine. As Hales remarked, "It were indeed a very extraordinary Circumstance, that two Persons at so great a Distance from each other, without getting a Hint of it, one from the other, should happen to hit on inventing a like very useful engine." But it was even more remarkable than this, because at the same time Sutton, a coffee-house keeper in Aldersgate Street, contrived a method of drawing off the bad air on board ship by means of the cook-house fire. Sutton's invention remained in obscurity, but Hales's ventilators at once attracted the attention of the Admiralty and they were fitted on board H.M.S. *Captain*, a seventy-gun man-of-war. His ventilators, however, were received with "coolness by some, and contempt by others." But if they did not find favour at first in the Royal Navy, they met with great success in convict ships and the vessels of the slave trade. Five Nova Scotia ships were equipped with them by the Earl of Halifax. Only one slave died in the ventilated ships for every twelve in those unventilated. In a letter to Hales, Captain Thomson wrote as follows: "We found this good Effect from Ventilation, that though there were near 200 Men on board, for almost a Year, yet I landed them all well in *Georgia* notwithstanding they were pressed Men, and delivered me out of Gaols with Distempers upon them."

Entering the City of London from the west, the traveller of those days must have been confronted by a curious spectacle. Newgate, the ancient gate of London, had been rebuilt with considerable magnificence. "It consisted of a carriage archway in the centre; on the side, the footpath was continued through it, which supplied a shelter for two or three old women, who fried small sausages for sale: and in the centre of it was an entry to the chief prison of the city: the mendicant prisoners for debt stood within the iron-grated door, vociferating their constant supplication for benefactions to a leathern bag which they drew in as often as it was touched: the upper chambers of the buildings constituted the prisons for felons, for whom a door was opened on the South side adjoining the old wall, and it was from this door that the malefactors were received into the cart for their last journey to Tyburn. Upon the summit was a machine for air, invented by Dr. Hales."

In 1750 a tragedy had occurred during the trial

of malefactors at the Sessions House in the Old Bailey. The Lord Mayor, two judges, and a total of sixty persons had died of the gaol distemper, communicated to them by the felons from Newgate. The aldermen of the City of London, naturally seriously alarmed, consulted Hales, and decided to install ventilators in Newgate to be worked by a windmill erected on the 'leads.' Hales's ventilators were also installed in the Savoy Prison, in the gaols at Northampton, Shrewsbury, Winchester, Maidstone, Bedford, and Aylesbury: in the London Small-pox Hospitals, and at St. George's; also in hospitals at Durham, Winchester, and Bristol, and even at Naples. Later they were introduced into the naval and military hospitals and prisons at Gosport, Portsmouth, and Plymouth. So eventually even the Navy was convinced. "God be thanked," writes Hales, "they are now come into general esteem for the apparent salutary good effect of them in our fleets, hospitals, etc. In the beginning of the year 1756, the Lords Commissioners of the Admiralty ordered them to be put on board the *Royal George*, our largest ship: in which the honourable Admiral Boscawen, taking care to have them properly worked, they were found to have the desired good effect, so to refresh the whole air in the ship, as to preserve in good health 850 men: which happy event occasioned their being ordered to be put into the whole fleet."

Wherever Hales's ventilators were installed the air in the wards is said to have been rendered much purer, and the mortality among the inmates from the gaol distemper considerably reduced. But typhus is due to lice, and not to foul air as Hales supposed. No amount of ventilation, however perfect, could have abolished the gaol distemper. Hales's bellows ventilator has gone. Hospitals and prisons are so built in these days that mechanical ventilation is seldom necessary. But his idea of the forcible propulsion of air still persists, and adequate ventilation remains one of the first principles of preventive medicine. Hales must therefore stand for all time not only a great biologist, but also one of the pioneers in public health.

It may seem remarkable that scientific work like this should have been performed by a country parson. But in the study of pure science, though he sought for mechanical explanations always, Hales found confirmation of his faith. "Nature works according to the Laws established at her first Institution," he wrote. "The farther researches we make into this admirable scene of things, the more beauty and harmony we see in them: and the stronger and clearer convictions they give us, of the being, power and wisdom of the divine Architect, who has made all things to concur with a wonderful conformity, in carrying on, by various and innumerable combinations of matter, such a circulation of causes and effects, as was necessary to the great ends of nature." Hales was an ardent parish priest. He made the women of his parish do public penance for irregular behaviour. He prevailed upon the Lord of the Manor to enlarge the churchyard. He arranged for a new parish water supply. He caused a lantern to be erected on the church tower "in which to hang a loud bell to be heard at a much greater distance, not only for the benefit of the serious and the well disposed, but also as a constant memento to the careless, the negligent, and the profane, who with the wicked in Job are but too apt to say, *Who is the Almighty that we should serve him? And what profit should we have if we should pray unto him?*" He also built a new aisle, and replaced the old wooden tower by a brick one. The money for these alterations was largely raised by the sale of pews, but in addition, Hales contributed £200 himself.

Of his character one of his contemporaries wrote: "He possessed a native innocence and simplicity of manners, which the characters of other men and the customs of the world could never alter; and though he often met with many unworthy objects and uncharitable offices, yet they never once lessened his natural and unwearied disposition of doing good and relieving distress. His knowledge appeared to everybody near him to feed his mind with a nourishment that gave him, in decline of life, and even in its last stages, that vigour and serenity of understanding, and clearness of ideas, which so few possess, even in the flower of manhood: and which he used often to say, he valued as the most perfect of all human pleasures. There are two things in his character which particularly distinguish him from almost every other man: the first was, that his mind was so habitually bent on acquiring knowledge, that, having what he thought an abundant income, he was solicitous to avoid any farther preferment in the Church, lest his time and his attention might thereby be diverted from his other favourite and useful occupations. The other feature of his character was no less singular: he could look even upon wicked men, and those who did him unkind offices, without any emotion of particular indignation; not from want of discernment or sensibility, but he used to consider them only like those experiments, which, upon trial, he found could never be applied to any useful purpose, and which he therefore calmly and dispassionately laid aside."

Hales had been elected a fellow of the Royal Society and awarded the Copley Medal, but his reputation as a scientist was now international. In 1753 he was elected one of the eight foreign members of the Royal Academy of Sciences in Paris. Three years later war was declared with France. Hales laboured unceasingly to get Louis XV. to order the installation of ventilators into the French hospitals and prisons where British soldiers were confined. Exerting all his influence through Duhamel and the Duc de Noailles, he was at last successful, and his ventilators were installed into some at least of the French gaols, with, it is said, considerable reduction in the death-rate among the British prisoners. On this occasion the minister of Teddington was heard to say that he hoped no one would inform against him for corresponding with the enemy!

Hales was now more than eighty years of age.

He had advanced science by fundamental experiments on the circulation of the blood, the flow of sap, the chemistry of respiration, and the growth of bone. By his work on ventilation he had established one of the first principles of preventive medicine. He had ministered faithfully to his parish for more than fifty years. In the last scene of his active life we see him triumphant, reducing the mortality among British prisoners exiled in the gaols of France. Thus did Hales serve science and humanity, his King and his country. "He delighted to promote the honour of his God by advancing the best welfare of mankind. In this employment, blessed with serenity of temper, he calmly met his death as an acquaintance long familiarised to his mind." Stephen Hales died in 1761 in the eighty-fourth year of his age. His monument stands in Westminster Abbey, but his body lies buried under the tower which he had built himself for the church he had loved so well. There is no epitaph written on his grave, but 250 years after the birth of this great son of this College, let us adapt the words John Wesley wrote of him:

"How well did Science and Religion agree in this man of sound understanding!"

A National Bureau of Information.

By Dr. S. C. BRADFORD, The Science Library, South Kensington.

ALREADY means of ascertaining what information has been published on any subject is of the highest importance to every worker in science and technology. As Sir Philip Cunliffe-Lister said in a foreword to the Report of Proceedings of the first Conference on Information Bureaux and Special Libraries, in 1924, "The growth of knowledge during living memory has been remarkable and its application evident in every direction. Whilst it is generally recognised that knowledge is power, it is none the less true that a considerable proportion of accumulated knowledge is lying dormant and untapped. An immense amount of extremely valuable information is in existence, if only one knows where to find it. The volume of modern knowledge being far beyond the mental grasp of any individual, it becomes a vital necessity to provide a master-key whereby the common storehouse may be unlocked."

To this end much bibliographical work has been carried out. Perhaps the earliest suggestion to prepare a comprehensive catalogue of scientific papers was made to the British Association in 1855 by Prof. Henry of Washington. Afterwards, the suggestion bore fruit in the production of the "Catalogue of Scientific Papers" issued by the Royal Society from 1867 and onwards, and later, of the "International Catalogue of Scientific Literature" from 1902, which came to an end with the volume for 1914. Both these indexes covered pure science only. However, the increasing importance of science in every-day life has led to a growing demand for a comprehensive index to the printed records of both scientific and technical activity. Many applications for information or lists of books and papers on special subjects have been received at the Science Library from time to time, and recently such demands have increased in number considerably. These applications have been answered so far as possible from the subject-matter catalogue of the books, monographs, and separate papers which are in the Library, and from the extensive collection of bibliographies of every kind that has been gathered together for this purpose; but the labour of preparing such lists is very considerable, and the need for a comprehensive subject-matter card-index from which the desired information could be ascertained immediately has long been realised.

An information service covering the whole field of science and technology has been in process of organisation for some years, and recently the acquisition of a very large collection of subject-matter index-cards relating to articles and books on science and applied science, published during the period 1902–1914, together with an almost equally large collection of bibliographical slips, which require only to be mounted on cards to bring this index up to date, has placed the Science Library in possession of an exceptionally large card repertory which is now being arranged.

The Library now possesses:

1. A large and increasing collection of the scientific literature of the world, both books and periodicals, which are available for consultation in the Library or for loan to scientific institutions and research associations in Great Britain. (The catalogue of books is in the form of a card-index only, but a list of current periodicals is available, price 1*s.* 3*d.* post free.) The Library contains already more than 6000 of the scientific and technical journals recorded in the "World List" and, together with the older series and those acquired after the marking of the List, now possesses more than 7000 such periodicals, which are being added to at the rate of about 1000 periodicals annually.

2. A comprehensive subject-matter card-index to papers in scientific and technical books and periodicals, to be used as a key to recorded information and for the supply of lists of papers on given subjects. This index, which will soon include about one and a quarter million cards, is classified according to the Brussels Extension of the Dewey Decimal Classification, so that all references to information on a given subject can be found in one place under a single classification number, and this can be ascertained from the alphabetical index of subjects.

Bibliographies of special subjects are in course of preparation at very many institutions, but much of the labour expended in this work is only partially effective, because most of these bibliographies are classified on different systems, so that it is impossible to amalgamate them into a single index. To consult them, many volumes and parts must be

requisitioned, each different system of classification must be mastered, and then each part of each volume must be looked through separately.

There are, however, a considerable and increasing number of bibliographies, some of them very extensive, that are classified on a single system, the Brussels Extension of the Dewey Decimal Classification, already mentioned, and, as this system is the one which has been most widely used, and is the most convenient for indexing scientific literature on a large scale and in the greatest detail, it has been adopted in the Science Library. This classification, which has been described recently (NATURE, Mar. 19, p. 429), consists essentially of two parts, (*a*) a more or less logical detailed arrangement of subjects, each class being given a decimal number, and (*b*) a copious alphabetical index of subjects from which the class numbers can be found without reference to the classification. The new edition of the "Manuel de la classification décimale" is about to be published by the Imprimerie de l'Institut International de Bibliographie, Brussels, rue Piers, 101.

The index-cards are classified by writing on each of them the numbers of the corresponding subjects in the Classification, so that, when the cards are put away in their places in numerical order in the index-drawer, all the entries relating to a given subject fall together automatically. Conversely, to find what information is available on a particular subject of inquiry, it is merely necessary to ascertain the number from the alphabetical index and look at the cards bearing that number.

Practically all the available material that is classified by this system has now been gathered in the Science Library, and it includes :

1. The card repertory (1902–1914) of a well-known continental bibliographical institute that has recently ceased to operate, containing about 350,000 cards.
2. *Bibliographia Anatomica.*
3. *Bibliographia Biologica.*
4. *Bibliographia Palæontologica.*
5. *Bibliographia Physiologica.*
6. *Bibliographia Zoologica.*

These five bibliographies comprise about four hundred thousand printed subject-matter cards from 1896 onwards, published by the Concilium Bibliographicum, Zurich ; but the cards for the period 1916–1925 are being acquired gradually.

There are also the following bibliographical periodicals, which are being cut up, mounted on cards, and amalgamated with the above :

7. *Bibliographia Geologica*, 1801–1904.
8. Optical Society, *Transactions*, Index to vols. 1-25 and onwards.
9. *Optician*, Review of optical literature, 1927 and onwards.
10. *Revue de l'Ingénieur et Index technique*, published by the Brussels Institute, 1903–1925.
11. *Bibliographie technique*, 1923–1924. Continued as :
12. Nederlandsch Instituut voor Documentatie en Registratuur, *Meddeelingen*, 1925 and onwards.
13. *Le Mois Scientifique*, 1911–1914, 1919.
14. *Technos*, 1920–1924.
15. Koninklijk Instituut van Ingenieure, *Aanwinsten van de Bibliotheck*, 1925 and onwards.
16. *Nederlandsche technische wetenschappelijke Literatur*, 1924 and onwards.
17. *Revue générale de l'Électricité.* Documentation, 1921 and onwards.
18. *Chimie et Industrie.* Documentation, 1920 and onwards.
19. *Sciences administratives et les tablettes documentaires menuisibles* 1925 and onwards.
20. *Photographic Abstracts*, 1927 and onwards.
21. Société française de Photographie, *Bulletin*, 1925 and onwards.
22. *Science et Industries Photographiques*, 1925 and onwards.

