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A State Scientific Service.

WE are justly proud in Great Britain of the esteem in which our Civil Service is held throughout the world; and although opinion may differ on the sagacity of the various political chiefs who temporarily influence it or are influenced by it, the reputation of its permanent chiefs is unquestioned. To them are attributed sagacity, foresight, breadth of outlook, incorruptibility, and those other qualities associated with high intellectual ability and respect for the Civil Service ideals and traditions. Their responsibility is enormous. The machine of government which they control is almost bewilderingly complex. Upon their knowledge of its parts and appreciation of its respective functions, their receptivity of new ideas, their capacity to develop the machine to cope with its ever-increasing tasks, upon their judgment of its personnel, the smooth working of the Service depends.

Probably no civil servants are more appreciative of the nature of the responsibilities of the permanent administrative heads of the Civil Service than scientific workers. They realise that they themselves comprise a comparatively new element in the government machine, that the machine as originally designed and constructed took little account of their introduction as an integral working part. They realise that in many cases their introduction has been in the nature of an experiment in State-craft. Their immediate preoccupation has been to justify the experiment. Those creative energies identified with scientific training and outlook have found new scope in the service of the State, and have given the State more intimate contact with the activities of the peoples whose destiny it controls. Until comparatively recent years, moreover, State scientific workers were left comparatively free from what may be called 'lay' administrative interference. Consequently, as a class, they exhibited little of that impatience with their material and other conditions of service which is usually associated with State servants. Unfortunately, the heads of the Treasury appear to have interpreted their patience as a proof of their contentment with their position in the service.

When the Civil Service National Whitley Council was constituted its first task was to consider the reorganisation of the Civil Service and the adjustment of pay and other conditions of service of civil servants to standards approximating to those of persons with equivalent qualifications and responsibilities outside. The position of the clerical and executive officers of the service was greatly improved as the result of the recommendations contained in the report of the Whitley Council, and that of administrative officers, although not specifically dealt with in the report, was improved also. But for some reason the Council did not consider at the same time the claims of scientific and technical grades for improved conditions.

It was some time before the representatives of the Institution of Professional Civil Servants on the National Whitley Council managed to obtain any consideration for these grades. It was urged by the Official Side that the Heath Committee had really done all that was necessary to adjust the emoluments and status of the scientific grades to those of others. Eventually, in 1922, a sub-committee of the National Whitley Council was set up to deal with certain groups of scientific officers. But scientific workers in what was regarded as 'research' establishments, according to the terms of reference, were not included in the inquiry. This was unfortunate, as it prevented scientific workers in the Civil Service being considered as a unit. It created the impression that an attempt was being made to differentiate arbitrarily between the scientific officers in different departments, to define arbitrarily the functions of the personnel. This impression was re-inforced by the findings of the sub-committee and the scales of salary it recommended. What was even worse, the official members of this sub-committee refused to regard the duties of the scientific groups which they had under consideration as comparable in any way with the administrative group in the Civil Service.

In the year 1923, in response to a clamour in the Press, another committee was set up to report on the pay of State servants. This committee, which was presided over by Sir Alan Anderson, found abundant reasons in every case for leaving things alone. It did not consider the pay of administrative officers excessive. On the other hand, it saw no reason why it should be equated to that of men holding high administrative posts outside the Service. It saw no reason why the salaries of the scientific personnel should be increased, because the scales of pay attracted candidates of sufficient quality. But what offended scientific officers more than anything else was its reply to the suggestion "that the efficiency of those departments which control a large number of technical officers is lowered and prospects of promotion impaired by the practice of appointing a non-professional head ". On this the Anderson Committee expressed the opinion that "the head of a department should be so detached from technical bias that he can weigh the advice of his various officers and judge correctly between competing claims, each of which may, to its technical advocate, seem to be paramount ". It went further and said: "There is a danger that if a man is appointed head of a Department because of his technical qualifications, he may not be able to free himself from his technical outlook and that the Service may not gain, but suffer, by his special knowledge in one direction ".

This pronouncement was regarded, rightly or wrongly, as an expression of the opinion of the administrative heads of the Civil Service. It gave offence because it apparently assumed that scientific officers as a class, by reason of their training, special knowledge and experience, were less likely to produce men not only capable of assuming administrative control over Departments with the work of which they were thoroughly familiar, but also able to relate the activities of such a Department with those of other Departments of State—in other words, scientific officers as a class were men whose judgment was warped by their special knowledge. The hope then, which had been cherished by a large number of scientific officers, that the day was approaching when the administrative heads of the State machine would realise the need for the creation of a Ministry of Science, the administration of which would be entrusted to fully qualified scientific workers, the director of which would have immediate access to the political head of the Department, appeared to be frustrated.

Since the publication of the Anderson Committee Report in 1923, the two bodies which can be said to be almost fully representative of the scientific personnel in the Civil Service, namely, the Institution of Professional Civil Servants and the Association of Scientific Workers, have given further consideration in concert to this far-reaching question of the relationship of the scientific worker to the State machine. After deliberation they decided to press again the Civil Service National Whitley Council to set up a committee of inquiry to embrace the whole of the scientific personnel of the State. The Official Side of the National Council yielded sufficiently to their pressure to agree to the appointment of a Treasury Committee of Inquiry into the organisation and staffing of research and experimental establishments under the chairmanship of Sir Harold Carpenter. As announced in NATURE of Aug. 3, the Institution of Professional Civil Servants gave evidence before this Committee.

The preliminary statement of evidence submitted to the Committee of Inquiry by the Institution is worthy of careful study by all classes of scientific workers whether in State or other employ. Its representatives state :

"There is a considerable body of scientific opinion within the Institution which considers that the only finally satisfactory resolution of the defects arising from the sporadic growth of the State scientific services must be attained by the co-ordination of all branches of scientific research and experiment into a unified State Scientific Service. The conception of a Ministry of Science is a very old one, suspect through the excesses of romancers, and inviting the facile labels 'visionary' and 'utopian'! While the details of the scheme are still under discussion, the outline is sufficiently definite for it to be urged that the proposal, visionary or not, is immediately 'practical politics'. That there are difficulties of definition, delimitation, organisation, and liaison to be faced is fully recognised, but the gains in effective and economical working which would result are such as to justify the most drastic reorganisation."

The deputation further asked that recruitment of the scientific personnel for the Civil Service should be placed on a more systematic and satisfactory basis. The system under which candidates for the diplomatic service are chosen is one which in broad outline commends itself apparently to the Institution. Certain modifications in the system will obviously suggest themselves. It would be unnecessary, for example, to submit men who have already taken a good honours degree at one of the recognised universities to a further examination. They could be selected as probationers for the Service on the results of their degree examination and their general record. Once they were appointed as probationers, they could be given a further study period to prove their capacity for research or technical development, and afterwards drafted to scientific departments, the requirements of which presumably could be made known well in advance. The creation of a *corps d'élite* for science would be the natural corollary.

There is much else that is interesting in the statement submitted by the Institution, but these are its revolutionary proposals. It can be said that they are such as to merit the closest attention of the scientific world. If adopted by the State, they would probably go far to remove the growing antagonism between the majority of State scientific workers and the administration. If a Ministry of Science were created the State would be enabled to offer an honourable career to men trained in science and attract the very best brains to its service. The findings of the Carpenter Committee will be awaited with the greatest interest.

Economic Entomology.

(1) *The Problems of Applied Entomology.* By Prof. Robert A. Wardle. Pp. xii + 587 + 4 plates. (Publications of the University of Manchester, No. 191 : Biological Series No. 5.) (Manchester : Manchester University Press ; London : Longmans, Green and Co., Ltd., 1929.) 30*s*. net.

(2) *The Principles of Applied Zoology.* By Prof. Robert A. Wardle. Pp. xii + 427. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1929.) 21*s*. net.

(3) *Destructive and Useful Insects : their Habits and Control.* By Prof. C. L. Metcalf and W. P. Flint. (McGraw-Hill Publications in the Zoölogical Sciences.) Pp. xii + 918. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1928.) 37*s*. 6*d*. net.

PERHAPS in no branch of science have greater developments occurred in the last half-century than in the realm of economic entomology. Since the pioneer days of Miss E. Ormerod and her co-workers, there has been a prominent change of attitude towards the subject on the part of economic entomologists, which has resulted in a corresponding change of attitude of academic entomologists towards workers in the applied field. Though the work of the entomologist will always be primarily that of observing the living animal in all its activities, more and more is he finding it necessary to attack his problems by the use of methods employed by his colleagues of cognate sciences. The greatest qualitative development of the subject has resulted from this invasion of chemistry, physics, and botany. Thus the chemist and physicist investigate in detail the effect of insecticide on plant and animal, and the botanical aspect is expressed in a determination of the effect of the insect on plant physiology. The most recent development lies in the hands of the mathematician, embodying for the most part attempts to measure the intensity of insect infection before and after treatment. It is because of this active co-operation that the economic entomologist is no longer regarded as a dabbler in science, but one who awaits and welcomes active collaboration with chemists, physicists, and botanists. Such collaboration does exist, and is resulting in the establishment of a sound scientific foundation.

Treatises on economic entomology are written with different ends in view—to serve the student, lecturer, adviser, or agriculturist. In the books under review we have happily two widely different presentations. Prof. Wardle in general deals with principles, and therefore caters for the academically minded. Messrs. Metcalf and Flint are here to help the man in the field, whether he be farmer or entomologist; giving at the same time assistance to the student during his course of instruction.

(1) Prof. Wardle is well known as the senior author of that excellent book, "The Principles of Insect Control", by Wardle and Buckle (1923). One outstanding fact emerges from reading his new book, namely, that empiricism, almost inseparably bound to all applied branches of science, is quickly being replaced by science in the proper sense of the word. That entomologists are alive to the need for co-operation with chemists, physicists, and botanists is shown by the first chapters in the book, dealing with such problems as host and climatic resistance, tropic behaviour, and insecticides. Instead of merely accumulating facts on what insects do, more and more is the war being carried into the enemies' camp by finding the reason for their actions.

The influences of climate on distribution in space and of weather on distribution in time are well reviewed, while in the summary of work on tropic behaviour, the importance of further researches into insect tropisms in all stages of the life cycle is rightly pointed out. Biological, chemical, and cultural control are subjects which bring the first part of the book to a conclusion. This first part of 247 pages is supplementary to "The Principles of Insect Control", and therefore only deals with literature which has appeared since 1922.

The second part is of great value, bringing together for the first time the problems which confront entomologists in all parts of the world. For this purpose two areas are recognised, that of ancient and that of modern agricultural practice. The areas of ancient practice—those following the small plot system—it is suggested, are free from major pests except where the plantation system of cultivation has been introduced. Modern agricultural methods mass insects' food media together, tend to remove competition from certain insect types, and enable them to increase in numbers and so acquire the status of pests. Geographical barriers to distribution are removed by the agency of man under civilisation, and the spread of insects from endemic areas is thereby facilitated. These are the fundamental factors underlying the outbreaks of the most serious insect pests. The main problems of the several areas are then dealt with from both the agricultural and medico-veterinary points of view, reference being freely made to the third part of the book, which consists of a copious bibliography of about forty pages.

One would like to see each chapter of this excellent book enlarged to book form. It is a book which ought to be in the possession of every entomologist. In both of Prof. Wardle's books under review the author shows that he has an extraordinary grasp of the research front of the field of economic entomology.