It is intended that other important bibliographies that are not classified by this system shall be reclassified gradually, so that their entries also can be intercalated in place in the general card-index with other references to the same subjects.

This great subject-matter index will be comparatively simple to understand and rapid to use. Having ascertained from the alphabetical index of subjects the number or numbers of the classes that relate to the various aspects of the subject to be investigated, all the cards bearing titles of recorded information that is pertinent will be found together in chronological order under the corresponding numbers.

By this autumn the preparation of this subject-matter index will have advanced sufficiently for it to be made available to the public, when its extent will be approximately as follows :

Subject.	No. of Bibliographical References.	Approximate Period Covered.
Mathematics	100,000*	1893→
Physics	15,000	1903→
Geology	48,000	1801–1904
Biology—		
General biology, Palæontology, Zoology, Anatomy, Physiology	200,000	1896→
Steam and locomotive engineering	39,000	..
Electrical engineering	61,000	..
Telegraphy and telephony	2,700	..
Motors, transmissive machinery, machine tools, and workshop practice	45,000	..
Mining and economic geology	30,000	..
Bridges, roads, railways	33,500	..
Canals, docks	10,000	..
Hygiene, public health	11,000	1903→
Water and road transport	19,000	..
Aviation	4,500	..
Communications, transport	19,000	..
Chemical technology	76,000	..
Metallurgy	39,000	..
Building construction	10,000	..
Agriculture, economic botany, and forestry	250,000*	1919→
Other subjects	100,000	1903→
Total references	1,112,700	..

* These sections require reclassification and therefore may not be completely arranged until some months later.

For those who are unable to visit the Library, lists of books and papers will be typed from the cards so far as the general work of the Library permits. Photostat copies of articles can also be furnished on payment.

Obituary.

PROF. ALBRECHT KOSSEL.

PHYSIOLOGICAL chemistry has suffered a severe loss by the death of Albrecht Kossel, emeritus professor of physiology in the University of Heidelberg and director of the Institute for Protein Investigation in that city. He was in his seventy-fourth year, and died after a very brief illness on July 5.

Kossel was (with Baumann and Thierfelder) one of the most distinguished pupils of Hoppe-Seyler. After being assistant to the latter at Strasbourg, he spent some years at Berlin, occupied the chair of physiology at Marburg from 1895 until 1901, and then migrated to Heidelberg. A physiologist by training and a medical graduate, he devoted his researches almost entirely to chemical subjects; both as an investigator and as editor of the *Zeitschrift für physiologische Chemie* for more than thirty years, he was one of the leaders in the new science of biochemistry. His earlier investigations were concerned with the nucleic acids; he recognised xanthine and hypoxanthine as among their constituents, and discovered adenine. The sugar group was detected in yeast nucleic acid (1893) and in thymus nucleic acid (1894); the pyrimidine derivative thymine was discovered in the same year.

Turning his attention to the simplest proteins of fish-roe, the protamines (first investigated by Miescher), Kossel recognised their high content in arginine and the other amino-acids termed by him "hexone" bases. Thus salmine was investigated in 1896, and in the same year the important amino-acid histidine was discovered by the hydrolysis of histone. Next he worked out the classical method for the quantitative separation of the hexone bases by means of phosphotungstates and silver compounds. Thus at the beginning of the century Kossel had reached a position of pre-eminence by his utilisation of the exact methods of organic chemistry, in contrast to the less precise processes of older physiologists.

Arginase, the ferment which hydrolyses arginine to urea and ornithine, provided perhaps the most physiological of Kossel's investigations, carried out in conjunction with H. D. Dakin, his distinguished English pupil. Later he discovered decarboxylated arginine (agmatine) in herring-roe, and based a most convenient method for preparing that amino acid on the use of naphthol yellow (flavianic acid).

Kossel naturally received many distinctions; in 1907 he presided over the International Congress of Physiology at Heidelberg; in 1910 he was awarded the Nobel prize for medicine. He received honorary degrees from several universities, including Edinburgh, where in 1923 he was recognised as the leading representative from Germany at the Physiological Congress of that year. He visited London so recently as April last as a delegate to the Lister Centenary Celebrations. Many British friends will mourn his loss. Kossel leaves one son, Walther, the well-known professor of theoretical physics at Kiel, and one daughter.

The words which Kossel wrote of Hoppe-Seyler are peculiarly applicable to himself: "Always ready to acknowledge the merits of others, he could not understand attempts to import personal motives into science. . . . For years he strove to secure the foundation of separate chairs of physiological or medical chemistry in German universities, in order to ensure the independent development of these subjects." Such was his character; such was his life's work. G. B.

SIR WILLIAM ASHLEY.

SIR WILLIAM ASHLEY, whose death we regret to record, was an economist of note. He studied history at Oxford and afterwards went to Germany, where he came under the influence of Schmoller, which gave an impetus to most of his later work. For a period he held various university posts in the United States of America, returning to England to found the Commerce Department at the University of Birmingham, where he was professor, dean of the Faculty of Commerce, and later Vice-Principal of the University. On his retirement he settled at Canterbury and had several inquiries in hand, but these expectations were frustrated by a serious illness which terminated fatally on July 23.

Sir William Ashley was a realist in economics. He established his reputation early by his remarkable "Introduction to English Economic History." This book occupies a special place in British economic literature. While it is true that Archdeacon Cunningham had made important contributions earlier in the same field, Ashley's work had special qualities. He emphasised the comparative treatment of economic development, and showed the general continuity of that of England with the results already arrived at by a number of German writers. The book—considering that it was written in America—may be regarded as in many respects a *tour de force*. It opened a new field and almost set a new standard for British investigators. Also it opens up an interesting problem. Ashley traced the development of English economic life in the Middle Ages. The effect of the centralising power of the Church was towards a uniformity of organisation and of methods in different countries. With the bursting forth of distinctive national peculiarities at the beginning of the modern period, national diversity replaced uniformity, and one wonders how Ashley's method would have dealt with England of the sixteenth and seventeenth centuries or the period of the industrial revolution—alas, one wonders vainly.

Though Ashley was primarily an economist and historian, he had a great appreciation of scientific method and scientific discovery. This showed itself in an interesting way. When he was establishing the Faculty of Commerce at Birmingham, he was greatly impressed with the idea that the student who looked forward to a career in a manufacturing industry needed not only to know the economic issues involved and the commercial

technique, but also something, at least, of the main scientific ideas which lie at the root of the actual manufacturing operations, and in the conditions of study he made provision for this.

One important aspect of Ashley's work was the part he took in public affairs where economic issues were involved. More than twenty years ago he took part in the Tariff Reform controversy, and since the beginning of the War he was an able and energetic member of a great number of important commissions and governmental committees. Amongst these may be mentioned those on the Cost of Living and the Balfour Committee on Industry and Trade. In this way during the last twenty years Ashley spent himself freely, for, as a rule, when he accepted membership of a committee, he himself undertook a considerable amount of research on aspects of the terms of reference, while he was a valuable member in initiating investigations to be carried on on behalf of the committee. He had the gift of seizing what were the central points of an inquiry and of drawing together the data that existed bearing upon them. Then (as always happens in any inquiry which is worth making) there were gaps, and he was both fertile and happy in devising plans for bridging these so far as it was possible in the time available. For these reasons a great deal of Ashley's work—and that not the least valuable—is known only to a few, and it is fitting that this side of his labours, as well as his better known work, should be recorded. W. R. SCOTT.

MR. J. H. REYNOLDS.

MR. JOHN HENRY REYNOLDS, whose death occurred on July 17 at the advanced age of eighty-five years, may be truly described as one of the great pioneers of technical education in Great Britain. Though his work was wrought chiefly in Manchester, his influence was felt throughout the whole of the United Kingdom, and even beyond the seas, and it is not too much to say that he is to be numbered among those to whose early vision and service we are indebted to-day for the great development in the teaching of technology and applied science during the past forty or fifty years. Mr. Reynolds' work began in days when the need for technical education had not been realised, save by an enlightened few, and he steadily set himself to the task of awakening interest in what he knew to be a thing of vital import to the industries of Great Britain—the provision of the highest instruction and training in science and technology for the equipment of those who are to guide and direct and, by the use of special knowledge, develop industrial work. He was in the highest sense an idealist, and in his early outlook visualised a national system of education which would afford a means of consecutive training from the elementary school to the highest work of the university for students of proved ability and application, however humble their circumstances. That he lived to see the fulfilment in large measure of his ambitions was due, in part at least, to his own strenuous endeavours and clear vision.

Mr. Reynolds became secretary to the Manchester Mechanics Institution in April 1879, at a time when, to quote his own words, it "had declined in numbers and influence, and was heavily indebted financially." But under his wise administration, and with the help of generous firms and individuals, the work developed steadily, and in 1902 the present College of Technology building was opened—the direct outcome of his untiring energy, devotion, and far-sightedness through some twenty-three years. In 1905 the Faculty of Technology in the University of Manchester was established in the College, and Mr. Reynolds became the first dean of the Faculty. When in 1912, having attained the age of seventy, he relinquished his task, the College stood as a worthy expression of his ideals and a lasting memorial of his life work, for it had become a centre of the highest type of technological education and research, with a reputation that was world wide.

Mr. Reynolds' distinguished services in the cause of technical education were recognised by the Association of Technical Institutions by his election to the presidency of that body in 1913. He also took a prominent and active part in the work of numerous other educational organisations.

A fearless fighter on behalf of any cause he espoused, he was yet gentle and considerate in all his dealings with others. He possessed a ready sympathy and a kindliness of heart that endeared him to all whose privilege it was to labour with him. He will be remembered by those who knew him as a man who not only cherished ideals—ideals of truth, human brotherhood, and liberty—but who sought also with untiring zeal to work out those ideals in his daily life. J. A. BINKS.

WE regret to announce the following deaths:

Prof. Alexander Backhaus, formerly professor at Göttingen and director of the Agricultural Institute of the University of Königsberg, and from 1906 until 1913 director of the Agricultural School at Montevideo, aged sixty-one years.

Mr. C. W. Daniels, formerly Director of the London School of Tropical Medicine and a member of the Royal Society Malaria Commission to India and Central Africa, on Aug. 6, aged sixty-five years.

Dr. Henry Mills Hurd, emeritus professor of psychiatry at the Johns Hopkins University and president in 1899 of the American Medico-Psychological Association, who was editor of the *American Journal of Insanity* and the *Johns Hopkins Bulletin*, on July 20, aged eighty-four years.

Prof. V. Lenher, professor of analytical and inorganic chemistry in the University of Wisconsin, known for work on the chemistry of gold, tellurium, and selenium, on June 12, aged fifty-three years.

Dr. Erwin F. Smith, pathologist in charge of the laboratory of plant pathology in the U.S. Bureau of Plant Industry since 1886, and president in 1910 of the American Botanical Society, an authority on bacterial diseases of plants, on April 6, aged seventy-three years.

News and Views.

THE Gold Medal of the African Society is awarded for pre-eminent services rendered to Africa. So far, only five men have received it. The first was the late Sir Harry Johnston, who as explorer, administrator, zoologist, and writer left a deep mark upon the continent. For some years he was the president of the African Society. The second recipient was Sir Alfred Sharpe, who did splendid work as explorer and administrator in Nyasaland and Northern Rhodesia. The medal was next given to Sir Frederick Lugard, in recognition of his great achievements in both East and West Africa. Since his retirement from the Governorship of Nigeria, Sir Frederick continues to serve Africa as a member of many important committees, as chairman of the Executive Council of the International Institute of African Languages and Cultures, and as member of the Mandates Commission of the League of Nations. Sir Reginald Wingate, Bart., received the medal in acknowledgment of his great career in the Sudan. Now the medal has been given most fitly to Sir Ronald Ross. By this act the African Society pays homage, not only to Sir Ronald personally, but also to all who by their researches into the problems of health in the tropics have wrought such beneficent changes in the conditions of life in Africa.

A PUBLIC appeal for £35,000 for the purchase of 1444 acres of land on Salisbury Plain adjoining Stonehenge has been issued by a Stonehenge Protection Committee with the support of the Prime Minister, Mr. Ramsay Macdonald, Lord Crawford and Balcarres (president of the Society of Antiquaries), Lord Grey of Falloden (vice-president of the National Trust), and Lord Radnor (Lord Lieutenant of Wiltshire). The land upon which options have been secured includes the whole 'sky-line' of Stonehenge and covers the area upon which are situated the huge aerodrome and the huts which now disfigure the site and dwarf the monument. If the purchase is effected, these will be cleared away and the land vested in the National Trust. When it has been added to the actual site of the monument, which was presented to the nation nine years ago by Sir Cecil Chubb, building in the neighbourhood of the monument or the undue encroachment of the plough will be effectually prevented.

THE disfigurement of the Stonehenge area has been made imminent by the development of motor traffic and the increase of the number of tourists visiting Salisbury Plain. Extensive plans for building, indeed, are already in existence. On more than one occasion in recent years, it will be remembered that those who are interested in the protection of the surroundings of the monument from anything that would detract from its unique character and dignity have been alarmed seriously by the nature of proposals for the development of this part of the Plain. That it should be placed beyond the reach of such risks is a matter of even more than national concern. It may confidently be hoped that the appeal will receive the strong support it deserves. Contributions should be made to the National Trust (Stonehenge Fund) and addressed to the Secretary, 7 Buckingham Palace Gardens, London, S.W.1.