(2) In the second book from Prof. Wardle's pen a glance at the parts into which it is divided leads one to assume that the author has attempted an impossible task. To condense into four hundred pages medico-veterinary, agricultural, and horticultural aspects of zoology, and a part dealing with animal industries, is a big order. One soon finds, however, that the author is master of the art of abstracting the part that matters from lengthy papers without sacrificing interest. There is a lucid account of the main protozoa associated with man and domesticated animals. Perhaps it is here, and here alone, that the information appears in tabloid form. Elsewhere, as for example in the chapters dealing with helminthes and arthropods, the interest of the reader is well sustained. Life histories are readably summarised, and in the case of helminthes, methods of diagnosis with descriptions of the main types of eggs are given. The entomological bias of the author appears in his excellent treatment of the chapters on arthropods. Relation to disease, categories of insect pests, the conditions which govern the length of life cycle, behaviour, and mortality of insects are treated in a refreshingly broad manner.

For the rest, the student who wants to know something of breeds of cattle, and animal industries from bee-keeping to whaling, will find it in this book. A book of such scope and so well-written will be read with equal profit by students of zoology and agriculture alike. To the diploma student of agricultural zoology it supplies a much-felt want.

A copious bibliography of twenty-seven pages is appended, to which the author might have referred more specifically.

(3) The authors of "Destructive and Useful Insects", one an experienced teacher, the other a practical entomologist, present us with a well-balanced book. It is essentially a book for the practical man, a guide for the farmer, gardener, and adviser. Theoretical considerations are reduced to a minimum, and practicability is expressed in brief life histories and advice on the method of control applicable to each case. The elements of insect morphology, physiology, development and

systematics occupy the first part of the book. Here the morphologist will disagree with the statements that eyes are specialised appendages of a head segment and that the labrum belongs to the third head segment, but the purpose for which the book was written greatly minimises the gravity of these errors. Insects' mouth parts are clearly and simply explained, and the use which is made of the success of insects in the struggle for existence, as a peg on which to hang the account of morphology, is admirable.

The field entomologist is obviously responsible for the next part of the book dealing with insect control and the main insect pests of the United States and southern Canada. Accompanying about fifty pages dealing with insecticides and apparatus for their application, we find one page and a half devoted to the subject of biological control—obviously too little in a book of some nine hundred pages.

An orderly arrangement of insects according to the crops or products they attack follows. For each category the authors have inserted a most valuable field key for diagnosing the pest by the form of damage suffered by the particular commodity, and for each insect the type of injury, distribution, life history, and control measures are clearly given. There is a limited number of literature references, but these are well chosen, consisting of standard text-books or easily accessible entomological publications. The book is well written, and illustrated with 561 figures ; it should have a good reception, especially from American entomologists and agriculturists. L. EASTHAM.

Modern Sea-Urchins and their Origin.

A Monograph of the Echinoidea. 1 : *Cidaroidea.* By Dr. Th. Mortensen. Text : Pp. v + 551. Plates : Pp. 24 + 88 plates. (Published at the Expense of the Carlsberg Fund.) (Copenhagen : C. A. Reitzel ; London : Oxford University Press, 1928.) 2 vols., 100*s*.

ALL students of both Recent and extinct sea-urchins must be glad that so high an authority on these animals as Dr. Mortensen of Copenhagen is also an audacious optimist. Without that quality he would scarcely have proposed to write " A Monograph of the Echinoidea ", of which the first section, dealing with but a single family, runs to 551 pages in super-royal quarto and 88 plates. Fortunately, pecuniary assistance by the Danish Government enabled the author to pursue his task without distraction, while grants from the Carlsberg Fund assisted the necessary journeys and the preparation of the plates. The task, moreover, is not quite so enormous as the title implies, for it is only Recent species that are described in detail. None the less, the numerous extinct genera are adequately discussed and figures of characteristic species are provided, so that the necessary foundation is laid for the systematic superstructure.

There are two aspects of such systematic work : the broad plan, and the treatment of details. The plan of the classification of any Recent group of animals should, according to modern principles, be determined by the ancestry. There are two contrasting hypotheses of the early history of the Echinoidea. Dr. R. T. Jackson, the monographer of the palæozoic echinoids, so many of which have numerous columns of plates in both radial and inter-radial areas, believes that all arose from such a simple form as the Ordovician *Bothriocidaris*, with its two columns in each ambulacrum and single column in each interambulacrum. Dr. Mortensen, more familiar with genera in which only two columns in each area is the rule, seeks the ancestor in some many-plated form from which the post-palæozoic genera have been derived by reduction of plates. To make this view plausible, he has had to get rid of *Bothriocidaris*, which he regards as probably an offshoot from Cystidea Diploporita. It is interesting to note that similar conflicts of opinion obtain concerning both Asteroidea and Crinoidea, and the solution will probably be of the same nature for each class.

The idea that the Echinoidea (and Asteroidea) are derived from some ancient Edrioasteroid type is gaining general acceptance, and Dr. Mortensen is not the first to cast doubts on the echinoid nature of *Bothriocidaris*. Unfortunately, his recent study of its fossil remains is not so convincing as one had hoped ; but, even if *Bothriocidaris* be an echinoid, it may just as well be specialised as ancestral. A many-plated echinoid was its contemporary. On the other hand, the regular growth of the columns in many-plated forms favours Jackson's view of a progressive increase in the number. Assuming, then, an Edrioasteroid ancestor, one may imagine the change to an echinoid as accompanied by a speedy regularisation of the inter-radial plates into two columns. From this norm subsequent *plus* or *minus* deviations may have arisen.

Dr. Mortensen would derive the Cidaroids from the Archæocidaridæ by reduction of columns, and the Diademoids from the Lepidocentrids. In the Echinoidea, as in some other groups, many branches withered at the close of palæozoic time, and mesozoic life burgeoned afresh from very few twigs. Those twigs one would expect to be unspecialised forms. While, therefore, the grouping of the Cidaridæ with the 4-columned Archæocidaridæ seems natural, some obscure Carboniferous and Permian fossils may really be in a more direct ancestral line of 2-columned genera. The further possibility, that the Diademoids were derived from Cidaroids, is not discussed by Dr. Mortensen.

Restricting attention now to the Cidaroids, we find Dr. Mortensen placing all post-palæozoic genera in the single family Cidaridæ. He discusses the possible separation of those early genera in which the test was still flexible with bevelled imbricating sutures, but rightly decides that the gradual change to rigidity along many lines precludes a family grouping. Of those characters on which he does rely for family and generic diagnosis, Dr. Mortensen gives an admirably lucid account. Among other features utilised is the microscopic structure of the cortex of the radioles. On well-preserved recent specimens this often bears long delicate extensions of stereom; these, which the author rather infelicitously terms 'hairs', have diagnostic value. From Lovén onwards, students of Echinoidea have attached importance to the supposed streaming of the ambulacral plates downwards on to the membrane round the mouth. Dr. Mortensen believes that the appearance is due merely to the growth of this area by resorption of the interambulacrals. Neither here nor elsewhere does Dr. Mortensen mention the great name of Lovén: the omission is astounding.

Many of the characters utilised by Dr. Mortensen are not preserved in fossils, but this regrettable fact does not prove his method unsound. The ultimate classification will, however, have to take extinct forms into account, and palæontologists must seek, in those parts of the skeleton that are preserved for them, microscopic structures no less characteristic than pedicellariæ and more widely applicable.

In presentation of results, whether by word or picture, Dr. Mortensen's work takes high rank. Its technical excellence justifies the strength of his protest against the disorderly descriptive writing still too common, and against the half-tone reproduction of obscure photographs, both of which methods leave the reader to do the scientific work for himself. As a clear compendium of results scattered through publications both large and small throughout the world, this monograph will be welcome in every zoological library.

F. A. Bather.

Mechanics and Acoustics.

Müller-Pouillets Lehrbuch der Physik. Elfte Auflage. Herausgegeben von A. Eucken, O. Lummer, E. Waetzmann. In 5 Bänden. Band 1: *Mechanik und Akustik.* Teil 1: *Mechanik punktförmiger Massen und starrer Körper.* Herausgegeben von Erich Waetzmann. Pp. xvi + 848 + xii. Teil 2: *Elastizität und Mechanik der Flüssigkeiten und Gase.* Herausgegeben von Erich Waetzmann. Pp. viii + 849 – 1258. 75 gold marks. Teil 3: *Akustik.* Bearbeitet von Erich Waetzmann. Pp. xii + 484. 29 gold marks. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1929.)

In view of the recent important additions to the literature of physics contributed by German writers, it is natural to pause and inquire what precisely is the difference between a 'Handbuch' and a 'Lehrbuch'. It appears to the reviewer, particularly from a consideration of the books now before him, that the answer to this inquiry is very simple. The former is designed to satisfy the needs of the research worker who requires the most detailed information upon any of the special branches of physics with which he is intimately concerned, whilst the latter is designed to meet the demands of a busy teacher of physics who only requires accurate information upon the fundamentals of the whole of those branches of physics upon which he may be expected to lecture.

Now the books under review form the first volume of the eleventh German edition of Müller-Pouillets' "Lehrbuch der Physik". There is clearly no need, then, to discuss whether this particular 'Lehrbuch' satisfies the demands of teachers of physics. It only remains to decide whether these portions of the latest edition present an up-to-date account of the branches of physics with which they deal. On this point we are quickly satisfied.

Turning to Part 1, on the mechanics of particles and of rigid bodies, we find that it has been entirely rewritten. It opens with an excellent introduction to physical concepts written by G. Mie. This is followed by a comprehensive section on the measurement of length, mass and intervals of time, by G. Berndt. Dimensional formulæ are treated by H. Dieselhorst, and Newtonian mechanics by E. Madelung and W. Thomas. The mechanics of particles are also dealt with by H. Dieselhorst, and the mechanics of rigid bodies by W. Hort, who might with advantage have included a fuller statement of the errors to which pendulum measurements are open. Gyroscopic motion, including astronomical and geophysical examples, is treated by M. Schuler.

Part 2 deals with the mechanics of liquids and gases, and is particularly noteworthy for the masterly treatment of the motion of liquids and gases by L. Prandtl. It is really unfortunate that Part 2 cannot be separately purchased, and it is not too much to say that this excellent section ought to be rendered accessible to a wider circle of readers by translation into English. Other interesting features are sections on the rupture of materials by T. Pöschl, and on the preparation and properties of single metal crystals by P. Ewald.

Part 3, on sound, has also been almost entirely rewritten, only two sections from the tenth edition being used in their entirety. It contains an excellent account of modern electrical methods of measurement and analysis of sound waves, and of modern work on acoustics of buildings.

It should be added that references are everywhere freely given, in many cases work carried out in 1928 being mentioned, so that the whole volume may confidently be recommended to the attention of English physicists.

Theoretical Mechanics.

The Principles of Mechanics : an Elementary Course. By Prof. H. C. Plummer. Pp. xii + 307. (London : G. Bell and Sons, Ltd., 1929.) 15*s.* net.

FOR the student beginning theoretical mechanics a treatment based entirely on Newton's laws of motion seems to be not only desirable but also absolutely necessary if a sound basis on which further development may rest is to be assured. At the outset the reduction to mathematical form of the problems of mechanics has to be faced, and this proves as a rule to be the greatest stumbling-block ; the subsequent mathematical treatment appears in the main to offer much less difficulty than the original formulation. The reason for this difficulty in formulation is generally traceable to two causes : (1) an insufficient appreciation of the simplifying assumptions in the external conditions which must be made in order to render the problem manageable; (2) an inadequate grasp of the mechanical principles contained in Newton's laws. To overcome (1) there must be a careful specification of the conditions under which the solution is sought and a minimum use of conventional language. The remedy for (2) is a proper explanation and exemplification of principles. This, it is Prof. Plummer's object to supply.