THE ether is becoming seriously overcrowded with radio waves. Two or more stations having nearly the same official frequency often 'jam' one another in an ordinary receiving set. The problem of inventing a simple method of cutting out the interfering stations is therefore one of great importance to the radio engineer. In a paper read by G. G. Blake to the Radio Society of Great Britain on May 25, a description is given of a method of improving the selectivity of a receiving set by means of ordinary sound resonators. The results obtained were most encouraging. Even when several stations were working with considerable mutual interference and bad atmospherics were present, it was found possible to isolate the selected station by means of a sound resonator. It is concluded that there is no reason why many more frequencies could not be selected for stations in the wave bands at present employed for broadcasting. The author suggests that by the use of a hot wire microphone and a number of sound resonators each tuned to a different station, all the signals could be heard or recorded simultaneously. He points out that the hot wire microphone or thermo-telephone receiver was described by Sir William Preece to the Royal Society in 1880. It consists of a tightly stretched fine platinum wire fixed at one end and attached at its other extremity to the centre of a diaphragm. The wire is heated by a current from a battery and the expansion or contraction of a wire in response to words spoken towards a microphone in series with it cause the diaphragm to vibrate.

IN his presidential address to the Devonshire Association for the Advancement of Science, Literature and Art, delivered on July 19, Mr. W. C. Dampier Whetham took as his subject "The Newtonian Epoch, 1685–1920." Mr. Whetham sums up as the two most important consequences of Newton's labours, the establishment of the validity of terrestrial mechanics in celestial spaces, and the removal of philosophical dogma from the basis of natural science. This rational outlook was carried over into chemistry by Lavoisier and formed the basis of the work of Dalton, Joule, Kelvin, Darwin, Young, Clerk Maxwell, etc., in the nineteenth century. The discovery of Neptune gave final proof to Newton's theory, and the science of spectrum analysis extended terrestrial chemistry to the heavenly bodies. Towards the end of the nineteenth century a new era began with the discovery of X-rays, electrons, radio-activity and atomic disintegration. The distribution of energy in the radiation from a hot body led to Planck's quantum theory, and this was used by Niels Bohr for the construction of a new and brilliant theory of the atom. Concurrently a new view of the ether developed, giving rise to the revolutionary outlook on space and time put forward by Einstein in 1905. This was summed up by

Minkowski in the conception of a space-time interval, which, with the principle of equivalence, gave in the hands of Einstein the relativity theory of gravitation. In the two directions of the quantum theory and the theory of relativity, physics seems to be breaking away from the dynamics of Newton. "The new vision of Nature is utterly unlike the materialistic nightmare which afflicted some who suffered from ill-digested Newtonian philosophy. We must hope that a future Newton may reconcile the discrepancies, and bring the laws of these new phenomena into subjection to the human mind."

THE fourth International Congress of Theoretical and Applied Limnology will be held in Rome this year, and a full programme has been arranged covering the period from Sept. 18 to Oct. 3. The congress will be divided into four sections, dealing with physics and chemistry, geology and hydrography, biology, and applied limnology, respectively. The first week will be spent in Rome, during which time lectures and papers will be given and opportunity will be afforded for visiting the Limnological Exhibition, the Royal Central Laboratory of Hydrobiology, the Royal Fish Breeding Establishment, and the Zoological Gardens. Receptions will also be given on the Capitol and at the Royal Italian Geographical Society. The remainder of the programme offers some very enjoyable excursions. Two days will be spent at Naples, where the visitors will be received at the Zoological Station and at the University. The congress will conclude with a most attractive itinerary to the Hydrobiological Stations situated amongst the delightful scenery of Lakes Garda, Como, and Maggiore, while nights can be spent *en route* at Perugia, Verona, and Milan. The congress will end on Monday, Oct. 3, at Lake Maggiore. Members of the congress on payment of the sum of 50 L. will be entitled to reductions on the Italian railways, and to cards of admission to all the meetings and excursions. They may be accompanied by members of their families for a fee of 30 L. All communications and inquiries relative to the congress are to be addressed to the Segretaria del Comitato Esecutivo at the R. Laboratorio Centrale di Idrobiologia, piazza Borghese 91, Roma (9).

BY an Order of the Committee of Privy Council, Sir Hugh K. Anderson (Master of Gonville and Caius College, Cambridge) and Prof. T. R. Elliott (Director of the Medical Unit, University College Hospital, London) are appointed members of the Medical Research Council into the vacancies caused by the retirement of Sir Frederick Andrewes and Sir Cuthbert Wallace.

ON Aug. 8 Prof. Henry Fairfield Osborn completed his seventieth year. The event has given his many friends the opportunity to present him with a Queen Anne cup of beautiful design and an illuminated manuscript with their greetings and signatures. At a reception to be held later, the surplus of the fund subscribed will be presented to Prof. Osborn for the advancement of his research work. We offer congratulations on the successful labours of the past and best wishes for the future.

FROM a notice just issued by the Ministry of Agriculture and Fisheries, we learn that in accordance with a recommendation of last year's Imperial Conference, an Imperial Agricultural Conference will be held in October next. It may be recalled that the Imperial Conference laid great stress on the potential value of co-ordination between the research agencies in various parts of the British Empire. Many will be interested to see what concrete shape co-ordination will take. There is as yet little co-ordination within Great Britain, though the need for it positively glares at one from the pages of a recent publication by the Ministry, "Research and the Land." In the words of the adage, "charity begins at home."

THE Washington Science Service *Daily News Bulletin* contains a brief comparison of the ancestry of present-day American statesmen with that of statesmen in Revolutionary times. It is found that the law-making of the United States is still chiefly in the hands of 'Nordics' as it was in Revolutionary days. Mr. Frank L. Babbott finds that 90 per cent. of the statesmen who met in Philadelphia to frame the constitution were English, Scotch, or Irish, while in the last Senate 81 per cent. were of similar descent, although the numbers are about twice as great. Of the others, several were partly and two wholly of French origin, two were Swedish, and one Norwegian.

THE series of observations of the sound of the firing of heavy guns at Shoeburyness, to which reference was made in NATURE of July 23, was continued on Aug. 3, when ten rounds were fired. The time of firing of each round was broadcast by the B.B.C. from Daventry. So far, reports have been received from sixteen observers, of whom five only heard the sounds. Of these five, four were located on the east coast, from Clacton to Ipswich, and the fifth was located at Isleworth. Four observers in London and seven observers distributed over a wide area, state that they failed to identify the sounds of firing. The reports so far received are not sufficient to define with accuracy the zones of audibility. Instrumental observations were obtained at the Universities of Birmingham and Bristol. At Birmingham the records showed that the time of transit of the sound waves from the gun to the instruments averaged about 12 min., compared with the time of transit of 11 min. 51 sec. on July 9, and 12 min. 16 sec. on July 13.

FROM time to time interesting accounts of the lives of the earlier American chemists are published by Dr. E. F. Smith, of the University of Pennsylvania, and one of his recent sketches concerns James Blythe Rogers (1802–1852), the eldest son of Dr. P. K. Rogers, an apothecary of Baltimore. The latter became professor of chemistry at the William and Mary College, and it was at this college that J. B. Rogers and his three brothers, William, Henry, and Robert, all men of science, were educated. After a brilliant college career James studied medicine, and received his doctor's degree from the University of Maryland in 1822. He was not pleased with his profession, however, and so he became the superintendent of an

extensive chemical factory in Baltimore. Father and sons were in regular correspondence, and the many quotations which are taken from their letters are very illuminating. Each became eminent in his particular branch of science, James being well known as a competent analyst. He did most of his work in connexion with the geological surveys carried out by his brothers William and Henry. The chemical factory with which he was at one time associated derived great benefit from his labours, as he was ever ready to apply his knowledge to industrial purposes.

THE Report of the Fuel Research Board for 1926 (H.M.S.O. 1*s.* 3*d.* net, pp. 62) reveals how well based is the research into the fuel resources of Great Britain which has been developed in the last few years. This work is carried on not only at the Government station but also at various university and other institutions, where independent workers receive assistance from State funds. Much of what is contained in the Report has been published elsewhere, but some information is new. An apparatus devised for determining the reactivity of coke is described. Perhaps the section dealing with coal treatment by carbonisation at low temperatures and by hydrogenation will be read with most general interest. The opinions as to commercial success attained by such processes are guarded but hopeful. A welcome feature is the announcement of an arrangement whereby the Gas Light and Coke Co. undertakes to operate a setting of the cast-iron vertical retorts devised at Greenwich under the commercial conditions of a modern gasworks for a period of years. Such an arrangement ensures for the process a commercial trial under the most favourable economic conditions, but nevertheless a searching trial alongside carbonisation plant which must and does pay its way. Hydrogenation of coal is regarded as still more immature from a commercial viewpoint, but it is pointed out that even if the process cannot compete with imported natural oils at present prices, conditions may change at any time. It is of great importance that information should be available of any process for producing liquid fuels from home sources. No one can read the Report without feeling reassured as to the measure of scientific effort in Great Britain to make the best use of native fuels.

PART I. (Medical) of the Registrar-General's statistical review for 1926 of Great Britain has recently been issued (London: H.M. Stationery Office. 15*s.*). From this it appears that the birth-rate for the year 1926 was 17·8 per 1000 population. Excepting the rate of 17·7 in 1918, the last year of the War, which at that time was regarded as phenomenally low, that for 1926 is the lowest recorded since the establishment of civil registration in Great Britain. In view of the continued decline during the first half of the current year it is probable that the rate for 1927 will be lower than that for 1918. The crude death-rate was 11·6 per 1000 population, and was equal to that of 1923, the lowest on record. In 1924 and in 1925 the rate was 12·2 per 1000. The provisional birth- and death-rates and infantile mortality in 1926 for some other countries were as follows:

	Birth-rate.	Death-rate.	Natural Increase.	Infantile Mortality.
Sweden . . .	16·9	11·8	5·1	..
England and Wales	17·8	11·6	6·2	70
Switzerland (1925)	18·4	12·2	6·2	..
France . . .	18·8	17·5	1·3	98
Belgium . .	19·0	12·9	6·1	..
Germany . .	19·5	11·7	7·8	101
Norway . . .	19·7	10·6	9·1	..
U.S.A. . . .	20·1	12·1	8·0	73
Scotland . .	20·9	13·0	7·9	83
Holland . . .	23·8	9·8	14·0	61
Hungary . .	26·7	16·5	10·2	168
Italy (1925) . .	27·8	16·8	11·0	119

Thus, the birth-rate in England and Wales has now fallen below that of France, and with the exception of that of Sweden, is the lowest of the principal European countries. On the other hand, the general death-rate and the infantile mortality are low compared with the rates prevailing in most of the other countries.

THE Pathological and Bacteriological Laboratory Assistants' Association is holding a conference at Cambridge from Aug. 22-26, under the presidency of Prof. H. R. Dean. A scientific programme has been arranged for each morning, whilst the afternoons will be reserved for excursions. The conference will be opened by the Vice-Chancellor of the University, the Rev. G. A. Weekes, at 10.30 A.M. on Monday, Aug. 22, and the opening ceremony will be followed by a lecture on Cambridge, by the Vice-president, Mr. W. A. Mitchell: in the afternoon the Association will be entertained in the Fellows' Garden, Downing College. On the four following mornings, papers and demonstrations will be given in the Department of Pathology of the University. These cover a wide range of subjects, among which the following may be noted: a standard dietary for laboratory rabbits and guinea-pigs, by E. Pleasance; the manufacture of smallpox vaccine as carried out in the laboratories of the Shanghai Municipal Council, by A. E. P. Grimmo; cinema films of infusoria, spirochætes, trypanosomes, etc., by G. Harper; virulence tests in the identification of *B. diphtheriæ*, by S. J. Denyer; the preparation of plague vaccine, by F. Leeson; difficulties encountered in the differentiation of paratyphosus A, B, and C, by S. J. Denyer; tissue cultivation technique and pulsating heart cultures, by V. C. Norfield; the cultivation of protozoa, by W. Cooper and W. J. Muggleton. This selection from the list of papers and demonstrations on the programme gives a good idea of the standard of knowledge and technique required of a modern laboratory assistant. The Conference dinner will be held in the hall of Trinity Hall on Thursday, Aug. 25, and during the evening the Woodhead Medal will be presented to Prof. J. Lorrain Smith. The meeting concludes with demonstrations on the morning of Friday, Aug. 26.

THE annual report by the Conservator, Sir Arthur Keith, on the Museum of the Royal College of Surgeons of England has recently been issued. The Conservator has reported on many discoveries of human remains, and several of the skulls have been added to the Museum. The odontological collection is once more on view, after extension of the room, with many additions. The pathological, osteological, teratological, and physiological collections have received numerous additions, many old specimens have been re-mounted, and some re-cataloguing has been undertaken. A valuable collection of books relating to the history of surgical instruments has been presented by Mr. J. Barry Hopkins. Several pieces of research work have been carried out in the Museum, *e.g.* one on the lymphatic system of fishes by Mr. R. H. Burne. The Conservator acknowledges the assistance he has received from the sectional curators and voluntary helpers.