The book is divided into five parts, the first dealing with the geometry of motion. In the second, Newton's laws are introduced and applied to the dynamics of translation. This part would have been improved by a somewhat fuller treatment, with more examples, of impulsive motion, for it is here that mechanical principles appear in their most applicable form without mathematical elaboration. In Part III. statical considerations are explained. Part IV. returns to dynamics, the two-dimensional motion of a rigid body. Part V. gives elementary principles of the elastic behaviour of bodies under stress. This is a welcome addition to the ordinary treatment of elementary mechanics, as it gives a glimpse of the deviations of actual solid bodies from rigidity.

Elementary notions of the infinitesimal calculus are used throughout. This is quite as it should be ; in fact the beginner profits doubly by a concurrent use of the two subjects, while to exclude the calculus is deliberately to obscure and restrict the possibilities of elementary mechanics. Good introductory text-books on mechanics are rare. Where a teacher is available the book is not the most important matter. For a student reading by himself a good book is absolutely essential. This one can be recommended.

L. M. MILNE-THOMSON.

Our Bookshelf.

The Sun. By Dr. Charles G. Abbot. Revised edition. Pp. xxvii + 433 + 28 plates. (New York and London : D. Appleton and Co., 1929.) 12*s.* 6*d.* net.

THE first edition of this book was published in 1911. Since then, modern atomic theory has been applied as a powerful means of research into the constitution of the sun from its outermost boundary to its core, whilst observational work has been carried on with increasing scope and success. The time is therefore opportune for the publication of a revised edition embodying some account of recent achievements in solar physics.

The general reader will find that Dr. Abbot has provided a lucid account of our knowledge of the sun whether considered as the central body of the solar system (Chapter i.) ; the great luminary exhibiting a host of interesting phenomena (Chapters ii.-vi.) ; the earth's source of radiant energy (Chapters vii.-ix.) ; or, lastly, as a sample unit of the stellar universe (Chapter x.). Throughout, a good deal of attention is paid to observational methods. Chapter ix. describes the attempts made to utilise solar energy by means of solar engines and cookers.

To the astronomical reader, Dr. Abbot's book is a standard work of reference, containing a number of useful tables, and also first-hand information on the measurement of the solar-constant of radiation—

a work long associated with the name of the author and the Smithsonian Institution. It is therefore thought to be a regrettable omission that this revised edition does not include a table of collected results of measures of the solar-constant; Fig. 64, presenting the results from 1918 to 1927, is inadequate and rather exasperating with its microscopic figures. Turning the pages more or less at random, one also expected to find, in a work entirely devoted to the sun, fuller information under such headings as—faculæ, magnetic storms, latitude and time distribution of prominences, hypothetical section of a sunspot, etc. But a concluding remark must surely express gratitude to Dr. Abbot for having renewed, by this timely second edition, the usefulness of his very readable book.

Experimental Hydrostatics and Mechanics for School Certificate Students. By E. Nightingale. Pp. xi+244. (London: G. Bell and Sons, Ltd., 1929.) 4*s.* 6*d.*

Mr. Nightingale has written a sound and interesting book, covering that dreary stretch in the older text-books, the elements of mechanics and hydrostatics. In general it can be commended strongly as a book which will appeal to that elusive being the normal boy. It reasons in a way he can understand; all its arguments are clear and lead somewhere soon. Both pictorial and literal illustrations are good. The large number of questions from the usual examination papers have been chosen well and are very useful.

Two features of the book are its experimental character, and the welcome prominence given to the historical development of the subject. The author believes that " a sure foundation can only be based on experiment ". Here he agrees with modern educational theory, which seems to regard this as a truth beyond question. Yet experienced science and mathematics masters know there are limitations to the usefulness of experimental work, and in particular that the time spent on experiments in mechanics is out of proportion often with the benefit resulting from them. Involved here is a fundamental educational problem over which many teachers have puzzled and will puzzle. As it happens, Mr. Nightingale keeps his experiments in due bounds. Even doing them all, the course, under ordinary conditions, could be covered easily in two years, while by judicial selection of some experiments ' as read ', the book can be used with advantage in the one-year course which frequently is all the student has in preparation for the School Certificate Examination. A. J. White.

Plant Ecology: the Distribution of Vegetation in the British Isles, arranged on a Geological Basis. By Mary A. Johnstone. Pp. vi+185+16 plates. London and Toronto: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co., 1928.) 5*s.*

Miss Johnstone's book on plant ecology provides at a low cost an elementary account of British vegetation. Owing to the fact that there is so small a literature on British vegetation that is not scattered in various periodicals, this book will doubtless be welcome to many students and teachers. It is, however, to be regretted that, as indicated by the sub-title, the geological nature of the substratum has been utilised as the basis of treatment. Whilst a certain measure of correlation is obvious even to the superficial observer, there are so many exceptions that undue emphasis on this relationship is to be deplored. Many mistakes in the older literature of ecology, notably in relation to calcicole and calcifuge vegetation, were the outcome of an undue faith in the connexion between soil characteristics and geological formation. The occurrence of *Querceta sessilifloræ* on the Wenlock Limestone or of typically ash-wood vegetation on bands of cornstone in the Old Red Sandstone serve as sufficient warning against attaching too much importance to the major geological features, but when to these we add the modifying influence of topographical, biotic, and historical factors, the influence of even what may be termed the micro-geology may become entirely obscured. If, however, we discount the influence of the basis of arrangement, the student will find this introduction simply written and free from the gross teleology by which so large a proportion of elementary treatments of ecology are marred.

Traité d'embryologie comparée des invertébrés. Par Prof. C. Dawydoff. Pp. xiv+930. (Paris: Masson et Cie, 1928.) 120 francs.

This volume is the development of a manual of embryology which the author produced, in Russian, in 1914 based upon his course in the University of Petrograd. He set out to give the elements of embryology rather than to produce a treatise, and he has kept the needs of students steadily in mind. He gives them sound advice when he remarks that they are not to accept the view, so often stated, that the science of embryology is exhausted. In many of the groups of invertebrates the development is incompletely known or requires reinvestigation by modern methods, and much remains to be done in the study of organogeny.

An introductory chapter on the structure of the egg, on the different types of cleavage, on gastrulation and the germ-layers, is followed by the systematic study of the embryology of members of the different phyla—cœlenterates, Porifera, annelids, etc., up to tunicates, to which a hundred pages are devoted. Due attention is given to such matters as asexual reproduction and life cycles (for example, of trematodes and cestodes), and a short bibliography is added at the end of each section. The author has given a clear exposition of the essential facts of the subject.

The illustrations have been drawn in line by the author and are for the most part entirely satisfactory. Here and there a figure would have been improved by fuller lettering of its parts. At the end of the book is an index of authors referred to in the text, and a fairly detailed table of contents; an index of the genera referred to would have been helpful.

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.*]

A High-Temperature Modification of Manganese.

DURING the course of X-ray studies on the copper–manganese–aluminium system (Persson) and the iron–manganese–carbon system (Öhman) respectively, we had reason to investigate the crystal structure of manganese at high temperatures. Dr. Marie Gayler (*Jour. Iron and Steel Inst.*, **115**, 393 ; 1927) found no less than four thermal arrest points in the solid state of manganese. From the study of micrographs she concluded that only one of the two lower critical points, namely, 742° ± 1° C., is accompanied by a change of crystal structure, while no such change is apparent at the other, 682° ± 1° C. The former point has also been generally recognised as the transition point β-manganese–α-manganese. Bradley (*Phil. Mag.*, **50**, 1018 ; 1925), however, has advanced the theory that the two forms of manganese exist together in a state of isodynamic isomerism within the temperature interval 650°-850° C., the equilibrium gradually shifting over to the β modification as the temperature is raised. As reference to this view has quite recently been made by Bernal (*Trans. Faraday Society*, **115, 367** ; 1929), we may mention that we have found nothing to support such a theory. Powder photograms of pure manganese quenched from 730° C. show no trace of β-manganese, while from a specimen quenched from 760° C. faint α-manganese lines are obtained in addition to those of the β modification. This must, however, be considered as due to ineffective quenching, as in alloys of manganese with copper, which does not dissolve to any appreciable extent in α- and β-manganese, the copper phase is found to be in equilibrium with pure α- and pure β-phase at the temperatures 730° and 760° C. respectively.

If either of the two higher critical points found by Gayler, 1024 ± 3° C. and 1191 ± 3° C., is accompanied by a structural change has not been previously ascertained. The fact, however, that the alloys of manganese with copper, iron, nickel, and cobalt, which metals all have a face-centred cubic lattice, show unbroken melting curves, could not be explained if the β-manganese were stable up to the melting-point of manganese. Early in these investigations, one of us indeed found faint lines in photograms of quenched specimens of alloys of manganese with 10-25 per cent of iron, which seemed to belong to a face-centred cubic lattice.

Attempts were first made to expose a wire of manganese in a high-temperature Debye camera, but no results have so far been obtained by that method. We therefore turned to the study of quenched specimens, and this time with more success. Pure manganese on quenching gives nothing but the β modification, but by alloying the manganese with a low percentage of other metals we have succeeded in establishing the existence of another high-temperature modification. The metals employed were copper, iron, nickel, and cobalt. The manganese used for the alloys was prepared by distillation *in vacuo*.

Alloys of manganese with copper are quite malleable, and show no resemblance to α- or β-manganese even if the copper content is so low as about 5 per cent. Powder photograms of quenched specimens of alloys containing less than about 20 per cent of copper show that these alloys contain only one phase with a face-centred tetragonal lattice. The higher the copper content, the more does the structure approximate to the face-centred cubic lattice, as will be seen from the following table:

Copper (per cent).	*a*.	*c*.	*c*/*a*.
3·8	3·771 ± 0·003 A.	3·556 ± 0·005 A.	0·943
8·2	3·765 ± 0·003	3·601 ± 0·005	0·956
10·5	3·763 ± 0·003	3·617 ± 0·005	0·961
15·0	3·755 ± 0·003	3·660 ± 0·005	0·975

If a and c are plotted against the concentration, the parameter values for pure manganese can be obtained by extrapolation as follows: $a = 3{\cdot}776 \pm 0{\cdot}005$; $c = 3{\cdot}525 \pm 0{\cdot}008$; $c/a = 0{\cdot}934$ (Fig. 1). These values agree very closely with those determined by Westgren and Phragmén for the tetragonal modification of manganese obtained by electrolysis, namely, $a = 3{\cdot}774 \pm 0{\cdot}003$ A. ; $c = 3{\cdot}533 \pm 0{\cdot}003$ A. ; $c/a = 0{\cdot}937$ (*Zeit. Phys.*, **33**, 777 ; 1925 : cf. Bradley, loc. cit.). There seems to be no doubt that this modification, γ-manganese, and the high-temperature phase found by us are identical. The γ-manganese is thus in reality a high temperature modification, which explains the fact that it is rapidly transformed into α-manganese by heating to 150° C., and even at room temperature is completely changed after a few weeks.

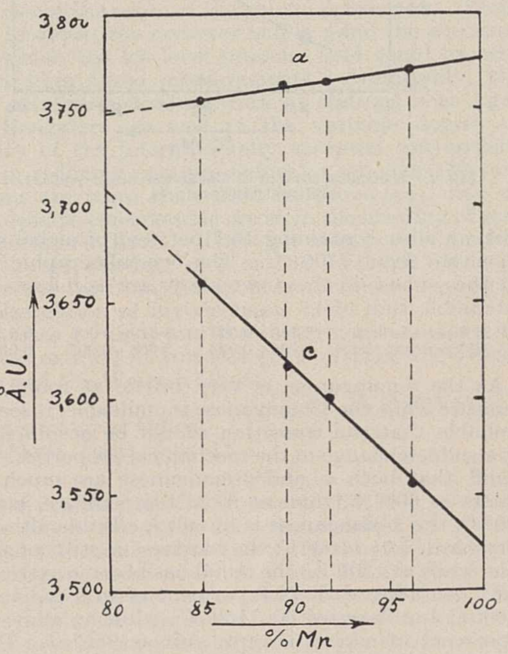

FIG. 1.—*a* and *c*, edges of the unit cell of γ-manganese with different contents of copper.