THE International Hydrographic Bureau at Monaco has issued as *Special Publication* No. 18 a list of life-saving stations of the world with their equipment and exact geographical positions. It has been compiled from Sailing Directories and other official documents. The text is in both English and French. When notice of errors, omissions, and changes are received, the Bureau will issue a corrected list and hopes to arrange for a translation into all maritime languages. The list should prove valuable to ship masters, marine insurance companies, steamship companies, and others. Its price is 30 cents.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in mechanical engineering in Swansea Municipal Technical College—The Director of Education, Dynevor Place, Swansea (Aug. 20). An inspector of weights and measures and two qualified assistants to the Chief Inspector of Weights and Measures of the Weights and Measures Department of the Essex County Council—The Clerk of the County Council, Shire Hall, Chelmsford (Aug. 22). A Statistical Director of the Cotton Trade Statistical Bureau now being established by the Manchester Chamber of Commerce—The President of the Manchester Chamber of Commerce, Manchester (Aug. 24). An assistant lecturer on machine design in the University of Birmingham —The Secretary, The University, Birmingham (Aug. 24). A lecturer in agricultural chemistry in the University of Reading—The Registrar, The University, Reading (Aug. 26). A professor of anatomy in the University of Durham College of Medicine—The Registrar, University of Durham College of Medicine, Newcastle-upon-Tyne (Aug. 31). A lecturer in biochemistry in the Physiological Department of the University of Birmingham—The Secretary, The University, Birmingham (Sept. 21). A senior lecturer in physiology in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Sept. 26). A senior demonstrator in the Department of Physiology of the University of Otago, Dunedin, New Zealand—The Registrar, University of Otago, Dunedin, New Zealand (Oct. 20). An agricultural economist in the Agricultural Department of the Tanganyika Territory—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Steet, S.W.1 (Nov. 1). An assistant inspector of plants and produce in the Lands and Forests Department of Sierra Leone—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/15528).

Our Astronomical Column.

COMET NOTES.—Miss J. M. Vinter-Hansen has computed the following orbit of Reid's Comet (1926 VII. = 1927 *b*) from observations made at the Cape Observatory on Jan. 26, Feb. 3 and 8 (*Copenhagen Circ.*, 159) :

T	1926 Dec. 30·676 U.T.	
ω	225° 5·48′	1927·0
Ω	108 50·96	
i	83 39·69	
log q	9·87818	
O-C	$\Delta\lambda_2 \cos\beta_2 = +0·52'$	
	$\Delta\beta_2 = -0·08$	

The large residual in the middle place suggests possible departure from a parabola. The comet may still be observable : the following ephemeris for 0^h is by A. V. Nielsen from the above orbit :

	R.A.	N. Decl.
Aug. 16.	7^h 43^m 2^s	13° 6′
24.	7 49 4	13 17
Sept. 1.	7 54 32	13 28
9.	7 59 22	13 39
17.	8 3 32	13 51
25.	8 6 57	14 4

Estimated magnitude, 14.

EPHEMERIS OF STEARNS'S COMET (1927 *d*) BY H. THIELE.

	R.A.	N. Decl.
Aug. 19.	14^h 11^m 44^s	24° 39′
23.	14 14 ·8	24 39
27.	14 16 42	24 39
31.	14 19 26	24 38
Sept. 4.	14 22 19	24 38
8.	14 25 21	24 38
12.	14 28 31	24 38

Observations of Blathwayt's Comet, 1927 *a* = 1927 II., made at the Cape Observatory between Jan. 17 and Mar. 29, have been sent to the I.A.U. Bureau at Copenhagen ; from these Miss J. M. Vinter-Hansen has deduced the following parabolic orbit (*Copenhagen Circ.*, 160) :

T	1927 Feb. 14·503 U.T.	
ω	231° 50·84′	1927·0
Ω	18 47·71	
i	92 21·27	
log q	0·01518	
O-C	$\Delta\lambda_2 \cos\beta_2 - 0·08'$	
Feb. 15	$\Delta\beta_2 - 0·12$	

EPHEMERIS FOR 0^h.

	R.A.	S. Decl.
Aug. 8.	3^h 13^m 55^s	8° 39′
16.	3 8 15	8 47
24.	3 0 47	9 2
Sept. 1.	2 51 31	9 19

Estimated magnitude, 12.

Research Items.

THE ROCK SHELTER OF LA GENIÈRE.—MM. C. Gaillard, Pissot, and C. Cote describe in *L'Anthropologie*, T. 37, Nos. 1-2, the results of an exploration of the rock-shelter at Serrières-Sur-Ain, one of a number of rock-shelters and grottoes on the Ain examined in 1903, in which the traces of occupation then discovered were attributed to the early neolithic. Beneath the level opened up in 1903 has now been found the evidence of an earlier period which the authors assign to the end of the Magdalenian. This level of occupation has produced a relatively small number of animal remains, including *Bison priscus*, *Cervus tarandus*, species of goat, ox, and pig, and *Canis vulpes*, a human skull—of a child—and a large number of examples of a microlithic industry in which sub-triangular forms are numerous. Of bone points, four only were discovered. An engraving of a reindeer and another of a bison present a very close analogy with the paintings of the Font du Gaume. The australoid or negroid characters of the skull suggest that this is a race of late Magdalenian date descended from the Grimaldi people and the culture a specialisation of Magdalenian rather than Azilo-Tardenoisian. It is possible that this same race was responsible for the art of the Font du Gaume, and it is suggested as probable that its culture is to be attributed to a strong infiltration of the Capsian of North Africa.

THE INHERITANCE FACTOR IN PNEUMONIA.—An interesting study of a family which is subject to pneumonia and other respiratory diseases has been made by Prof. Raymond Pearl (*Annals of Eugenics*, vol. 2, p. 1). It is usually assumed by medical clinicians that pneumonia is merely the result of a chance bacterial infection, but here is a working family living under fairly good conditions and showing a far higher incidence of pneumonia than their neighbours or others living in similar conditions. Every child in this family of thirteen had had pneumonia, one having had it twice and one three times, and seven had died of it. They could not have immediately infected each other because of the time intervals between attacks. By a careful study of the pedigrees of father and mother, Prof. Pearl shows that the father's family stock had a high incidence of tuberculosis, fertility somewhat above the average, and respiratory diseases in childhood; while the mother's family showed low fertility and very low infant mortality. The evidence as a whole points strongly to an inherited constitutional condition as the cause of the very high incidence of pneumonia in this family. The same probably applies to bacterial diseases generally, some individuals and families inheriting greater susceptibility than others. But the nature of these differences in power of resistance to a specific bacterium and the manner of its inheritance are as yet very inadequately known. Further knowledge should make a genetic analysis possible, as has been done with susceptible and resistant strains of certain cultivated plants.

PLAGUE IN SOUTH AFRICA.—An important publication of the South African Institute for Medical Research (Publication No. 20, vol. 3, pp. 85-256) has recently been issued dealing with the plague problem in South Africa. Dr. Harvey Pirrie contributes notes on veld rodents susceptible to plague, illustrated with eight plates, and on plague infection among these rodents. A hitherto undescribed bacterial disease has been found in the gerbille. Experiments have also been carried out with vaccines, sera, etc., on the prophylaxis and treatment of plague. Dr. Ingram discusses plague investigation from an entomological aspect, and Dr. Alexander Mitchell contributes a historical summary on plague in South Africa.

AGRICULTURE IN INDIA.—Dr. Clouston, in a "Review of Agricultural Operations in India, 1925–26," surveys in detail the conditions throughout the country, and includes reports and statistics on a number of crops, soil investigations, animal nutrition and veterinary science, engineering, insect pests and plant diseases, together with a list of the agricultural publications during the year (Calcutta: Government of India Central Publications Branch. 2.6 rupees; 4*s*. 3*d*.). On the whole, in spite of an uneven distribution of rain, the season was fairly good. Much progress has been made in the seed selection and hybridisation of rice and wheat, and the particular importance of phosphate manuring for the former crop in dry seasons established. Considerable organisation and legislation has been necessary in the case of cotton, but experimental work, such as spinning tests at the new technological laboratory and the development of a fumigation scheme for use on imported cotton, has been successfully carried out. Important advances have also been made in the technique of breeding sugar-cane, and improved methods of cultivation and manuring are yielding good results. Research on fundamental soil problems is being carried out by the various agricultural departments. The soil in general is very deficient in nitrogen owing to prolonged cultivation without the addition of manure. Organic materials, such as cattle or green manures, are the most suitable, much that could be used with advantage being at present exported. Economical modifications of the original method of making artificial farm-yard manure have already been devised. A new line of work, which is yielding interesting practical results, is the determination of the feeding properties of pasture grasses and the relative value of Indian fodders. The serious rinderpest disease of cattle has been effectively diminished by the widespread use of preventive inoculation, but the loss incurred during the year under review was extremely serious, and further investigations with the view of conferring permanent immunity are being undertaken. The co-operative movement started by the Government in 1904 is now working in touch with the agricultural departments, but further extension is still needed as, for example, in the organisation of the marketing of produce. Useful work in this direction has been done by the cotton-sale societies in Bombay and the milk societies in Bengal.

PETRIFIED FORESTS.—In the June issue of the *Scientific Monthly* Miss Winifred Goldring, of the New York State Museum, describes the oldest known petrified forest, located near the village of Gilboa in the Catskill Mountains. The first discoveries were made in 1869, but it was not until 1920 and the succeeding years that material was brought to light in sufficient quantity to enable the nature and extent of the forests to be reasonably determined. The fossils belong to the Upper Devonian horizon. During this period the Catskill Mountains formed the low shore-line of a shallow sea. At the present time the fossil trees are found on three distinct levels, indicating that the swampy shore-line was very unstable. Gradual submergence of the coast carried the trees beneath the water and sediment piled over their trunks. When the deposits accumulated the forest again crept down to the water edge. Evidence shows that three successive forests flourished here, were

submerged and buried. These Gilboa trees in general appearance must have resembled the tree ferns of the tropics at the present day. They were, however, seed ferns or Pteridosperms, standing in a position between the tree ferns and the higher seed plants. A new genus, Eospermatopteris, has been created for the Gilboa forms, and two species, *E. textilis* (Dawson) and *E. erianus* (Dawson), have been distinguished. The outer part of the cortex of the stem is the only part of the structure to any extent preserved, the interior parts having been washed out and the structures filled with sand. The cortex consists of interlacing strands of sclerenchymatous tissue, and the outer surface is marked with shallow ridges and furrows, in some cases giving the effect of a bark. These trees were probably 25 ft. to 40 ft. high and bore fronds from 6 ft. to 9 ft. in length, on the dichotomous tips of some of which were borne the seeds. The bulbous stem bases were undoubtedly buried in the swamp mud as the roots were not heavy, and otherwise the trees would have had no adequate support. Foliage was light and much looser than in the tree ferns of to-day. The lycopod-like trees (*Protolepidodendron*) also grew in small numbers in the forests.

VERTICAL DISTRIBUTION OF PLANKTON.—Mr. F. S. Russell (*Biological Reviews*, vol. 2, No. 3, pp. 213-262, 1927), in a very able and exhaustive article, reviews the present position of the problem of the vertical distribution of planktonic organisms. He begins by surveying the possible controlling factors in the vertical distribution of plankton, such as light, temperature, winds and currents, pressure, salinity, chemical constitution of the sea water, and so on. The author next summarises the known facts of the vertical distribution of planktonic organisms themselves, and concludes that each plankton animal has its own vertical zone, varying for each species and for individuals of different ages and stages of development, and even for different sexes. The type of distribution for any one species may vary from place to place, season to season, and day to day. In fairly homogeneous waters, light intensity may be the prime factor governing vertical distribution, though other factors such as temperature and salinity, rate of movement, and distribution of food must not be ignored. The author then deals with the results obtained by experimental work on planktonic organisms in order to discover how far the observations in the field are borne out and supplemented in the laboratory. He rightly points out that field work should always precede laboratory experiment in order that a proper interpretation of laboratory actions should be possible. In the closing section of the article the author discusses mainly the evidence that light is the most important controlling factor in the vertical distribution of marine planktonic animals. The article concludes with an exhaustive bibliography.

GENETICS OF POLLEN TUBES.—A new gene mutation of *Datura Stramonium* called tricarpel is being studied by Drs. Buchholz and Blakeslee (*Proc. U.S. Nat. Acad. Sci.*, vol. 13, p. 243). By making various crosses between tricarpel and normal and studying the pollen tubes as they grow down the style, it is found that the factor for tricarpel suffers a considerable amount of elimination through slower growth and also through bursting of the pollen tubes as they pass down the style. The latter process occurs more frequently in pollen tubes of the tricarpel type. When this type is self pollinated, more than half the pollen tubes are abnormal in appearance, and the rate of growth of the normal pollen tubes is slower, although the percentage of pollen germination is essentially the same as in the type. This gametophytic selection is believed to be an important evolutionary factor. Pollen tube growth has also been studied in the trimorphic self-sterile plant, *Lythrum salicaria*, by Mr. D. Kostoff (*l.c.*, p. 253). It is found that germination takes place equally well in all pollinations, but that the rate of growth of the pollen tubes is much retarded by 'illegitimate' pollination, *i.e.* by putting the wrong kind of pollen on a particular stigma. With 'legitimate' pollination the curve of growth of the tubes is symmetrical, with decided acceleration in the later stages. It has already been shown in self-sterile tobacco that in incompatible matings the pollen tube growth is so slow that the flower falls before the pollen tubes reach the ovary.