The copper alloys were found to be specially favourable for the study of the γ-manganese, since even a small addition of copper lowers the transition point γ-β considerably and copper does not dissolve to any appreciable extent in α- and β-manganese. It was thus comparatively easy to obtain the γ-phase pure, with different contents of copper, and also to obtain γ-phase and β-phase in equilibrium with each other at different temperatures. With the help of the curves in Fig. 1, the maximum manganese content in the γ-phase at different temperatures could then be determined. If this maximum content is plotted against the temperature a curve is obtained (Fig. 2) which by extrapolation should give the transition point γ-β. It will be seen that this point undoubtedly corresponds to the highest critical point found by Gayler, namely, 1191° ± 3° C. This is further elucidated by the fact that in the manganese–iron and manganese–nickel systems the γ-phase can only be obtained by quenching from temperatures considerably higher than 1024° C. Thus an alloy with 21·8 per cent of iron when quenched from 1150° C. gives γ-phase with some β-phase, and the same is the case

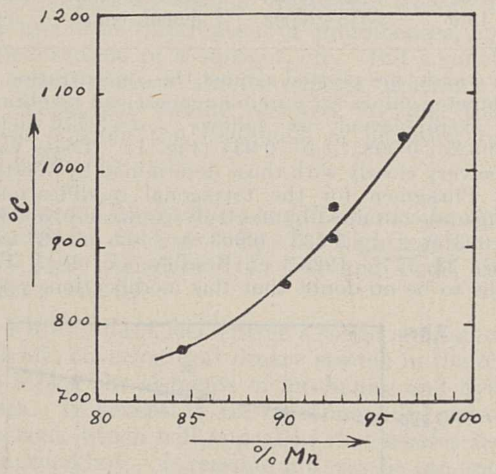

FIG. 2.—Maximum content of manganese in the γ-phase at different temperatures.

with an alloy containing 15·7 per cent of nickel when quenched from 1100° C. The crystallographic data for the γ-phase in these two alloys are as follows :

	a.	*c*.	*c*/*a*.
21·8 per cent iron	3·705±0·003	3·619±0·005	0·976
15·7 per cent nickel	3·736±0·003	3·606±0·005	0·965

As the β-manganese is very brittle at room temperature while the γ-manganese is malleable, it seemed probable that the transition should be accompanied by a sudden change in the mechanical properties. We found that both α- and β-manganese are much less brittle at 600° C. than at room temperature, and at 900° C. the β-manganese is in fact malleable although very hard. At 1160° C. the hardness is still considerable, while at 1200° C. the metal has become extremely soft. An alloy with 21·8 per cent of iron is hard at 1100° C. but very soft at 1150° C., while an alloy with 8 per cent of copper is quite soft at 980° C. There seems to be no doubt, therefore, that the transition point γ-β is 1191° ± 3° C. The point 1024° ± 3° C., on the other hand, does not seem to be accompanied by any change in crystal structure. It might be pointed out that the higher point in Gayler's curves is more pronounced than the lower.

No alloy of manganese with cobalt having γ-manganese structure has yet been obtained. A specimen containing 11·5 per cent of cobalt quenched from 1100° C. gave the interference lines of a face-centred cubic lattice together with β-manganese lines. The range of γ-manganese is thus considerably narrower in this system than in the others investigated.

It should be mentioned that G. Hägg of this Institute recently found a high-temperature face-centred tetragonal phase in the manganese–nitrogen system (*Zeit. Phys. Chem.*, in press). This phase was found in equilibrium with both α- and β-manganese, but the highest quenching temperature used, namely 1150° C., did not, of course, exclude a connexion at still higher temperatures between the nitride phase and a tretragonal manganese modification. There seems, therefore, to be no reason to doubt that the structure found by Hägg is identical with γ-manganese.

In no case has the γ-manganese phase been found in equilibrium with the face-centred cubic one (copper, γ-iron, etc.). This does not prove, of course, that the cubic lattice continuously changes into the tetragonal, but if a two-phase range exists, it must certainly be very narrow.

ELIS PERSSON.
EINAR ÖHMAN.

Institute of General and
Inorganic Chemistry of the University,
Institute of Metallography,
Stockholm, July 25.

Wild Birds and Butterflies.

RECENT correspondence in NATURE (May 11, p. 712; Aug. 3, p. 183; Aug. 10, p. 225) has once again brought to the fore the question of whether or not wild birds prey upon butterflies. The subject has been frequently discussed in the past both by entomologists and ornithologists and a voluminous literature exists, directly or indirectly relating to the subject, but, as Marshall (*Trans. Entom. Soc. Lond.*, pp. 329-383; 1909) has so pertinently pointed out, the supporters of adverse views are mostly those who disagree with the theories of mimicry, such as Scudder, Packard, Pryer, Piepers, etc.

It is now well known that certain species of butterflies exhibit what has been termed 'cryptic coloration', or, in other words, their colours are such that when at rest they very closely resemble their surroundings and in consequence are difficult for human beings to see. Moreover, different species of butterflies resemble one another, and in such groups there is usually one species that has a nauseous taste or foul odour, and such is said to protect the species from the attacks of wild birds. Further, as a result of natural selection, those species which resemble their surroundings and those that resemble unpalatable or inedible species, are preserved.

Here we are not concerned with the validity of any theories of mimicry or protective coloration, but rather with the evidence in support of or against the claim that butterflies constitute an appreciable part of the food of wild birds. Incidentally, we would remark that it should be borne in mind that it by no means follows that colour schemes or patterns that are difficult for the human species to see are difficult for a bird to appreciate ; and further, that an insect which smells disagreeable to man is not necessarily one that is unpalatable to birds—indeed the very reverse would seem to be the case.

The question to which we wish to confine ourselves is, Do butterflies to any appreciable extent constitute an item of the food of wild birds ? Apart from the observations and evidence that exist, we should very much doubt butterflies forming a food item of wild birds, for two reasons, namely, first, in proportion to other insects they are few in numbers, and, secondly, as an item of food their difficulty of capture, owing to their rapid and tortuous flight, make them not worth the time and trouble of catching. A bird invariably feeds upon what is easiest to obtain and present in large quantities.

That butterflies are occasionally eaten by birds, no one can deny, but not habitually ; on odd occasions they will eat them just as they do earwigs, ticks, woodlice, etc. Marshall (loc. cit.) has brought together a long list of records of cases where different species of wild birds have been observed catching, eating, or pursuing butterflies, and, interesting as these are, they are inadequate as positive evidence. When this list was compiled in 1909, very little detailed observations on the insect remains found in the stomachs of wild birds had been made in Great Britain, and little attention had been given to work done elsewhere.

Judd, who examined many thousands of stomachs, writes, " I do not know of a kind [of bird] that feeds upon butterflies during any month of the year to the extent of one-tenth of one per cent of its food ". Beal, who in his lifetime examined 37,825 stomach contents, very rarely refers to butterflies amongst the various items. In his investigation of the food of seven species of American swallows (U.S. Dept. Agric., *Farmers' Bull.*, No. 630, pp. 1-27; 1915) he examined 2030 stomachs and found that 70 per cent of their food consisted of Hymenoptera, Hemiptera, and Diptera. A specimen of *Vanessa atlanta* was found in one stomach. This same investigator in his work on the food of seventeen species of American flycatchers (U.S. Dept. Agric., *Biol. Surv., Bull.* No. 44, pp. 1-67; 1912), of which he examined 3398 stomachs, makes no mention of butterflies or their larvæ. Moths and their larvæ constituted 9·93 per cent of the food of all species.

Cleland (Dept. Agric. N.S.W., *Sci. Bull.*, No. 15, pp. 1-112; 1918) in his work on the food of Australian birds examined 1133 specimens referable to 224 species, and butterfly remains or their larvæ occurred in one case only, namely, a tricoloured chat (*Ephthianura tricolor*) which contained two larvæ. Mason (" The Food of Birds in India ", 1912), after examining the stomach contents of 1329 specimens of Indian birds referable to 107 species, states, " Butterflies do not form any appreciable proportion of the food of any one species of bird, though a good many birds take these insects at times ".

My own investigations, embracing more than one hundred and fifty species of wild birds and upwards of twelve thousand post-mortems, lend no support to the contention that butterflies are part of the normal food of birds. Interesting as are the observations and experiments of Swynnerton (*Ibis*, 6, pp. 635-640; 1912; *Trans. Second Int. Cong. Entom.*, 1912, pp. 351-354; 1913; *Jour. Linn. Soc.* (Zool.), **33**, pp. 203-385; 1919), they mostly refer to birds in captivity. In the very extensive investigations of McAtee, Fisher, Forbes, Forbush, Barrows, Kalmbach, and others, I find only rare and odd references, such as " and one butterfly ".

The work quoted above embraces considerably more than 100,000 post-mortem examinations of the stomach contents of wild birds in the United States, India, Australia, and Great Britain, and the number of butterflies or their remains found was negligible, indeed so infinitesimal as to be of no account economically, whereas other insects occurred in thousands.

From what has been said I think we may conclude that a careful and very extensive series of examinations of the stomach contents of upwards of one hundred thousand birds lends no support to the view that wild birds do prey upon butterflies to an appreciable extent, nor are they " liable to habitual attacks upon the part of birds ".

WALTER E. COLLINGE.
The Yorkshire Museum, York.

Meteorology in India.

IN NATURE dated May 4, p. 698, there appeared a review notice of the first three numbers of the *Scientific Notes* published by the Indian Meteorological Department. In criticising the first Note by Mr. Mohammad Ishaque on " A Comparison of Upper and Gradient Winds at Agra and Bangalore ", the reviewer took exception to Mr. Ishaque's statement that the gradient wind equation does not hold at the equator, and described the statement as " an unfortunate mistake ". Though Mr. Ishaque might with advantage have expressed himself a little more fully, it is profitable to recognise that there may be much truth behind his statement. For, it is not at all certain, as the reviewer would seem to imply, that motion in the free air over the equator under steady conditions is normally along isobars under the sole, effective control of the cyclostrophic component. On this very question Sir Napier Shaw ("Manual of Meteorology ", vol. 2, p. 266) has expressed the opinion that " we can no longer assume that the motion is along isobars for the equatorial region; it is controlled by some other consideration, and we do not know how far the new form of control may extend North and South of the equatorial belt ".

Mr. Ishaque's work indicated that upper winds at the levels of 0·5 km. or 1·0 km. are less closely calculable from sea-level isobars in India than in England, and the reviewer suggests that the poorer agreement in India is " a measure simply of the point to which accuracy of measurement of barometric pressure has been carried in each " country. I have good grounds for believing that want of accuracy in the actual measurement of pressure at individual stations in India is not the cause of the poorer agreement. Probably, however, the reviewer had in mind the accuracy with which the sea-level pressure field could be estimated from these measurements. Admittedly, the want of a very close network of stations near Agra and Bangalore, as well as the variable degree of validity of the internationally accepted conventions used in reducing pressure-values to sea-level (Mysore stations are more than 2000 ft. above sea), may at times lead to considerable errors in the drawing of sea-level isobars in India. There are also, however, other contributing factors, such as the fact that the conditions are far from steady near the surface owing to the alternation of inversions at night with adiabatic lapse-rates by day, and the disturbing boundary influences exerted at surfaces of inversions, the Himalayas and the Western Ghats.

C. W. B. NORMAND.
Meteorological Office,
Poona, India, July 12.

I quite agree with Dr. Normand that it is going too far to assert definitely that the possible interpretation of the small correlation between gradient wind and observed wind at 0·5 km. and 1·0 km. height at Agra, quoted above, is the true one, but I think that errors in the determination of the gradient wind are at the present time too large to justify one in accepting the results of comparisons made in different countries as indicative of the influence of latitude, without a critical examination of the effect of such errors.

On reading the chapter of Sir Napier Shaw's " Manual of Meteorology " which contains the quotation cited by Dr. Normand, and in particular the second paragraph on page 249, I concluded that the statement that " we can no longer assume that motion is along isobars for the equatorial region " is meant to apply to *mean* isobars and not to the isobars existing at a particular moment. There seems to be no obvious reason why the virtual disappearance of the term in the gradient wind which depends upon latitude should affect the closeness with which the actual free air wind on a particular occasion approaches the value appropriate to air moving under balanced forces, and a high correlation between the two seems not unlikely over those great stretches of tropical ocean where horizontal gradients of temperature are normally small. THE WRITER OF THE ARTICLE.

Quantum Theory and Special Relativity.

IN NATURE of Mar. 2 a communication by Prof. Wiener and myself was published directing attention to the urgent need of a more thorough harmonisation of quantum theory and relativity than is found in Dirac's theory of the electron. It was further pointed out that the latter can be formally carried over into Einstein's unified theory of electricity and gravitation by making use of distant parallelism and interpreting the operators p_0, p_1, p_2, p_3, of Dirac's theory as a differentiation along the Cartesian axes of the local quadruples, which themselves need not be integrable. Since then this suggestion has been discussed more fully and independently by E. Wigner (*Zeit. für Phys.*, **53**, 592 ; 1929), and by I. Tamm (*Kon. Ak. van Wet. te Amsterdam*, **32**, 288 ; 1929). Now the Dirac theory is an attempt to reconcile the demands of the transformation theory of quantum mechanics, which alone is consistent with the observed dualism of particle and wave as Heisenberg and Dirac have shown, with the requirements of special relativity. Hence it would appear that a unified theory of matter, electricity, and gravitation is possible along these general lines.

Closer examination, however, reveals what appears to be a very serious difficulty. Let A_k be the electromagnetic potentials of the field in which the electron moves. The Dirac equation is then $(\Sigma(\alpha_k p_k + eA_k/c) + mc)\psi = 0$ $(k=0, 1, 2, 3)$. The probability of the electron being within a unit cube is $\Sigma\bar{\psi}_k\psi_k$ and the probability of its crossing unit area perpendicular to the axes $\Sigma\bar{\psi}_k(\alpha_i\psi)_k$ $(i=1, 2, 3)$. These quantities satisfy equations $\Sigma\bar{\psi}_k\psi = \Box\phi_0$, $\Sigma\bar{\psi}_k(\alpha_1\psi)_k = \Box\phi_1$, etc., and form a solenoidal four-vector, which can be interpreted as the charge-current density vector. But the potential ϕ which describes the 'external' electromagnetic field of the electron is *not* the same as the potential A which describes the field in which the electron is moving.

This difficulty, which Schrödinger strongly emphasised in 1927 (*Ann.*, p. 270), now appears under another guise. While it is possible in principle to define the 'internal' potential A locally in a way consistent with the interpretation of the p-operators mentioned above, the 'external' potential ϕ cannot be so defined because the probability of finding the electron at any point in space is always finite, no matter where the source of the 'internal' potential (for example, proton) may be.

Prof. Weyl has given a hint as to a method of separating the protonic from the electronic field (*Proc. Nat. Acad. of Sci.*, April 1929), but it does not seem to me that his treatment is more than suggestive. In particular, it seems reasonable to suppose that if the two-body problem requires two separate electromagnetic fields, one can scarcely dispense with n fields in the case of n bodies, be they protons or electrons. Thus if the unified field that all relativistic theories up to this time have striven for has real physical significance, it must be a statistical average of some sort. Hence it appears that the time is coming when a decision must be reached on the following question : either one admits the possibility of a unified field theory of matter, electricity, and gravitation, and abandons statistical quantum mechanics, which does not seem possible in view of the accumulated evidence ; or one constructs a statistical theory of gravitation and electricity and gives up the attempt to devise a unified field theory in the current sense. I feel strongly in favour of the latter alternative.

It might properly be mentioned here that an electrostatic spherically symmetrical field is incompatible with Einstein's definition of the electromagnetic potential unless past and future are not symmetrical, as Prof. Wiener and I have shown (*Proc. Nat. Acad. of Sci.*, **15**, 353 ; April 1929). While the method used in this paper is defective, a correct argument, which leads to precisely the same general conclusions and only introduces unessential modifications in the final formulæ, will appear shortly in the same publication.

M. S. VALLARTA.
Massachusetts Institute of Technology,
Cambridge, Mass., U.S.A.,
May 25.

Aquaria for Rearing Minute Organisms Requiring Running Water.

THE aquaria described here were designed in connexion with experimental work on oyster larvæ, and may be useful to workers on these or similar organisms. Each aquarium is a square trough, say 20 in. × 12 in. × 12 in., which will conveniently hold about 22 gallons of water. It has near the base on two opposite sides circular outlets ⅝ in. in diameter, through which is cemented a stopcock of ¼ in. internal diameter. On the inside these outlets are each covered over with a glass box about 4 in. high and 2½ in. broad, open on the side facing the opposite outlet, and containing three vertical grooves, through which glass-framed curtains of bolting silk of different mesh can be passed. These curtains can be used either jointly or singly, according to the degree of filtration and outflow desired, and the grooves or the frames should be lined to prevent leakage.

For organisms which are too minute to be filtered by bolting silk, slabs of the filtering substance employed in bacteriological filters may be used, but they would reduce the rate of outflow very considerably, and the substance known as 'Filtros', which is made in grades of known porosity, would seem to be superior. H. F. Prytherch, whose work on the artificial propagation of oysters is well known, has used it with great success in his experiments. It can be obtained in London from Messrs. Lassen, Hjort, and Menzies, Ltd., Imperial House, Kingsway, W.C.2.

The aquaria are best used by placing them side by side on a long table, the stopcocks being joined on to each other with rubber tubing and intervening T-tubes with a stopcock on the upright of the T. To carry away the waste a ½-in. pipe may be fixed under the table with T-pieces at desired intervals, which are reduced to ¼ in. by means of a reducer and nipple, to allow the convenient attachment of rubber tubing. These T's can be connected up with the aquaria in various ways, one being to direct the outflow from two aquaria through a single T on the waste pipe by means of a Y-tube and rubber tubing. The aquaria can be easily fed from a small tap by means of rubber tubing and glass T-pieces with stopcocks on the upright of the T. This method of using the aquaria permits very considerable elasticity in working, an elasticity which increases with the number of aquaria employed.

The circulation in any application of this system where an outflow is permitted will be found sufficient for most requirements, but if further aeration is desired, mechanical agitation can be readily obtained. For this I fix upright guides between the aquaria, through which a shaft, with vertical wooden blades passing into each aquarium, is passed. This shaft is propelled by means of a small motor or water-wheel. This circulatory apparatus, except for the blades, can be quickly constructed with one of the larger Meccano sets.

CEDRIC DOVER.
Calcutta.

Feeding Habits of the Angler-fish, *Lophius piscatorius*.

IN a recent publication ("The Seas", by F. S. Russell and C. M. Yonge) a statement is made with regard to the feeding habits of the angler-fish which does not accord with my own repeated observations, and it has been suggested that I should describe the feeding habits of this interesting fish as seen by myself on many occasions in the tanks of the Marine Biological Station at Port Erin.

In the publication referred to, the angler-fish is stated to lie perfectly still with its huge mouth wide open and to appear to use the tentacle borne on the top of its head as a lure. There is no doubt, as is shown below, that the tentacle is so used, but, though the fish was always kept in a dimly lighted tank, I have never seen the tentacle luminescent. However, I have never observed the fish during the night. It was our practice on many occasions to put into the tank containing the angler a few living young specimens of the coal-fish, *Gadus virens*. These would soon be noticed by the angler, which, while remaining stationary with closed mouth, raised the lure from its horizontal position along the back and jerked it to and fro. Suddenly, as the unsuspecting coal-fish hovered over the head of the angler and sampled the living and actively moving bait—I cannot say that I ever saw it touch the bait with its snout—the angler's mouth would open and as suddenly close upon its prey; the head of the coal-fish always disappearing first, while the tail projected from the tightly closed mouth. A few seconds later the tail would be drawn by a sort of suction into the still closed mouth and the angler would be ready for another meal.

I never saw the angler attempt to pursue its prey. It was its invariable habit to lie perfectly still on the bottom of the tank, the lure being actively jerked to and fro when the coal-fish were introduced. When no prey was in view, the lure always lay horizontally along the top of the angler's head.

H. C. CHADWICK.

Marine Biological Station,
Port Erin, July 17.

Crystal Structure of Solid Nitrogen.

IN a previous communication, dated June 28 (NATURE, Aug. 17), I gave results regarding the crystal structure of the form of solid nitrogen, which is stable below 35·5° K. It was stated that the X-ray powder diagrams can be interpreted with respect to the positions of the lines by means of a cubic unit cell the length of the side of which is 5·65 A., and containing 8 atoms.

Since then, the work has been continued, and after a long and laborious discussion of the various possibilities, we have now succeeded in finding the atomic arrangement which satisfies the intensity distribution of the X-ray spectrum. Our results, which will be more fully described in a subsequent paper, may be shortly stated as follows:

Solid nitrogen of the form considered has a pronounced molecular structure belonging to the space group T^4, and similar to that of the sodium chlorate type. The molecules—each consisting of two atoms—are placed on the four non-intersecting trigonal axes typical for this space group. The structure has two parameters, by a proper choice of which we obtained a remarkably good agreement between calculated and observed intensities. The parameter values thus found led to a distance of 1·06 A. between the two atoms of a molecule. If we could consider the molecules as spheres, the structure might approximately be regarded as a cubical close packing of molecules, with a minimum distance of about 4·0 A. between their centres.

Sodium chlorate, in the cubical form, turns the plane of polarisation and shows anomalous behaviour in producing double refraction. The similarity with regard to crystal structure would indicate that solid nitrogen should possess similar optical properties. In fact, D. Vorländer and W. H. Keesom (*Comm. Phys. Lab. Leyden*, No. 182 *c*; 1926) have found that solid nitrogen shows double refraction, and we intend to undertake experiments at this Institute with the object of discovering whether solid nitrogen gives any rotation of the plane of polarisation. L. VEGARD.

Physical Institute, University,
Oslo, Aug. 1.

Optical Excitation of Phosphorus Vapour.

ON illuminating the vapour of phosphorus by the light of various sparks, we obtained a fluorescent emission in the region 3500-1900 A. The vapour was contained in an evacuated and sealed quartz tube into which a quantity of carefully dried white phosphorus distilled *in vacuo* was previously introduced. The temperature and pressure of the vapour could be varied independently by an oven and a water bath. In order to obtain the fluorescence, heating of the vapour up to 600°-700° C. was found to be necessary, the vapour pressure being kept low (*c*. 0·1 mm.). The phosphorus molecules, which consist normally of four atoms (P_4), dissociate under these conditions into diatomic molecules (P_2) to an appreciable amount.