THE PHYSIOLOGY OF FRUIT TREES.—Two points of general interest emerge particularly from Dr. T. Swarbrick's first paper, under this general title, which is published in the *Journal of Pomology and Horticultural Science*, vol. 6, No. 2, June 1927. His own observations, as also his extensive citation from the literature, make it clear that there is a very interesting phenomenon presented by the temporary disappearance of starch from the phloem of broad-leaved trees, which takes place early in the spring. Usually this is ascribed to a fall of temperature, but Dr. Swarbrick directs attention to Prof. Chandler's warning that the same phenomenon is reported from the genial Californian spring climate as from the fruit trees of the regions, with hard winters, in the east of the United States. Similarly, Dr. Swarbrick found in one- to five-year-old apple branches at Long Ashton, near Bristol, a disappearance of starch from the cortex and phloem in the middle of January, followed by its reappearance at the end of March. Dr. Swarbrick also reports that the formation of new xylem from the cambium in the spring begins at the distal end of the apple shoots in the spring, its commencement being associated with the position of the swelling buds. In apple trees, xylem formation was at least three weeks later in the four- than in the one-year-old shoots, whilst on the one occasion in which a standard plum tree was cut down, on the date of cutting, June 15, 1926, no xylem was forming in the trunk at eighteen inches from the ground, although several rows of xylem elements were present in the one-year-old shoots. These observations confirm and extend the work of the East Malling station published in a previous number of the same journal.

A CAMBRIAN FISH.—In the fifteenth biennial report of the Vermont State Geologist, recently published, Dr. William L. Bryant describes the impression of a small fossil from the Cambrian shale of Franklin County, Vermont, U.S.A., which he considers may prove to be the dermal tubercle of a primitive fish. It is an ellipsoid plate 3 mm. in length, truncated at one end. Its outer face is ornamented with rows of tubercles, which radiate from a point near the truncate border. Dr. Bryant compares it with the polygonal head-plates of the Cephalaspids, and proposes the name *Eoichthys howelli* for the supposed fish to which it belongs.

SOME HELICINNÆ FROM MEXICO AND TEXAS.—Dr. Pilsbry has been studying "The Structure and Affinities of Humboldtiana and related Helicid Genera of Mexico and Texas" (*Proc. Acad. Nat. Sci. Philad.*, vol. 79). The group of belogonous helices (Helicinæ) which comprises these genera seems to be as widely distributed in America as in the old world. No doubt the group became established in America in Mesozoic times, and the evolution of its members

has been along various widely divergent lines. The anatomy of Humboldtiana and its allies Lysinoe, Leptarionta, and Tryonigens is fully described and illustrated with text figures and four plates. The representations of the enlarged surface sculpture of the shells are especially well done.

DECLINATION CHANGES IN GREAT BRITAIN.—The Meteorological Office has published as *Geophysica Memoirs*, No. 35 (price 3*s*. 6*d*. net), "A Comparison of the Records from British Magnetic Stations Underground and Surface," by Dr. C. Chree and R. E. Watson. The purpose of the work was to find to what extent the changes of magnetic declination in the south of England agree with those in other parts, particularly the mining areas, and below ground as well as above. Since 1918 two-hourly values of the declination, at Kew until the end of 1924, and since then at Abinger, have been supplied to certain journals for the use of mine-surveyors; henceforward they are to be replaced by hourly values. The present investigation indicates that on quiet days these values fairly represent the changes of declination throughout Britain, and that there is no appreciable difference in the changes below ground. On disturbed days, however, the changes of declination, both regular and irregular, increase in size as we go north; on highly disturbed days, or even on quieter days in the case of short period changes, the increase with latitude is rapid—by 50 per cent. at Eskdalemuir, and more than two-fold at Lerwick in the Shetland Isles.

LIGHT QUANTA.—A recent paper communicated by Prof. M. Planck to the Franklin Institute (*Die Naturwissenschaften*, June 30) contains some of the views of this eminent theoretical physicist on the trend of modern work. In his opinion, the existence of quanta was definitely proved when, in order to obtain agreement with the results of experiment, it became necessary to supplement the fluctuations in the energy of black-body radiation predicted by classical theory, by other fluctuations, also based on considerations of entropy, which required the presence of discrete units of energy. He regards the partial coherence of quanta which is needed to account for interference as connected in some way which has still to be specified with the classical contribution to the fluctuations, and in concordance with other relations of general mechanics and atomic physics, he looks upon radiant quanta as having an extension in the generalised space of the theory of relativity. Prof. Planck believes that the most important problem awaiting solution at the present time is that of the relation between the corpuscular equations and the wave equations in the most general case, since this is needed to connect the mechanics of a particle moving in a path of large curvature with the properties of radiation of high frequency.

SPECTROMETER MEASUREMENTS OF SOFT X-RAYS.—There is a short paper by J. Thibaud in the *Comptes rendus* of the Paris Academy of Sciences of July 4, in which he describes a grating spectrometer suitable for work in the soft X-ray region. The radiation produced by electron bombardment of a suitable target is limited by fine slits, and then analysed at grazing incidence with one of Prof. R. W. Wood's glass gratings, with 25,000 lines to the inch. One plate which has been reproduced shows the $K\alpha$ line of carbon in three orders, as well as a sharp K line of oxygen. Apparently the success of the method is due to a high efficiency of conversion of kinetic energy of electrons into characteristic radiation of about 30 Å.U., as the necessary exposures of the carbon line could be made on oiled plates in minutes, five with a dissipation of only ten watts in the X-ray tube. It is claimed that the wave-length measurements of the $K\alpha$ lines of oxygen and carbon, and of the $L\alpha$ line of iron and the $M\alpha$ line of molybdenum have been made with a relative accuracy of 0·1 per cent. and an absolute accuracy of 0·5 per cent.

EXPLOSION OF LEAD BROMATE.—A serious explosion resulting in two deaths is reported by the *Chemiker-Zeitung* to have been caused at Seelze near Hannover on May 26 by the grinding of lead bromate in a mortar. The salt, which hitherto had been prepared from lead carbonate and bromic acid, was on this occasion precipitated from solutions of potassium bromate and lead acetate, and had been well washed on a filter and dried in the oven at 70°-80° C. Grinding 1 kgm. of it in a mortar caused a very violent explosion and considerable damage was done.

HARDENING STONE.—The method of hardening calcareous stone by treating it with a solution of silicate of soda, discovered by Kuhlmann nearly a century ago, has at various times been used to harden the surfaces of roads, but the results obtained have varied so much with the stone used, the method of application of the solution, and the weather conditions at the time, that it has fallen into disfavour. Recently, however, both in Great Britain and in France, attention has been again directed to the method, and in the issue of the *Bulletin de la Société d'Encouragement pour l'Industrie nationale* for May, M. R. Feret, head of the laboratory of Ponts et Chaussées of Boulogne, gives an account of the observations he has made on the nature of the hardening process and the influence on it of the conditions under which it takes place. His solution contained 24·9 per cent. of SiO_2 and 7·3 per cent. of Na_2O and was used on rocks of many kinds. He concludes that the hardening process is due to adsorption of the silica at the surface of the stone in a gelatinous form which slowly becomes hard and insoluble. The process is facilitated by drying, by dialysis in the stone, and by the action of the carbon dioxide in the air.

PULVERISED FUEL AT SEA.—Now that the use of pulverised coal has been successfully applied in land boilers, its adoption in marine boilers is thought by some to be only a matter of time. The importance of the subject was referred to in a recent paper, "Pulverised Fuel for Marine Purposes," by Engineer-Captain J. C. Brand of the Australian Navy, read to the Institution of Naval Architects at Cambridge, and by various speakers who took part in the discussion. Capt. Brand dealt with the practical problems involved and the economy of the system, and gave some drawings of typical installations. For certain services the fuel would be pulverised ashore and conveyed by piping into the ships' bunkers, but in other cases ships themselves would be fitted with the necessary pulverising plant. With the improvement in combustion resulting from the burning of the coal in the form of very fine dust, it was stated that a vessel could go 15 per cent. to 30 per cent. farther with the same weight of fuel as compared with the distance she could steam with mine coal. Then, too, with pulverised fuel there is a great reduction in the number of firemen. There are to-day many types of pulverising mills, conveyors, burners, etc. As regards the dangers of using pulverised coal, these have been greatly exaggerated in the same way as were the dangers of oil fuel. So long ago as 1917, Capt. Brand carried out experiments for the Naval Board, Commonwealth of Australia, and in his paper gave the results of tests made in H.M.S. *Sealark*.

Chemistry in 'Iraq and Persia in the Tenth Century A.D.

AN important communication with the above title appears in the *Memoirs of the Asiatic Society of Bengal*, vol. 8, No. 6, pp. 317-418 (1927), the authors being Principal H. E. Stapleton, of Presidency College, Calcutta, the late R. F. Azo, and M. H. Husain, professor of Arabic at Presidency College. The principal object of the paper, which is provided with numerous references and notes of great value, and is illustrated, is confined to supporting the thesis that "in 900 A.D. such a degree of exact knowledge of chemical substances and apparatus was displayed that historians may henceforward be justified in antedating the birth of scientific chemistry by—in all probability—at least 900 years; and, secondly, to indicating briefly the influences, both personal and racial, that appear to have controlled the development of chemistry in the period of investigation."

There is nothing in the paper which would incline any one acquainted with the works of the Greek-writing practitioners of the 'Divine Art' at Alexandria, some 500 years before the period dealt with in the present memoir, to assent to the first part of the thesis, and it is much to be regretted that the enthusiasm of some writers on chemistry in Islam should often lead them to overstep the bounds of reality.

The subject matter of the memoir falls naturally into two parts. The first contains an account of the chemical information contained in two treatises written by Muhammad bin Zakarīyā ar-Rāzī, who is generally known (and will in what follows be called) by the name of Rhases (although this is really his address), and an encyclopædia of sciences written about A.D. 980 by Abū 'Abdallāh Muḥammad bin Aḥmad bin Yūsuf al-Kātib al-Khwārazmī, the Arabic text of which was published by Van Vloten in 1895; an English translation of the part of the latter dealing with alchemy is given.

Rhases was born in A.D. 866 at Ray, and was, like many other Arabic writing men of learning, a Persian. Rhases' treatises on alchemy are said by our present authors to be "scientific works in the modern sense of the word," and free from that "veil of mysticism with which even Jābir had continued to conceal from public view the mass of chemical facts that had gradually accumulated in the Near East up to the middle of the eighth century A.D." It may be useful to notice at this point that the writings of Jābir ibn Hayyan do, in fact, contain a good deal of childish mysticism, and that the claims put forward for his 'rationalism' are exaggerated.

One of the sources of Rhases' information, according to our present authors, was the "Book of the Seventy," a Latin translation of which in the Paris MS. Latin 7156 was mentioned by Hoefer in 1842 ("Histoire de la chimie," vol. 1, p. 409, 1842: "Liber de Septuaginta translatus a magistro Renaldo Cremonensi de lapide animali"—a treatise which, says Hoefer, "pourrait beaucoup intéresser les amateurs de la science hermétique. Il a été, selon toute apparence, traduit de l'arabe"). It was published by Berthelot in 1906, after he had suggested in 1893 that it was the work of the same title attributed to Jābir ibn Hayyan in the "Kitab al Fihrist" of al Nadim. This has been confirmed, since the present memoir was written, by Julius Ruska, who has discovered the Arabic original. "The substances, apparatus, and processes mentioned by ar-Rāzī are, almost without exception, found in the 'Book of the Seventy.'" The authors proceed to demonstrate in detail the indebtedness of Rhases to Jābir ibn Hayyan.

The second part of the memoir deals with the interpretation of the word Khārṣīnī, which is mentioned as one of the metals in the treatise published by Van Vloten. It is there said to be "a rare metal, almost unprocurable." It is associated with the planet Mercury, and this leads the authors to a discussion of the planetary idols of the Ṣābians of Harran, which are described in a treatise of Al-Dimishqī (*d.* A.D. 1327) translated by Chwolson, and also in full by Mehren ("Manuel de la cosmographie du moyen âge," Copenhagen, 1874), in which the idol of Mercury "is made of an alloy of all the metals as well as of Khārṣīnī, and in the hollow of which much quicksilver is poured" (Mehren translates Khārṣīnī as "Chinese porcelain," as does Chwolson). The literal meaning of Khārṣīnī is, according to the authors, "the Barb, or [poisonous] arrow-head of China"; it takes the place of glass in Jābir's list of the metals, and after an exhaustive examination of the other sources of information (in which they refer to "a further possible source of Arabic alchemy, viz., the Chinese School of Alchemy which was flourishing at least as early as B.C. 200, and of which the chief exponent, Ko-Hung, wrote his treatise on Taoist Philosophy and Alchemy, called the *Pao p'o tsz'* in A.D. 330"), they conclude that "the original Khārṣīnī of ar-Rāzī represented the metal now known to us as zinc." They also refer to "the Chaldæan element in ar-Rāzī's chemistry, as indicated by the inclusion of Khārṣīnī in the list of metals," and suppose that "the ancient civilisation of Mesopotamia had still survived in his time at Ḥarrān" (a part of which comprised the Ṣābian planetary religion mentioned above), and that Chinese information was also available to him there. "Greek and Chinese alchemy must have had some common source of origin: and as the Chinese could hardly have drawn directly on Greek (or Egyptian) sources for this knowledge, China must either have discovered the facts for herself, and passed them on to some intermediary, like Babylonia, or acquired the knowledge from the same (or some other) intermediary. . . . In addition to the Greek knowledge of chemistry, which reached him through Jābir, ar-Rāzī also drew—in all probability through the Temple-priests of Ḥarrān in northern Mesopotamia—on the considerable body of knowledge at the disposal of the ancient Babylonian and Egyptian priests."

It is suggested that such information as that translated in R. C. Thompson's "Chemistry of the Ancient Assyrians" may have been transmitted directly, together with unspecified elements from other civilisations. This suggestion is clearly worth following up, since the usual opinion that chemistry is largely of Egyptian origin was put forward at a time when practically no information existed as to the technical knowledge of that people. Exaggerated claims for "a Babylonian origin of alchemy," such as those of Eisler, are still without confirmation, but the possible contributions from Mesopotamia grow more probable with fuller knowledge. In this connexion there is an interesting suggestion of Ruska ("Tabula smaragdina," p. 22) that the καιρικαὶ βαφαί of the Greek alchemical MSS. refers to the colorations of metals in the interior of the earth, which were formerly engendered by the action of the planetary spirits, but in the period when these actions had ceased, could be effected by the 'divine art' of chemistry. This, in turn, seems to be related to the old Babylonian belief in "spirits of mineral treasures" living under the earth, and related to the fire god.

The Chinese element assumed by our authors is

awaiting investigation, and it may be that Rhases' account of Khārṣinī refers to mercury as a compound such as corrosive sublimate, which would correspond better with the Ṣābian account and with the poisonous properties of the material. I-Tsing (A.D. 671–695) seems to know corrosive sublimate, the production of which in China may have been early.

It has been possible only to mention one or two of the numerous interesting matters dealt with in the memoir, and the authors have performed a most useful and valuable service in its publication. Students of this difficult period in the history of chemistry will await with keen interest the further memoirs which Principal Stapleton promises. J. R. P.

The Empire Mining and Metallurgical Congress.

THE first Empire Mining and Metallurgical Congress was held in 1924 at Wembley, on the occasion of the British Empire Exhibition, and the second will open at Montreal on Aug. 22. These conferences are for the discussion of scientific, technical, and economic problems connected with the mineral industry, and they have in view the development of the mineral resources within the Empire. They are arranged by an Empire Council consisting of delegates from five constituent institutions domiciled in Great Britain and five domiciled oversea.

The convening body for this second Conference is the Canadian Institute of Mining and Metallurgy. Invitations have been widely accepted from Great Britain, South Africa, Australia, and elsewhere within the Empire, while in addition many members of one or other of the institutions resident in the United States will attend. Probably, therefore, including ladies, there will be some 750 participants.

The venue of the conference in Canada is a particularly happy one, not only because this year is the diamond jubilee of the Dominion's Confederation, but also because the mineral industry in Canada has risen so rapidly to a position of great importance that it may be regarded as being on the threshold of further important developments.

The congress will begin by a session at Montreal on Aug. 22, and it will end by return to the same capital city on Sept. 28. Intermediate sessions will be held at Toronto and Winnipeg in succession, the major portion of the conference then proceeding westward to Vancouver to visit Edmonton on the return, at both of which places there will be further sessions, while the remaining participants will turn eastward from Winnipeg to hold a session at Sydney in Nova Scotia. There will be, accordingly, full opportunity to visit all of Canada's important mineral fields from the Atlantic to the Pacific.

With the greatest sympathy, interest, and assistance from the Dominion and Provincial Governments, as well as from the Canadian mineral industry itself, the presentation of Canada's mineral resources to the visitors will undoubtedly be as complete as the best possible auspices can ensure.

The wider question of the Empire's mineral resources will be the feature of the discussions at the opening session at Montreal, when papers dealing with it will be presented, particularly from the Institution of Mining and Metallurgy, London. So important, indeed, does that Institution consider the question to be that it has forwarded to the Conference the following resolution: "Resolved: That the Council of the Institution of Mining and Metallurgy being of opinion that the questions raised in the Paper submitted to the Institution by Sir Thomas Holland on a 'Proposed Review of the Mineral Resources of the Empire' are of vital importance to the British Empire as a whole, and to the Dominions, Dependencies, and Colonies, as units, think it desirable that they should receive serious consideration and discussion by competent authorities within the Empire."

Apart from this outstanding question, the Conference has been presented with an abundance of valuable papers from the other institutions and from prominent individuals, on the closer problems of the industry, scientific, technical, and economic, wherefrom all participants, whether from the homeland or from overseas, are assured of a lively and sustained interest in the proceedings. That interest, the delightful tour, and not least the friendliness promised both in Canada and on the way there, constitute a sum of entertainment which explains the large number who have seen their way clear to attend.

It is understood that the next of these Conferences will take place in South Africa in 1930.

Mycorrhiza.

DR. M. C. RAYNER concludes her series of papers on mycorrhiza in the May issue of the *New Phytologist*. The final chapter is devoted to a consideration of the significance of these structures, and the nutrition of mycorrhiza plants. The author holds a brief for the view that the relationship between fungus and host plant is a reciprocal one beneficial to both symbionts, and implies an exchange of food material with a credit balance on the side of the vascular plant.

Evidence is adduced from experimental work on the relationship in forest trees, orchids, and heaths. In the case of conifers, the fungi concerned show marked stimulation in contact with the roots, due no doubt to the small quantity of exudates, particularly phosphatids, present. The infected root, on the other hand, seems to absorb inorganic salts as well as, or in raw humus soils, better than, the uninfected roots. It is pointed out that the struggle for existence often centres about competition for suitable compounds of nitrogen, and the mycorrhiza habit enables the plant to draw efficiently on sources of nitrogen in the soil otherwise unavailable for its use.

On the other hand, there is no evidence that any of the known root fungi of trees can assimilate free nitrogen. While conifers can utilise ammonium compounds, more complex organic nitrogenous compounds are more readily utilised by the root fungi, and on acid humus soils, where such compounds constitute the chief source of nitrogen, plants with mycorrhiza are well equipped in competition with other forms. Orchid mycorrhizal fungi differ from those of conifers in retaining the power of autonomous existence. Seedling development is, however, conditional on infection. In the case of chlorophyllous forms, whether or not the mature plant can thrive in the absence of infection is an open question, but with non-chlorophyllous species, complete dependence on fungal symbionts is a condition of existence, as the food material of the plant must come from the humus in the soil.

The structural features of heath mycorrhiza

resemble those of conifers more than of orchids. Calluna grows in humus soil where there is a deficiency of mineral salts, particularly nitrates, and mycorrhiza have been found most profusely developed in soils with abundant humus, more sparsely in dry sandy situations, so it is possible that the beneficial effect upon the host may be directly related to soil conditions. Here again the mycorrhiza probably functions similarly to that of trees, enabling the plant to draw upon organic reserves in the humus.

In its evolutionary aspects the relationship now existing in orchids and heaths is considered to have originated in parasitism on the part of certain soil fungi. For this hypothesis it is necessary to assume that the invading strains were relatively mild in their action, and that the hosts had a relatively high resistance to parasitic attacks. Given this, it is easy to reconstruct the first stages of a symbiotic association.

University and Educational Intelligence.

CAMBRIDGE.—The John Winbolt Prize in engineering has been awarded to C. Hinton, Trinity College, and W. R. D. Manning, Sidney Sussex College, for a joint dissertation on "Transverse Oscillation of Bridges."

SYDNEY.—Prof. R. S. Wallace, professor of English language and literature in the University of Melbourne, has been appointed vice-chancellor of the University of Sydney. He will succeed Sir Mungo MacCallum, who, at the special request of the Senate of the University, has consented to continue to discharge the duties of the office during the present year.

THE following research scholarships at the Huddersfield Technical College are being offered by the Huddersfield Education Committee: A Drapers' Company's, in dyeing, value £100 with remission of fees; a Joseph Blamires, for research in colour chemistry, value £100 with remission of fees; and a British Dyes, for research in colour chemistry, value £75 with remission of fees. Particulars and forms of application are obtainable from the Technical College, Huddersfield.

IN the seventh series of "Methods and Problems of Medical Education," recently issued by the Rockfeller Foundation, the School of Medicine and Dentistry of the University of Rochester, Rochester, N.Y., is described, with full details and plans of the buildings and many illustrations. The building embodies many novel features, and efficiency with economical construction has been the aim throughout. Corridors have been kept at a uniform width of 8 ft., and the distance from floor to floor is 11 ft. 2 in. Throughout all parts of the school the inner surface of the building walls are faced with an inexpensive grey 'sand-lime' brick, which reflects the proper amount of light for general laboratory work. Partition walls are constructed of 'sand-lime' brick of single thickness, strengthened by steel door frames anchored to floor and ceiling. No plaster has been used except in toilet rooms, all walls, columns, and ceilings are untouched by paint, and all pipes are exposed. The cost per cubic foot, including everything except equipment, is 39 cents for the school and 62 cents for the hospital, and equipment costs 4 cents for the school and just over 6 cents for the hospital, per cubic foot.

PROF. H. B. FANTHAM, professor of zoology in the University of the Witwatersrand, has published in the *South African Journal* (vol. 23, p. 595) the address he delivered in 1926 at a joint meeting of Sections D and F of the South African Association for the Advancement of Science on the question of the teaching of animal biology in the Transvaal. In the course of the address he says, on the authority of Dr. Skaife, that in the Cape Province animal biology is now a compulsory subject in all the secondary and high schools, and that in 1925 no less than 2000 candidates took the subject in the junior certificate examination. In this respect the Transvaal apparently lags behind, and Prof. Fantham gives in his address reasons why biology should be taught in all the high schools throughout South Africa, and some practical suggestions as to the materials that might be used to illustrate the principles of the subject. In the Report of the British Association in 1921 a statement, drawn up by the Zoology Organisation Committee, was published on the teaching of natural history in the schools of Great Britain, in which similar reasons were given for the inclusion of the subject in all schools and a practical course was suggested. There has been some improvement since the date of the Edinburgh meeting, but education authorities in Great Britain are still far behind the Cape Province in their appreciation of the value of animal biology as a school subject. Prof. Fantham's suggestions for courses on animal biology indicate the wealth of material there is in South Africa for teaching purposes and is of interest to zoologists, but the school authorities would probably be more impressed by a shorter and more concise proposal for a course of study. It is obvious that no school could ever cover the ground of his list of possible studies, and the head-masters will look to the professional zoologists for something more limited in scope that it would be practical to carry out in the limited time and equipment at their disposal.

RESEARCH in secondary education in the United States is held to be of such importance to the nation that a national committee has been formed for the purpose of promoting and guiding it. The Federal Bureau of Education, which is represented on the committee by its Commissioner, J. J. Tigert, and by E. E. Windes, who acts as secretary to the committee, has recently issued as Bulletin, 1926, No. 24, an outline, sponsored by the committee, of methods of research, intended for the guidance of school principals and teachers who wish to investigate some phase of secondary school work. The bulletin points out that helpful and indispensable as is laboratory research, its experiments are usually performed on selected groups under conditions which often simulate very imperfectly those of actual school life; likewise that much research can be carried out *only* in the classroom. Hence the importance of helping the school principal to develop in himself and his teachers an attitude of scientific research toward the problems that confront them and to acquire the requisite technique for conducting and reporting investigations. Chapters on the conditions essential to scientific research, the qualifications for the research worker, and types of research problems, are followed by a criticism of the questionnaire method of investigation in which wholesome warnings are given as to its many demerits. A useful outline of desirable procedure to be observed in reporting the investigation and its results follows, and there are a descriptive list of established research agencies and a bibliography of fifty recent publications. So many problems connected with secondary education in Great Britain require immediate attention to-day that this bulletin (Government Printing Office, Washington, D.C., 10 cents) should find readers among English secondary school principals.

Calendar of Discovery and Invention.

August 15, 1869.—Imperishably associated with the name of de Lesseps, the construction of the Suez Canal was regarded as one of the greatest works undertaken. First suggested by de Lesseps in 1854, work was commenced in 1858, and on Aug. 15, 1869, the waters of the Mediterranean mingled with those of the Red Sea. When de Lesseps died, *Engineering* referred to the canal as being "far more truly the work of Lesseps than was the railway of Stephenson, the steam engine of Watt, and the spinning machine of Hargreaves."

August 16, 1822.—The discovery of thermo-electricity was first made known by Thomas Seebeck (1770–1831) on Aug. 16, 1822. Seebeck's early experiments were made with copper and antimony and then extended to other pairs of metals.

August 16, 1814.—Brewster, while on a trip to Paris, recorded in his diary on Aug. 16, 1814, a visit to the Institute, where the business included a report by Poisson, a proposal by Legendre, and a long paper on iodine by Gay-Lussac. Of some of the famous men of science present he left interesting notes, describing Legendre as "a very tall and very thin man, with an expressive and intelligent countenance, white powdered hair, tied and curled above the ears"; Poisson as "a young and active little man, with a sweet and expressive countenance"; Delambre as "a little, oldish man, very yellow; a little marked with the small-pox"; Monge as "below the middle size, stoops, has a full face, and white curled hair"; and Lamarck as "a good-looking old man, with a light coat and an embroidered waistcoat, little and rather crooked."

August 17, 1807.—Fulton's famous *Clermont*—the first regular passenger steamboat in the world—made her trial trip on the Hudson on Monday, Aug. 17, 1807. Fulton's own statement ran: "I left New York on Monday at 1 o'clock and arrived at Clermont, the seat of Chancellor Livingston, at 1 o'clock on Tuesday; time 24 hours; distance 110 miles. On Wednesday I departed from the Chancellor's at 9 in the morning and arrived at Albany at 5 in the afternoon; distance 40 miles; time 8 hours; the sum of this is 150 miles in 32 hours—equal nearly 5 miles an hour."