The spectrum of the fluorescence consists of resonance series excited by the spark lines 2195 and 2144 of cadmium, 2100 and 2062 of zinc, 1990 and 1935 of aluminium. The analysis of these series enabled us to estimate the first vibration quantum of the normal P_2-molecule as 775 cm.$^{-1}$ and its dissociation energy as 6 volts. Of various emission spectra of phosphorus in an electric discharge studied by Geuter (*Zeitsch. wiss. Phot.*, 7, 1; 1907) only one, designated by him as *C*, is ascribed to the P_2-molecule. It shows the same sequence of vibration quanta as our resonance series in the near ultra-violet. From the combination of these data an energy diagram of the P_2-molecule (similar to the N_2-molecule) was constructed in which the convergence of 'upper' vibration quanta ($\omega' = 450$ cm.$^{-1}$) seems to correspond to a dissociation of P_2 into $P + P'$, where P' designates the atom of phosphorus in its first excited metastable state ^2D, 1·4 volt above the normal state ^4S (cf. McLennan and McLay, *Trans. Roy. Soc. Canada*, **31**, 63; 1927). The results of a complete analysis of the emission and absorption spectra will be published elsewhere.

A. JAKOVLEV.
A. TERENIN.

Physical Institute,
University of Leningrad.

Iceberg Detection.
(BY CABLE.)

ONE of the interesting results of the Van Horne expedition just returned from iceberg study on the Atlantic was obtained with our submarine microphone detector. Very loud deep noises were heard three miles from an iceberg and became faint at six miles.

These noises are apparently due to the cracking under water of the iceberg, and they could readily be heard above the usual ship's noises. The succession of cracks was irregular, running from 11 to 68 a minute. The effect is so characteristic that we propose to extend the investigation in the hope of finding a method of iceberg detection.

HOWARD T. BARNES.
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Methods of Timing High-Speed Races.

By CECIL C. MASON.

IN the usual method of timing races with stop watches the errors can be divided into two main groups :

(1) Errors due to incorrect clock or watch rate, and also mechanical error due to incorrect starting and stopping or calibration.

(2) Errors due to inaccurate observation of the start or finish of the race ; including errors due to variations in the reaction times of the individual working the stop watch, that is, variation in the time between the mental observation and the mechanical response.

These errors are of different importance in short and long races. For example, in a very short race an actual error in the rate of the stop watch would cause errors quite negligible compared with many other probable errors, but, on the other hand, mechanical errors in starting and stopping the watch mechanism and in reading the dial due to inaccurate calibration are only important in short races. For short races, therefore, it is best to use a fiftieth-second stop watch, but for long races a greater over-all accuracy will often be obtained by using a fifth-second stop watch.

In an ordinary stop watch the motion is stopped by a light spring being pressed against the balance wheel ; and in motion the balance wheel in vibrating releases the escapement, and moves the hand forward one division every $\frac{1}{5}$th second.[1] When stopped, therefore, it may be any interval of time from 0 to 0·2 sec. since the last movement of the hand : and when again released it may similarly be any interval from 0 to 0·2 sec. before the first movement occurs. On the assumption that the balance wheel on starting immediately gets into a steady state, we therefore see the true meaning of a stop watch reading $5\frac{1}{5}$ is that the interval is between 5·0 sec. and 5·4 sec., and any reading between these limits is almost equally probable. If, therefore, two observers use two different watches, and the second reads 5 sec. for this same event, neglecting other errors it is scientifically correct to assume the true interval is between 5·0 sec. and 5·2 sec. ; and so on, if several observers use several watches, the mean reading has quite possibly, if the readings mutually agree well, a real scientific accuracy exceeding $\frac{1}{5}$ second.

Calibration errors in stop watches are probably negligible apart from the centring error. However, in small cheap watches often less than $1\frac{1}{2}$ in. in diameter, where the dial is divided in 300 divisions of $\frac{1}{5}$ sec. each, the centre of the hand need only be 0·01 in. out of centre to give, in parts of the dial, an error of $\frac{1}{5}$ sec.

In the second class of error, the chief cause of observational error is due to the usual practice of observing different things at the start and finish of a race. Perhaps the observer starts his watch on observing the flash of the pistol. This is a sudden event which cannot be anticipated, but must be closely watched for and awaited. Hence the watch is started after a delay due to the reaction time of the observer. However, in watching a runner approach a tape, the event can be exactly anticipated, and the observer can stop his watch almost exactly as the runner hits the tape. In this case there is no delay due to the reaction time of the observer. This can be proved by treating the second hand of a $\frac{1}{50}$th sec. stop watch as the runner and stopping the watch as the hand reaches a chosen division. Therefore the correct way to time a race is to have similar signals for starting and finishing both timed by the same observer. For example, if the race is started by a pistol, then the finish should be signalled by a second pistol, fired by a practised observer watching the runner hit the tape. The timekeeper then times the interval between the pistol flashes, or stands equidistant from the two pistols and times the interval between the reports. Certainly this introduces a second observer, and so increases the chances of human error, but the method is more accurate than the usual practice, and we are left with the small observational error in firing the second pistol, and with the error due to variation in the timekeeper's reaction times in the two events. Alternatively, the timekeeper should know his mean reaction time, and when timing himself directly on starting pistol and finishing tape, he should add his mean reaction time to the watch readings. This reaction time varies from individual to individual, but is roughly constant for most individuals, and resulting errors can never be abolished so long as the timing mechanism is worked by human agency, except by multiplying the number of observers.

Several Swiss firms now make good stop watches with escapements beating fifty times a second. When testing mechanical fuses, I had an opportunity of making some hundreds of observations of my own timing errors in easy conditions for observation with $\frac{1}{50}$ sec. stop watch against a reliable mechanical record. I found my mean reaction time to be about 0·15 sec. or 0·16 sec. with a probable variation of 0·02 sec., and it could vary between 0·11 sec. and 0·20 sec. without my being in the least aware that I had been exceptionally quick or slow. When I was slower than 0·20 sec., I was usually aware that I had made a bad observation. These experiments did not distinguish between the different causes of error mentioned. The mean starting error of the watch in this case would be 0·01 sec., and the observational error as distinct from my reaction time was, I think, small and constant. I think, however, 0·02 sec. is not a large mean error to assume for the variation of reaction time in the average observer. Using a $\frac{1}{50}$ sec. watch, therefore, a single observer in the best conditions can hope for a mean probable error of 0·04 sec., or even 0·03 sec. with care and practice ;

[1] The following argument and conclusion equally apply to a complete watch, fitted with centre seconds hand with stop mechanism, since in this case the hand is worked by toothed wheels thrown in and out of gear, which can only engage in steps of a whole tooth.

but the error may easily be 0·06 sec., and in bad conditions even much greater, especially when the observation error is likely to be large.

With several observers and several $\frac{1}{50}$ sec. watches, the probable error can be reduced to 0·02 sec. or less in the best conditions. The watch errors themselves, however, soon become large if a time interval exceeding a few minutes has to be recorded, as a fast escapement is necessarily very light, and therefore a bad regulator.

Using a $\frac{1}{5}$ sec. watch, a single observer cannot time an event with a mean probable error of less than 0·1 sec., even when the observation is properly made or corrected as above indicated, and I think, taking all errors into consideration, we shall not be far wrong in saying that the probable error is nearer 0·2 sec. than 0·1 sec. and that the error may be so large as 0·3 sec. without the observer being conscious of making a bad observation, and will certainly be from 0·1 sec. to 0·2 sec. too short if improperly observed and uncorrected.

Owing to the errors necessarily associated with the use of stop watches actuated by human agency, a demand arose many years ago for more accurate methods of timing, and recording chronographs have been used for many scientific purposes. The Cambridge Instrument Co., Ltd., for at least thirty years, has made a chronograph with three pens recording on a paper strip, and this instrument has been much used in laboratories for many purposes. The pens are moved by electromagnets, so that to obtain a record an electric current must be made or broken. One pen is actuated by a 50-period tuning-fork or by a seconds clock, and the other two pens are available for recording the instants at which electric currents are made or broken. With this instrument, without any particular care, accurate records of the making and breaking of the circuits may be taken to one-hundredth of a second, and as a current lasting for only one-thousandth of a second is sufficient to give a readable record on one pen when suitably adjusted, it is clear that by running the paper fast enough, the instrument itself is capable of giving readings to 0·001 sec.

For timing motor-car races a somewhat similar instrument made by Messrs. Thomas Mercer of St. Albans is now generally used. Messrs. Mercer are chronometer makers, and they have made a very convenient portable instrument comprising a three-pen chronograph and a chronometer giving seconds contacts, and the recording strip of paper is driven by clockwork. The recording pens are actuated by means of contacts placed on the track. These contacts are in the form of strips which are normally kept apart, but are pressed into contact by the wheels of any car passing over them. The chronograph is fitted with electromagnets of the Holden type. It is clear that the duration of the contacts caused by a car at high speed is exceedingly brief, so that the electromagnets operating the pens must give a very rapid response. The armatures are actually held against the poles by permanent magnets against the action of strong springs, and the springs can be adjusted so that they are only just insufficient to pull the armatures off the poles. The current from the track contacts then passes through electromagnets which temporarily slightly demagnetise these permanent magnets, thus releasing the armatures, so that the pens move a full distance, even for a very brief current.

The defect of the arrangement, of course, is that it necessitates the re-setting of the pens before a second record can be taken. Hence an accidental contact might throw a pen out of action just as it was required. However, with ordinary electromagnet pen control, a succession of contact strips could be used at short intervals at the start and finish of the track. This would avoid the risk of one contact failing, if an uneven track caused a wheel to jump the contact, and it would eliminate doubts as to the correct interpretation of contacts, and by giving multiple records it would increase the mean accuracy. There is a distinct risk with the Holden magnets that the start is operated by a back wheel, and the finish by a front wheel, giving an error at 200 m.p.h. of 0·03 sec. or more. With the Holden type of magnet, it is also necessary for a short race that the start and finish of the race be recorded on two separate pens. This always gives a slight risk of error if precautions are not taken to see that the pens are exactly in line. Also, as the chronograph only gives contacts every half-second, it is important that the speed of the paper be quite uniform. Care must be taken, therefore, to see that the governor acts smoothly and does not cause hunting between a lesser and a greater limit of speed.

However, with this type of instrument it should be quite easy to obtain records with an error not exceeding 0·01 sec., which should be good enough for all practical purposes. Actually the readings can be easily taken to 0·0025 sec., and with care this accuracy might be obtained, but I doubt if the chronograph contacts are really reliable to this order of accuracy. With a car moving at 200 m.p.h., this only means an error of 9 in. in the position of the car: and the tracks must be straight and accurately measured if this accuracy in time is to be of value. These Mercer chronographs were used by Sir Henry Seagrave at Daytona Beach, Florida, and also by Capt. Malcolm Campbell at Verneuk Pans.

We now come to the problem of timing speed records of an aeroplane. In this case it is clearly impossible to have the aeroplane making its own contacts at the starting and finishing points, but again, as the aeroplane must make a flying start, accuracy can be obtained by increasing the number of observations, or in effect increasing the number of starting posts and correspondingly increasing the number of finishing posts; also, the number of observers can be increased with ease, as the aeroplane is bound to be high up and, therefore, visible over a large area. Therefore with, say, two chronographs, I do not think there should be any difficulty in obtaining results accurate to one-hundredth of a second, if the starting and finishing posts can be near enough together, so that both starting and finishing can be recorded on the same chronograph. In this case the chronograph must not be fitted with Holden electromagnets, but must be of the usual type as fitted in the Cambridge instrument. The observer will then press a contact on observing the aeroplane cross each of a series of planes which can be defined by the observer looking through a small aperture and observing when the aeroplane crosses a series of wires.