August 18, 1854.—To Charles Bourseul (1829–1912), a French postal employee, we owe one of the first suggestions for a telephone. In an article in *Illustration*, Aug. 18, 1854, he suggested using vibrating plates to establish and interrupt connexion with an electric coil which acted sympathetically on a second vibrating plate.

August 19, 1868.—During the total solar eclipse of Aug. 18, 1868, Janssen, "inspired by the beauty and brilliancy of the variously tinted prominence-lines revealed to him by his spectroscope, exclaimed to those about him, 'Je verrai ces lignes-là en dehors des éclipses.'" On the following morning he carried into execution the plan which formed itself in his mind while the phenomenon which suggested it was still before his eyes, and, says Miss Agnes Clerke, "During the whole of that day [*i.e.* Aug. 19], and many subsequent ones, he enjoyed, as he said, the advantage of a prolonged eclipse."

August 20, 1841.—In the study of physiological chemistry none did more important work than Liebig in Germany and Dumas and Boussingault in France. Liebig's report to the British Association on animal chemistry was made in 1842, while another important contribution was the lecture of Dumas and Boussingault, "Statique Chimique des Êtres Organisés," delivered on Aug. 20, 1841. E. C. S.

Societies and Academies.

LONDON.

Geological Society, June 15.—J. E. Richey: The structural relations of the Mourne granites (Ireland). The Mourne Mountains are some 13 miles long by about 5 miles wide, and include many peaks of more than 2000 feet in height. The granite-massif of inferred Tertiary age is intruded into Silurian shales, and truncates a north-westerly basic dyke-swarm. The massif consists of at least four distinct intrusions, composed of different granite varieties. The Western Granite extends outwards on all sides below a slightly domed roof of shales, cappings of which rest upon the granite. The Eastern Granites are deeply eroded enough to show bounding walls as well as roofs. Floors are nowhere seen. These Eastern Granites are arranged one within the other, with a marked excentricity towards one side. The outermost granite is the oldest, the innermost the youngest. Features observed by Traill are that granite-margins transgress the bedding of the Silurian shales, and that the direction of the dip of the shales is unaffected by the intrusion of the granites. The absence of xenoliths, except at actual margins, and the plane surfaces of contacts, are other noteworthy features. The spaces occupied by the various granites have been provided by subterranean cauldron-subsidence of the pre-existing rocks. The intrusion of the Eastern Granites successively one within the other may be then explained by assuming renewed subsidence of the first-subsided block.—W. F. Whittard: The stratigraphy of the Valentian rocks of Shropshire: the main outcrop. It is the first of these that is described in this paper. The threefold classification of Salter and Aveline has been adopted, but their nomenclature has been modified: the rocks are subdivided as follows: (3) Purple shales; (2) Pentamerus beds; (1) Arenaceous beds. The Arenaceous beds extend from near Cardington north-eastwards to the Wrekin, and consist essentially of conglomerates, grits, and sandstones. Evidence is given for a southerly derivation of the pebbles comprising these beds, and a north-easterly longshore drift is postulated. The Purple shales consist almost entirely of purple, maroon, or green mudstones or shales; shelly limestones and calcareous sandstones occur irrespective of horizon. The Valentian rocks are displaced by a series of dip-faults, but no folding, other than that caused by slip, has been detected. The Valentian rocks of the main outcrop seem to have been deposited in partly isolated or protected waters. The few graptolites so far obtained show that only Upper Valentian rocks are exposed.

CAMBRIDGE.

Philosophical Society, July 25.—C. E. Wynn-Williams: A valve amplifier for ionisation currents. A method of using a valve for amplifying ionisation currents 100,000 times is described, which avoids the instabilities usually associated with such apparatus. Used in conjunction with a galvanometer of sensitivity 200 mm. per microampere, the system behaves in a similar manner to a low capacity quadrant electrometer of sensitivity 6350 mm. per volt, shunted by a leak of 360 megohms, the valve of the latter being slightly greater for negative currents than for positive.—C. F. Sharman: A differential retarding potential method for the study of the energy distribution of slow electronic emissions. A discussion, given in a previous paper (*Proc. Camb. Phil. Soc.*, Pt. 5, vol. 23, p. 523), of the respective merits of the magnetic spectrum and of the ordinary retarding potential

method for the investigation of electron energy distributions is here elaborated, and the difficulties peculiar to the low energy region (from zero to 20 volts) are pointed out. Results of the application of the method to the secondary electrons excited in a copper surface by primary electron beams of energies from 200 volts to 800 volts are described.—W. L. Webster: The Hall effect in single crystals of iron. Experiments were made to determine whether the Hall effect varied with the direction in the crystal for which it was measured. The Hall potential was measured in four thin plates cut from single crystals, with quite different orientations. For all of them, the Hall coefficient was the same within the limit of experimental error, having a value $+0{\cdot}97 \times 10^{-2}$.—L. H. Thomas: The production of characteristic X-rays by electronic impact. Two corrections are made to Rosseland's formula for the variation of the intensity of characteristic X-rays with the energy of the exciting electrons. The velocity in its orbit of the electron knocked out of the atom and the increased velocity of the impinging electron are taken into account. The formulæ are compared with Wooten's experimental results for the K_α line of molybdenum.—F. P. White: Simplexes and other configurations upon a rational normal curve.—R. W. Ditchburn: Notes on spectro-photometry.

PARIS.

Academy of Sciences, July 4.—Hadamard: The shuffling of cards.—H. Deslandres: The law of distribution of magnetic storms and of their elements. Consequences regarding the constitution of the sun.—J. Costantin: An attempt at a theory of the altitude cure (plants).—Paul Sabatier: The inversion of the rôle of catalysts.—Riquier: The integration of the partial differential equation of the second order linear in r, s, t, in the case where the coefficients of the three differentials depend only on the variables x, y.—Jules Andrade: The maximum of isochronism realisable to-day by elastic regulating organs.—J. Lebel: Analytical functions and the deformation of the paraboloid of revolution.—Octav Onicescu: The representation of a function on an ensemble of saturation of dimension zero.—A. Véronnet: The impossibility of a Poinsot movement for an isolated heterogeneous fluid mass.—André Planiol: The production of shocks in the heads of connecting rods.—P. Fatou: Periodic orbits.—Jean Mascart: Observation of the partial eclipse of the sun of June 29, 1927, at the Lyons Observatory.—V. Nechvile: The frequency of the apparent movements of stars.—Fernand Baldet: The nucleus of the Pons-Winnecke comet (1927c).—D. J. Struik and Norbert Wiener: The relativist theory of quanta.—Nageotte: The elementary plates of myeline in the presence of water.—J. Cayrel: The contact metal—cuprous sulphide.—Thadée Peczalski: Theory of the sub-electrons.—Max Morand: The distribution of the electric field in the dark space.—C. Bouhet: The application of the general method of Chaumont to the measurement of the elliptical polarisation produced by reflection at the surface of liquids.—Tsukamoto: The transparency of fused silica for ultra-violet radiations. The absorption of ultra-violet rays of short wave-length by fused silica appears to be variable from one specimen to another, a difference probably due to impurities. But even with the purest material used, prepared by fusing clear quartz, the absorption is still stronger than with crystallised quartz.—Bovis: The absorption spectrum of bromine in solution. The band $0{\cdot}414\mu$ appears in the absorption spectrum of bromine in all states, gas, liquid, and in solution, but the ultra-violet band $0{\cdot}260\mu$ is only given by bromine in solution.—H. Volkringer: The continuous spectrum and band-spectrum of mercury.—Jean Thibaud: The spectrographic connexion of the domain of the X-rays with the ultra-violet by the aid of ruled gratings.—Mario A. da Silva: The deformation of the ionisation curve in pure argon by the addition of oxygen. The experimental relations found between voltage and saturation current of pure argon and admixtures with oxygen are given graphically.—A. Tian: Equilibrium in a gaseous phase between acid and base: the volatility product.—Amand Valeur and Paul Galliot: The oxidation of cacodyl oxide. The gradual oxidation of cacodyl oxide by means of oxygen gas gives cacodylic acid as the main product together with trimethylarsine, monomethylarsine oxide, and arsenious acid.—Mlle Shioldvor Grundt: The estimation of lead as cyanide. Herz and Neukirch have proposed to estimate lead as the cyanide by precipitation with potassium cyanide. A repetition of these experiments showed that lead cyanide is not formed under these conditions: the precipitate weighed is a lead basic carbonate, which happens to contain the same percentage of lead as $Pb(CN)_2$.—F. Blondel: The red earths and the phenomena of alteration of rocks in French Indo-China.—A. Loubière: The coal flora of the Albi basin. The plants found are intermediate between the Stéphanian and the Westphalian, and represent a level not hitherto recognised in France.—Mlle H. Popovici: Some remarks on the elaioplasts of the Hepatics.—J. Chaze: The appearance and localisation of nicotine in the young tobacco plant. No trace of nicotine can be found in the seed, but the alkaloid appears in the first stages of germination. In seedlings 3 mm. long, nicotine is visible a little above the growing point of the root, in the absorbent hairs. It exists also, but in smaller quantity, in the cotyledons.—D. Chouchak: The antagonism between cultivated plants and the bacteria of the soil in their mineral nutrition.—Georges Truffaut and N. Bezssonoff: The measurement of the assimilability of various phosphates by their action on the bacterial fixation of nitrogen. Fluorides do not interfere with the biological fixation of nitrogen, and may even exercise a favourable action. The non-assimilability of the natural phosphates is due to their insolubility and not to a toxic action of calcium fluoride.—Daniel Auger: The electrical reaction of plant cells to polarisation.—J. Dadlez: Research on the production of ozone in the air by ultra-violet rays.—C. Levaditi and J. Longinesco: The relations between the spirillicidal and trypanocidal activity of the elements and their electrochemical classification.

ROME.

Royal National Academy of the Lincei, May 1.—E. Cartan: The geodetic deviation and certain allied notions.—P. Burgatti: The causes of the luminosity of falling stars. This phenomenon appears to be mainly of electrical, and not of thermal, character.—Giorgio Abetti: Activity and height of the solar chromosphere in 1926.—R. Nasini and C. Porlezza: Determination of the concentration of active hydrogen ions in Italian mineral waters. The colorimetric method offers advantages in the determination of the hydrogen ion concentration of mineral waters and yields constant results. The pH value appears to be of little value in investigating the solutions representing the various stages of the extraction of boric acid at Lardarello.—S. Franchi: Emile Argand's covered fault of Monte Rosa and the permo-triassic anticline Acceglio-Col Longet in the Southern Cottian Alps.—F. Zambonini and V. Caglioti: Double sulphates of rare earth and alkali metals (ix.). Sulphates of neodymium and rubidium. Study of a

portion of the system $Nd_2(SO_4)_3 - Rb_2SO_4 - H_2O$ over the 25° isotherm indicates the existence of the compound $Nd_2(SO_4)_3$, Rb_2SO_4, $8H_2O$, which is perfectly isomorphous with the analogous double salts already examined and, like these, exhibits typical faces replaced by vicinal faces. The crystallographic constants are $a : b : c = 0{\cdot}3015 : 1 : 0{\cdot}921$, $\beta = 96°\ 40'$.—L. Cambi and L. Szegö: Spectrographic study of complex iron cyanides (i.). The absorption spectra of the ferripentacyanides and of certain ferropentacyanides reveal marked divergences in the manifestations of the affinity in complex ions, notwithstanding the formal analogies based on the co-ordination theory.—S. Baglioni: Investigations on human physiology at the Central Military School of Physical Education.—G. Ascoli: Dirichlet's problem in spherical and hyperspherical fields.—E. Pini: Investigation of the primitive functions by functions of several variables.—J. Dubourdieu: Cartesian co-ordinates along a curve.—C. Poli: The principles of analytical mechanics.—F. Sbrana: The spherical vortical motion of an incompressible fluid.—B. Finzi: Energetic interpretation of a noteworthy exception to Kutta-Joukowski's theorem.—G. Armellini-Conti: Comparison of the colorimetric catalogues of Hagen, Sestini, Osthoff, and Kruger.—F. Eredia: Variation of the wind velocity from the ground to a height of 4000 metres, according to soundings carried out at Vigna di Valle (Rome).—N. Carrara: A new type of X-ray reflection.—A. Carrelli: Paramagnetic double refraction.—L. Mazza: The products formed during the working of lead accumulators. In conjunction with the results already obtained, those now furnished by investigation of the negative plates of lead accumulators confirm Gladstone and Tribe's double sulphation theory, and show that the other chemical theories are totally or partially invalid. The active substance constituting the charged positive electrode is composed of lead dioxide identical in crystalline structure with that obtained by chemical means, the almost black colour resulting from prolonged overcharging depending solely on the increased dimensions of the crystalline particles. The spongy lead forming the charged negative electrode has the crystalline structure of massive lead and is not an allotropic modification. Discharge of the accumulator leads to the formation, on both electrodes, of a product identifiable by its crystalline structure with lead sulphate, but probably of colloidal dimensions; this is mixed with considerable proportions of lead dioxide and lead respectively.—U. D'Ancona: Influence of the concentration on the loss in weight of young eels fasting in sodium chloride solutions.—V. Peglion and M. Sacchetti: The Peronospora of lilac (*Phytophthora Syringæ*, Klebahn).—R. Savelli: How a semi-mutant is resolved.—S. Campanile: Investigations on the seasonal variations of inorganic nitrogen compounds existing in the Lake of Castelgandolfo. Owing to the development of a rich plankton vegetation the proportion of nitrates in this lake during the warm weather is less near the shores than in the central parts. The fall of meteoric water also has a bearing on this phenomenon, which is contrary to what is usually observed.—D. Cattaneo: Ultramicroscopic investigations on the crystalline lens (ii.). Modifications of the ultramicroscopic structure by the action of salts, alkalis, and acids.