The observer should be a good distance from the course, so that the series of planes forming the starting posts may be a reasonable distance apart to enable the observer to get a series of records without being hurried, and also it is desirable that these planes, which must all meet in the vertical line through the observer, should not be at too great an angle with each other, thus introducing complications in the calculations, and even errors, if the aeroplane is far off its course. Errors, however, would be eliminated by having an equal number of observers on each side of the course and taking the means, or, if the exact track of the aeroplane is recorded, proper corrections can be calculated.

We will now consider alternatives to this method suggested by the practice of other sciences. The most obvious parallel occurs in astronomy. It is one of the commonest observations to take transit times, that is to say, the time at which a certain star crosses the meridian. It is practically the same problem as that of obtaining the time at which an aeroplane crosses a certain plane in space. If the observer can get far enough away, it is easy to follow the aeroplane in a telescope, and with a suitable mounting the telescope can be rotated in the plane containing the observer and the course of the aeroplane so as to keep cross lines in the telescope sighted on the aeroplane. If contacts are placed upon the training mechanism, the instants at which the aeroplane crosses a series of planes can be recorded without any lag or error due to the reaction time of the observer, and the error due to inaccurate following of the aeroplane can be greatly reduced by having a whole series of contacts. The observer does not know when each contact is occurring; in other words, there is nothing to flurry the observer; he can concentrate his whole attention on smoothly following the aeroplane with the lines in the telescope.

Since writing the above, I have been able to discuss the problem with Mr. R. S. Capon, who is now superintendent of scientific research at the Royal Aircraft Establishment, South Farnborough, and he tells me that he was led by exactly similar reasoning to the method which has been in use for some time on the speed course at Martlesham. With a large object like an aeroplane the telescope is unnecessary and open sights were used. To commence with, a camera free to turn about a vertical axis was used at each station as a check. Open sights on the cameras were directed by each observer on the aeroplane, and an arrangement was fitted whereby the shutter of the camera is automatically tripped when the axis of the lens is directed to the starting (or finishing) point. Simultaneously with the tripping of the shutter a recording pen marks the moving tape of the chronograph. Seconds from a reliable chronometer are marked on the tape by a third pen. The camera supplies information as to whether the observer has kept his sights correctly on the aeroplane. In this way it has been found that the method is normally so accurate that it is now usual to dispense with the taking of photographs and to rely on correct sighting by the observers (see *Jour. Roy. Aero. Soc.*, No. 194, vol. 31, February 1927).

A different method has been used for trial flights on the high-speed course at Calshot, mainly because certain apparatus happened to be available which could be applied to this problem without additional expenditure. The method has been worked out by Mr. Garner of the Royal Aircraft Establishment. In this case electrically driven Veeder counters are being used, operated from a tuning-fork giving ten complete vibrations per second. Two counters are used, one driven from a contact on one side of the fork and the second from a contact on the opposite side of the same limb of the fork. Hence the counters move forward alternately every twentieth of a second, each counter moving every tenth second. The problem in this case is simplified, as the Schneider Cup races start and finish at the same point. At the observation post a kinematograph camera is fixed in the starting (and finishing) plane, and the figures showing in the Veeder counters can be photographed simultaneously with any aeroplane crossing the observation plane. In this way, by running the kinematograph film at a fast speed, several pictures of the aeroplane are obtained, together with the readings of the two Veeder counters. From the photographs, the position of the aeroplane at start and finish and the time interval can be worked out with ample practical accuracy. The running of the tuning-fork can be checked immediately before and immediately after any flight.

This method is really only suitable when a race finishes at the starting-point, as there would be difficulties in synchronising Veeder counters at two separate observation posts. Generally, the method is not so accurate as Mr. Capon's, but it is no doubt attractive to persons who like to see instruments reading on actual dials in preference to having to measure up records.[2]

As a variant on Mr. Capon's method, which avoids turning the camera, and eliminates errors due to lag in working the shutters, I would suggest fixing the camera so that its position is very accurately known, and taking a single photograph when the aeroplane is known to be in the field. Behind the plate I should put a photoelectric cell which would record instantaneously on a chrono-

[2] Since this was written, it seems that a slight modification has been introduced for use on the straight three-kilometre speed course at Calshot. Instead of Veeder counters outside the camera, rotating discs controlled from the tuning fork are fitted in cameras at each end of the course, both cameras being electrically connected to the same fork. Thus shadow photographs of numbers perforated in the discs are obtained in the successive kinema photographs. The method for a short course is undoubtedly very accurate, as the position of the aircraft can be worked out from the photographs with any accuracy justified by the speed of the photographs.

graph through suitable amplifiers, or photographically with a string galvanometer, the exact moment of the exposure of the plate, and from the plate itself one could calculate with sufficient accuracy the exact distance of the aeroplane from the true starting or finishing post. This, however, considerably increases the cost of the required apparatus.

Mr. Capon has also patented (see Patent No. 279,959) an alternative method which is capable of very great accuracy. In this method a camera is placed at each observation post with the lens pointed normally to the course. A film is moved at constant speed in each camera across a narrow slot. In this way a continuous photograph is obtained of a narrow strip defining the starting (or finishing) plane. Any object crossing the plane is therefore recorded, more or less distorted, however, depending on its speed and that of the film. The films can be synchronised and marked with regular time intervals by means of sparks in spark-gaps near the slots, or by other suitable means.

Experimental Method in Psychology.[1]

By F. C. Bartlett.

The position which psychology occupies to-day in relation to the other biological sciences, both theoretical and applied, is due directly to its adoption of experimental method. Yet if the psychologist is asked to point out any single unshakable discovery of first-rate psychological importance, based directly and wholly upon experiment, his attempts to answer the question are always regarded as unsatisfactory.

As is known, the earliest experimentalists in psychology were physicists and physiologists, most of them with a strong bent towards philosophy in their outlook. They set up a standard which in various ways has cramped and confined experimental psychology ever since. When a physicist approaches a problem in which he has to state how a stimulus affects any kind of response, he is bound to lay the burden of explanation upon the stimulus. When the physiologist approaches the same type of problem, his emphasis is equally bound to be mainly upon the response side of the relationship. This he perfectly legitimately isolates so far as possible, trying to state its characteristics in terms of the functions of the mechanism immediately concerned.

These are precisely the type of problem that the psychologist has most often attempted to carry over into his own field. Let us consider one point which grew out of the early experimental work on psychophysical methods. Fechner believed that all the content of experience, from the relatively simple sensation to the most complex reasoning content, was definitely measurable. Mainly as a result of his own observations, but aided also by the earlier work of Weber, he thought he could demonstrate this experimentally by showing that stimulus intensities and sensation intensities are related by a definite principle, the value of the unit sensation varying with the modality of stimulation. In order to establish the zero point for a sensation of given mode, and also the series of just noticeable differences piled up from this point by increase of the stimulus, he carried out a wonderful and patient series of experiments. He employed and somewhat improved Weber's method of 'limits'; he developed the method of 'mean error', but he relied mainly upon the method, already proposed by Vierordt, of 'right and wrong' cases. This raised the problem of the doubtful judgments.

A controversy grew up which has proceeded voluminously ever since, though at the moment it seems nearly to have worn itself out. Broadly, four plans for dealing with these 'doubtful' judgments have been proposed and followed:

(*a*) to divide them equally between 'right' and 'wrong' cases;

(*b*) to ignore them;

(*c*) definitely to instruct the observer to 'guess' when he is uncertain and then, if doubt still persists, to lump all cases together with 'guesses of greater' and 'guesses of less' as constituting an area within which stimulus variations have no corresponding sensation differences;

(*d*) to prohibit the observer from being doubtful.

All these devices ignore the very points which are psychologically the most interesting and important. First they tend to treat each judgment in the series as equally and independently significant, the function of the immediate stimulus. This is certainly wrong. Secondly, no judgment of this type is the expression of a simple stimulus-response situation, but of a stimulus-attitude-response situation. To demand guesses and to prohibit doubt both alike determine an *attitude* of observation which spreads over the whole experimental situation, affecting judgments which are assigned certainty just as much as the others.

When an observer enters into an experimental situation, he brings with him propensities, tendencies, preformed organised systematic modes of response, the preformed cumulative organised effect of a mass of past discriminations. The stimulus, the situation that is presented, hits off some of these. They appear in him as an 'attitude', and it is under the active control of this that he makes his responses. Only when we know more about how this is set up and about its precise effect upon the responses made, can we safely give to the latter the necessary weighting which makes their statistical treatment genuinely significant. I think that the psychophysical methods, studied from this point of view, will yet yield some enormously important results.

If the physicist in his approach to the stimulus-reaction type of problem tends to treat the stimulus regarded objectively as the main point of interest,

[1] From the presidential address to Section J (Psychology) of the British Association, delivered at Cape Town on July 26.

the physiological method of approach is equally bound to concentrate its attack upon the immediate functional mechanism. From the earliest days up to the present a great part, perhaps the greatest part, of experimental psychology has been concerned with special sense reactions. Yet the psychologist has never staked out clearly any mode of investigation or characteristic problems which are specially his own in this field. In this he has again been over-influenced by the great founders of his science.

Yet it is not the psychologist's view of the problem, but his handling of it, that has been faulty. Suppose we are investigating some specific sensory threshold. The response of our observer will be determined by a number of groups of factors. There are the physical characters of the stimulus: its intensity defined physically, its duration, often its medium of conduction to the sense organ concerned, relevant facts of its physical and chemical structure. There is the absolute sensitivity of the local responding physiological system, though this can never be absolutely measured short of cutting it out of its organic setting, which is just what the psychologist must not do, though the physiologist certainly may. There is the order of presentation of the stimulus in its series, which raises problems already touched upon in connexion with the psychophysical methods; and the correlated physiological questions of the state of adaptation at the moment of the sensory system.

Operating over and above and through all of these are the tendencies, attitudes, moods, intellectual and emotional habits of the observer, the states variously characterised as states of confidence, hesitation, doubt, timidity, assertiveness, certainty. An image, flashing out suddenly at a given point, may change the whole character of a response and of succeeding responses. So may the verbalisation or formulation of a judgment.

These so-called higher mental processes are precisely the psychologist's main concern. They can be experimentally set up and controlled to a large extent, while the other factors are kept relatively constant. It is our business to show how they are set up, and how they then powerfully determine reactions within the special sense field, even in the simplest cases of reaction. It is of no use simply to say that there *are* these determinants, and then to take refuge in a fruitless hypothetical physiology of the central nervous system. Perhaps the time may come when the bulk of sense psychology will be swallowed up in physiology, but that time has not come yet, and if we act as if it has we gain little but deserved suspicion from other scientific workers.

Already there are a few experimental studies of special sense problems from this point of view. They are less frequent and less thorough than they should be, and this is because the psychologist has generally been content to follow his more physically and physiologically minded predecessors, instead of envisaging the problems of sensory reaction for himself. When the psychologist studies a special sense response, it is his business to try to show how that response, carried out in its normal organic setting, is being determined directly by facts other than those of the immediate sensory mechanisms. Cues other than those of the special sensory stimulus are operating through response systems of a higher, or more complex, order than those of the directly excited sense. For these response systems at present psychological names have to be used, and we have to show how they come into play and what they do.

It should therefore be particularly interesting to turn to the experimental attack upon the higher mental processes. I propose to take as typical the study of the responses called 'remembering' and 'recognising'.

The experimental investigation of memory is dominated by the work of one man who is commonly supposed to have been a great benefactor of experimental psychology, but who, in spite of his impressive work, seems to me to be the errant leader of a very sheep-like flock. In 1885 Hermann Ebbinghaus published his new programme for experiments on memory processes. Already, since 1879, he had been studying his own modes of recall by methods which were at that time novel. The publication of his results settled the direction of flow of the main stream of experiments on memory from that day to this.