GENEVA.

Physics and Natural History Society of Geneva, June 2.—W. H. Schopfer: Researches on the sexuality of the heterothallic Mucorineæ. Studying the heterothallic species *Mucor hiemalis*, the sexual physiological dimorphism of this species is confirmed. The toxic effect of copper sulphate is different on the two sexes.—A. Borloz: A critical study of the methods of analysis of antipyrin and pyramidon. After an examination of the known methods, the author recommends for the analysis of a mixture of these two substances the method of Pégurier-Lemaire, but avoiding the neutralisation by hydrochloric acid and methyl orange before the precipitation with picric acid.—E. Briner and Ch. Boissonnas: The energy yield of the formation of ozone by the silent discharge. In laboratory researches, the power absorbed in the ozoniser has been too often confused with the product of the voltage by the current. The true yields are up to ten times greater than those hitherto calculated, and their relations with the pressure are different.—L. A. Deshusses: A correction of the Avery-Beans method (the estimation of arsenic in Schweinfurth green). The comparison of the results of this method with those of the gravimetric method or by distillation of arsenic trichloride in the presence of methyl alcohol has proved that the Avery-Beans method has a systematic plus error.—P. Wenger and M. Gysin: The estimation of carbon dioxide in limestones. The limestone is attacked by a boiling solution of sulphuric acid (approximately 5 per cent.) and the carbon dioxide is fixed by caustic potash. Unlike hydrochloric acid, the sulphuric acid is not carried over into the potash tube because its vapour pressure is too small.

SYDNEY.

Royal Society of New South Wales, May 4.—W. G. Woolnough (Presidential address). The general chemical principles involved in the weathering of rocks during the last stages of highly perfect peneplanation are discussed, and it is shown that, if the rainfall of the region is markedly seasonal in distribution, the conditions favour the production of: (1) A very deep zone of completely leached rock, consisting essentially of kaolin and silica, (2) a sub-surface deposit typically concretionary in structure of amorphous silica, alumina, and iron oxide. All the alkalis and alkaline earths are completely removed in solution. An attempt is made to prove that the very widespread 'lateritic' and siliceous crusts so ubiquitous over western and northern Australia, are parts of a single chemically-formed deposit, produced under the conditions postulated in the first part. Such crusts have been referred to a number of different geological formations, and endless confusion has resulted. It is believed that 'Desert Sandstone,' 'Laterite,' 'Upland Miocene,' and other formations in different States may be brought into harmony with one another. For the formation thus produced the name of 'Duricrust' is suggested. Reasons are adduced for assigning the Miocene age to the structure. The 'Duricrust' is of economic importance as it yields precious opal, fireclays, road metals, water supplies in arid regions, and possibly bauxites of economic value. Its surface is mostly extremely barren, and its destruction has given rise to the great stony plains (gibber plains) so widely developed in the interior of the continent. Remnants of it give rise to the 'tent hills' and 'table hills' so characteristic of Central Australia.

VIENNA.

Academy of Sciences, June 17.—D. R. R. Burt: The ability of various regions in the body of *Pelmatohydra oligactis* to form head or foot; determination of the totipotent region. Tissue rings were transplanted from one part of the hydra and grafted on to the head or foot region of another specimen.—W. M. Diener: New observations on the geological distribu-

tion of fossil calcareous algæ.—A. Hintringer: The separation of seeds from the placenta and from the pericarp respectively.—E. Biel: Climatography of the former Austrian littoral.—A. Kailan and E. Goitein: Hydrochloride formation in glycerine and glycol and the esterification of the mon-oxy- and of the 2, 5- and 2, 6-di-oxy-benzoic acid as well as of phenyl-acetic acid.—R. Schumann: On vectorial adjustment of closed geodetic figures in the plane in the case of arbitrary weights for distances and directions.—A. Pongratz: Researches on perylene and its derivatives.—A. Zinke, G. Gorbach, and O. Schimka: Researches on perylene and its derivatives.—O. Dischendorfer: On *o*-nitro-benzal-di-β-naphthol.—A. Birula: Scorpions of the Anglo-Egyptian Sudan.

June 30.—E. Chwalla: The stability of girder struts.—F. Feigl and M. Fürth: The compounds of nickel with *o*-phenylene-diamine and 1, 3, 4-toluylene-diamine.—L. Schmid and E. Ludwig: Two stearine-like substances in *Asclepias syriaca* identical with α- and β-amyrin.—K. Przibram: Further experiments on the coloration of compressed salts. Many salts sold as chemically pure give pressure colours.—A. Kieslinger: Glacial lakes in Eastern Carinthia. The characteristics of such lakes are level terraces mostly of lake sand.—A. Kieslinger: Preliminary report on tectonics of middle Carinthia.—L. Kober: Geology of the Northern Apennines and the adjacent Alps.—A. Winkler: The tertiary basin of south-west Styria in the older Miocene.—O. Richter: Sodium, a necessary nutritive element for a marine micro-aerophil luminous bacterium.

Official Publications Received.

BRITISH.

Aeronautical Research Committee: Reports and Memoranda. No. 1053 (E. 22): Torsional Vibration in Engines. Effects of fitting a Damper, a Flywheel, or a Crankshaft-driven Supercharger. By B. C. Carter. (B. 4. Engines 57 and a, b and c.—T. 2227 and a, b and c.) Pp. 37+19 plates. 1*s.* 9*d.* net. No. 1082 (Ae. 261): The Pressures round a Cylinder rotating in an Air Current. By Dr. A. Thom. (A.3.t. Autogyros, Helicopters and Rotors, 1.—T. 2347.) Pp. 12+8 plates. 9*d.* net. (London: H.M. Stationery Office.)

City and Guilds of London Institute. Report of the Council to the Members of the Institute, 1927. Pp. lvi+85. (London: Gresham College.)

FOREIGN.

Shinsae Yobô Tyôsakwai Hôkoku. (Reports of the Imperial Earthquake Investigation Committee.) No. 100, C1. Pp. 210+253 plates. No. 100, C2. Pp 211-401+215 plates. No. 100, D. Pp. 8+303+260 plates. (Tokyo: Department of Education.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 20, Part 1: Uber die Entstehung des Corpus luteum beim Kaninchen. Von Shiro Kurashige. Pp. 47+4 Tafeln. (Sapporo.)

CATALOGUES.

A Catalogue of Rare and Valuable Books (mostly Antiquarian), Pamphlets, Excerpts, Periodicals and Plates on all branches of Natural History, with a large proportion of works on Ornithology. (No. 1, New Series.) Pp. 24. (Eastbourne: The Naturalist's Library (A. J. Bateman).)

Catalogue of Atlases, Maps, Sea Charts, Road Books, Military Plans, Facsimiles of Early Maps, and Books of Geographical Interest. (No. 498.) Pp. 61+6 plates. (London: Francis Edwards.)

Diary of Societies.

SATURDAY, AUGUST 20.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.—Annual Meeting.

CONGRESSES.

AUGUST 22–26.

PATHOLOGICAL AND BACTERIOLOGICAL LABORATORY ASSISTANTS' ASSOCIATION (in University Pathology Department, Cambridge).

August 22.—At 10.30 A.M.—W. A. Mitchell: Cambridge (Lecture).

August 23.—At 9.30 A.M.—A. E. P. Grimmo: The Manufacture of Small-pox Vaccine as carried out in the Laboratories of the Shanghai Municipal Council.

J. J. Ritchie: Antagonism and Symbiosis of Bacteria.

Prof. G. H. F. Nuttall: The Development of Parasitology.

August 24.—At 9.30 A.M.—S. J. Denyer: Virulence Tests in the Identification of B. Diphtheræ.

A. Saunders: Diversions of an Overseas Laboratory Assistant.

J. McLean: Rare Fæcal Organisms which simulate Pathogens.

August 25.—At 9.30 A.M.—F. Leeson: The Preparation of Plague Vaccine.

S. Linfoot: Laboratory Work in a Spa Hospital.

E. Steele, J. McLean, and others: Discussion on Laboratory Economics.

E. C. Haddon: The Biuret Reaction.

S. J. Denyer: Difficulties encountered in the Differentiation of Paratyphosus A, B, and C.

H. Gooding: On Mounting Frail Museum Specimens on Wax Plates.

V. C. Norfield: Tissue Cultivation Technique.

August 26.—At 9.30 A.M.—Demonstrations of Exhibits.

EMPIRE MINING AND METALLURGICAL CONGRESS.

Montreal Meetings, August 22 *and* 23.—Sir Thomas Holland: Proposed Review of the Mineral Resources of the Empire.—G. M. Carrie and C. S. Pascoe: Magnesia Refractories for Steel Furnaces.—A. Stansfield: Smelting Titaniferous Iron Ores.—W. A. Toohey: Portland Cement in Canada.—Mining and Metallurgical Practice in Australia.—Health Safety Problems.

Toronto Meetings, August 25 *and* 26.—C. Johnson: Winning and Refining of Precious Metals from Sudbury Ores.—R. C. Stanley: Nickel, Past and Present.—A. A. Cole: The Silver Mining Industry of Canada.—J. G. Morrow: The Cascade Method of Pouring Steel.—A. Mavrogordato and H. Pirow: Deep Level Mining and High Temperatures.

Winnipeg Meeting, September 3.—G. E. Cole: The Development of Gold Mining in Canada.—W. A. Quince: Methods of Eliminating Barren Rock from Ore at the Sub-Nigel Mine.—C. R. Davis, J. L. Willey, and S. E. T. Ewing: Notes on the Operation of the Reduction Plant at West Springs, Ltd.—E. J. Laschinger: A New Form of Air Meter and the Measurement of Compressed Air.

Vancouver Meeting, September 14.—C. P. Browning: Canadian Copper and its Production.—F. J. Alcock and T. W. Bingay: Lead and Zinc in Canada.—C. J. N. Jourdan: A Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa.—R. Craib: Dewatering the Lower Levels of the Simmer and Jack Mines, Ltd.—W. S. Robinson: Manufacture of Sulphuric Acid by the Contact Process. From Zinc Blende Roaster Gases.

Edmonton Meeting, September 20.—R. Strachan, W. J. Dick, and R. J. Lee: The Coal Industry in Western Canada.—J. Ness: Petroleum in Canada.—A. Docquier, L. Bataille, and R. Beetlestone: A Combination of the Baum, the Draper, and the Froth Flotation Systems as applied to the Washing of Coal at the Linsi Mine of the Kailan Mining Administration, North China.—A. E. Cameron: Impact Resistance of Steel at Low Temperatures.

Quebec Meetings, September 5 *and* 26.—J. G. Ross: Asbestos Mining and Milling.—A. W. Nash: Possible Auxiliary Sources of Liquid Fuel.—A. Job: The Sinking and Equipment of the Ventilation Shaft of the Government Gold-Mining Areas.—G. W. Sharp: The Tipping and Guiding of Vertical Skips.—P. M. Newhall and L. Pryce: Improvements in Drilling Efficiency with Jack-Hammers.

Sydney Meetings, September 9 *and* 10.—F. W. Gray: Mining Coal Under the Sea in Nova Scotia.—Sir Robert Hadfield: The Metal Manganese and its Properties: also, the Production of Ferro-Manganese and its History.—Raw Materials for the Iron and Steel Industry in India.—B. Yaneske: The Manufacture of Steel in India, by the Duplex Process.

AUGUST 27–SEPTEMBER 1.

INTERNATIONAL CONGRESS OF ORIENTALISTS (at Oxford). In following sections: General (including Anthropology, Ethnography, Prehistoric Archæology, Comparative Mythology, and Folklore), Assyriology and cognate subjects, Egypt and Africa, Central and Northern Asia, the Far East, India and Iran, including the Indo-European Languages of Asia, the Old Testament, the Language, Literature, etc., of Islam, and Oriental Art.

AUGUST 29–SEPTEMBER 3.

INTERNATIONAL COMMISSION FOR THE EXPLORATION OF THE UPPER AIR (at Leipzig).

SEPTEMBER 1–4.

SCHWEIZERISCHE NATURFORSCHENDE GESELLSCHAFT (at Basel) (in 14 Sections).—Presidential Address by Dr. F. Sarasin.—Lectures on, respectively, The Causes and Factors of Morphogenesis, by Prof. A. Brachet; Recent Work and Views in Astronomy, by Prof. L. Courvoisier; The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. L. Duparc; Paracelsus in Relation to Modern Thought, by Prof. H. E. Sigerist.

SEPTEMBER 3–10.

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS (at Prague).

SEPTEMBER 4–9.

INTERNATIONAL CONGRESS OF ZOOLOGY (at Budapest).

SEPTEMBER 11–17.

INTERNATIONAL CONGRESS OF PHYSICS IN COMMEMORATION OF THE CENTENARY OF VOLTA (at Como).

SEPTEMBER 11–18.

INTERNATIONAL CONGRESS OF GENETICS (at Berlin). In three sections: General Genetics and Cytology, Heredity in Man and Eugenics, Animal and Plant Breeding.

SEPTEMBER 18–OCTOBER 3.

INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED LIMNOLOGY (at Rome).