As is now well known, Ebbinghaus's great innovation was the use of nonsense syllables for memorising. He claimed four great advantages for these over any other type of material: they are simple; they are homogeneous; they can be indefinitely combined, but in all combinations the material remains essentially on the same level; they "admit of quantitative variation which is adequate and certain". It is fairly easy to show that not one of these four claims is in fact sound.

There is thus the old difficulty in a new form, the exaggerated respect for the stimulus or the situation. The psychologist is studying the complex responses of a highly developed organism and how they are determined. They have been called forth to meet the claims of a very unstable and varying objective environment. They are no doubt in many ways more stable than that environment. But if the environment is violently simplified it is mere superstition to trust that they also get simplified in a corresponding manner. They become different, but are just as likely to become yet more highly complex. Stability of determination, not simplicity of structure in objective determining factors, is what we need to make our experiments convincing. Stability of determination is compatible with complexity, and even with considerable variation of objective determinants. Somehow an experimental method has to be developed which recognises this fact.

I turn for a moment to experimental work on 'recognition' merely to bring out one further point of method. Since very early days an enormous amount of work has been done on this topic. It has issued in five or six different theories no one of which can claim finality. The diversity of this result is due to different causes, but one is perhaps particularly important. There is a strong tendency, when any complex response like recognition is being studied, to attempt to draw a ring round it and to seek its explanation within these imposed limits. Thus the explanation of recognition is sought in something that happens at the moment of recognition. This is surely wrong. An object or event may be recognised or not largely on a basis of how it was reacted to in the prior perception. A sound, for example, may be heard: it will not be recognised unless it is so listened to that it possesses qualities, characteristics, a setting, and a significance. To the persistent study of a complex mental response as if its psychological explanation must be found inside an imaginary circle that encloses it, much of the disrepute into which experimental psychology tends to fall may be traced. It is perhaps the last and subtlest form of the outworn 'faculty' psychology.

I said at the beginning that the early experimentalists in psychology were physicists and physiologists with a strong bent towards philosophy. If in the history of the subject experimental psycologists have shown themselves too submissive to physical and physiological methods, it is even more true that they have often pursued philosophical ideals. This pursuit is in full cry still. A very brief consideration of current movements which originate in the laboratory will illustrate this point.

There is probably no contemporary movement in psychology which has more profoundly influenced psychological thought in English-speaking countries than the so-called *Gestalt Psychologie*. I have, as every experimental psychologist must have, a very great admiration for the brilliant work of Wertheimer, Köhler, and Koffka. It has shed much new light on old problems, as well as a good deal of old light on new problems. It starts specifically from experiments upon visual perception and its primary method is that of phenomenological description. When we are presented with a perceptual situation, what is it that we experience? The answer is inevitable and is one which, from this point of view, has, I think, always been given. We cannot describe our experience in this sort of situation as a mosaic of tiny bits each corresponding with its isolable part of the stimulus or situation. The blue sky which is seen is not, as Köhler says, made up of an infinite number of blue sensation units, but is seen as a continuous blue expanse. The moving dots and lines, in Wertheimer's experiments, are seen, not as stationary points in temporal relations, but as a unitary and indivisible movement.

Sometimes the experiments are more behaviouristic, but still it is the attitude of phenomenalistic description that determines their interpretation. The animal that has been trained to react positively to *a* and negatively to *b* at once reacts positively to *b* if *a* is removed and *c* is introduced bearing that relation to *b* which *b* had to *a*. This must be because the initial reaction was not to *a*, or to *b*, and not to *a* and *b* and a relation between *a* and *b*, but to a total indivisible situation only to be described as *a-b-in-relation*. Again, an animal is set a complex problem and typically achieves the solution suddenly; for what we call the 'correct' solution is a reaction to the total situation as built, or figured, or formed.

Thus a fundamental psychological question tends to be: "What is the nature and what are the characteristics of these indefeasible forms or patterns which stand over against all our reactions, compelling them to be as they are?" In our answer we can easily slip into the persistent error of over-emphasis of the objective side of the situation-response problem. I do not say they do this, but in his doctrines of physical *Gestalten*, Köhler comes very near it. Or again, looking to the response side, we may try to build up inside the responding mechanism a complex system, somehow corresponding to the integrated phenomenal situation. Then, as in Köhler's theories of ionic concentration within the central nervous system, we are almost sure to slip into sheer speculative physiology. Finally, the phenomenological attitude seems bound to issue in a comprehensive theory about the nature of the world as we know it, rather than in a scientific study of the determination of human response. It is the latter alone which is truly amenable to experimental treatment.

There is another contemporary movement, also originating in Germany, much less widely influential in other countries at the moment, but likely to attract more and more attention. This springs from the work of Prof. E. R. Jaensch. It also has a definite experimental basis. Jaensch experimentally discovered a type of imagery which seemed to lie somewhere between the after-sensation on one hand and the genuine memory image on the other. I cannot attempt to describe his extremely keen investigation of this *eidetic* imagery, as he called it. At the moment the main point is that he considered it demonstrable that a proneness to eidetic imagery is correlated with a number of other reaction tendencies. He elaborated a theory of the twofold division of all human subjects into integrate and disintegrate types. The integrate is the artistic, synthetic type, taking everything as a whole and having an inevitable accompaniment of persistent marked temperamental qualities and tendencies. The disintegrate is the scientific, analytic type, tending to split up presented situations and to deal with them piecemeal, and he also has his invariable, persistent, accompanying temperamental character.

Now this view does certainly seem to be biological in bent, and it is being explored throughout by experimental study. Moreover it strives, and, I think, successfully, to avoid that artificiality which, as we have seen, hangs over conventional laboratory methods for the investigation of the higher modes of human response. It rightly treats our problems as problems of reaction tendencies, of their determination and their grouping. But it does seem to be rather in a hurry with its sweeping generalisations.

In contemporary English psychology there is only one complete and world-explaining system of this sort, and that is the system which has been developed by the keen and penetrating work of Prof. C. Spearman. Here again we are invited to begin with experiment, not merely upon perceptual processes, not merely upon imagery, not merely upon more complex intellectual responses still, but upon any psychological problem whatever. Where-ever we begin we shall speedily find illustrated the working of the few immutable laws upon which all mental structure, and it may be the very universe itself, are built. They stand indeed at the portals of our science. Know them and everything is plain; ignore them and all is confused. They are conceived, not as tendencies serving the ends of biological adaptation, but after the fashion of physical principles of universal scope describing the inevitable structure and frame of mental life.

That Prof. Spearman has done more for the development of several fields of psychological research than any other living Englishman cannot be disputed. His contributions to the development of psychological statistics, and his work in the field of the investigation of intelligence must give him a permanent place in the history of the subject. Yet the notion of experiment mainly as a tool for laying bare and illustrating the operation of a few basic and fixed laws must seem to the biologically minded investigator very unsatisfying.

No survey, however scrappy, of contemporary movements in experimental psychology can be satisfactory without some reference to behaviourism. Of all the movements this is the one which is most thoroughly experimental, alike in its methods and in its formation of problems. It has laid firm hold on the point of view that experimental psychology is an investigation of the conditions determining high level biological reactions in animal and man. It is so round in its denunciation of philosophy that its excessive readiness to systematise its own principles of explanation is amusing. We can see this readiness in the haste with which it has exalted the principle of 'conditioned reflex' into an all-embracing explanation, though many of the problems of human response concern the emergence of new effector functions and conditioned reflex has nothing to do with this, and though conditioning at the human level is excessively speedier and often far more stable than anything that has ever been experimentally observed.

We can see it, also, in the behaviourist's dogmatic assertion that the development of consciousness within any type of biological response never makes any difference in subsequent response. Such dogmatism is only another instance of the experimental psychologist's fatal proneness to run beyond his data. It is explicable in the light of a study of the origins of behaviourism, for it was by the adoption of behaviouristic methods alone that the investigation of animal response below the human passed from the anecdotal and analogical stage and became genuinely a part of biological science. But to push the principles involved into the whole of human psychology is just as bad as to carry out some departmental investigation into perceiving, or imaging, or thinking, or some sensorial function, and then to use the results forthwith as a master-key to all the problems of human determination.

Some of the reasons why experimental psychology has often attracted unfavourable criticism and failed to hold its students should now be clear. In work on the special senses it has frequently attempted to deal with problems that the physicist or the physiologist with their specialised training could solve more satisfactorily. In dealing with the higher mental processes it has been over-impressed with the necessity of standardising objective situations and has constantly proceeded as if the simplification of a stimulus were equivalent to the isolation of a response. Persistently it has shown unnecessary readiness to build upon specialised investigations wide systems which pretend a finality and universality that they do not possess.

I believe the time has now come for pushing these criticisms vigorously and for attempting to meet them in practice. It could scarcely have come much earlier. After all, whatever the limitations of his outlook, it may fairly be claimed that the experimental psychologist has done more than anybody else to keep alive the interest in special sense problems. As for the work upon relatively more complex processes, a new and struggling science was almost bound to imitate methods already fully established in other fields and to exploit them so far as they would go.

Holding all this firmly in mind, what conclusions can we draw? First, it follows that the experimental psychologist must claim that for the present, and perhaps for always, he is as much clinician as experimenter. He has not merely to arrange conditions and record results. There seems to be a notion abroad that there is so much uncharted ground in psychology that an investigator can do anything he pleases, and so long as he observes everything possible, his results are bound to be significant. This is utterly false. His observation is definitely that of a man with a problem, and generally also with a personality, in view; and it is by consequence almost glaringly selective. He is not alone among experimenters in this respect.

From a reading of the theory of the matter one might be tempted to suppose that the best experimenter would, once the experiment is arranged, be merely a rather complicated and delicate recording and calculating device. Those who have a reputation for brilliant experimental work in any field singularly fail to impress this character upon the intelligent and sympathetic onlooker. Anybody who by experiment is going to discover anything important about the determination of human reactions must first have developed a certain character of human reaction for himself. If this is to be used against him when he claims validity for his discoveries, it is a sort of stone he can return with some effect, whoever his opponents may be.

Yet it is extraordinarily important that the experimental psychologist should not be exclusively concentrated upon the particular reaction which he is specifically studying. Just because it is the intact subject, the intact organism, that we are concerned with, the conditions of any reaction are apt to branch widely. The problem for us, for example, is not to find out how the eye sees or the ears hears, but how the animal and man do. No doubt we can answer this problem only in an imperfect way, but it takes us no nearer perfection to cut the ear or the eye out of the man. This is true with increasing force as we go higher in the level of response. Indirect cues are neither to be ignored, nor to be cut out, but definitely to be studied.

Secondly, no experimental psychologist must profess, with unvarying belief, the dogma of constancy of objective conditions. If, biologically speaking, human reactions had been built up to meet a series of unchanging environments, emphatic insistence upon rigidity of conditions would be justifiable. Obviously, they are not so built. So far as the psychologist is concerned, many of the most important characters that dominantly set the course of our reactions belong directly to the organism with which he is dealing, to its immediate and remote past history and to its present specific and general state of adaptation.

In the third place, the position which I have stated carries with it that the experimental psychologist, at the end of his studies, has to be satisfied with indicating trends, directions, proclivities rather than dogmatic laws. His phenomena are essentially biological, in process of development, displaying no hard-and-fast boundaries anywhere. He may formulate dogmatic laws, and use experiments as imperfect illustrations ; but this is the wrong order of things, though it has been by far the commonest and is still the easiest.

Finally, there is the question of the relation of the results of specific experimentation to the claims of general systematic theorising. I am not for one moment for the haphazard experiment that has no idea, no broadly formulated problem, behind it. Also I would condemn that scatter of descriptive results, unco-ordinated, unsystematised, which is common in many directions nowadays. We must explain our results and not merely collect and exhibit them. Yet I would urge that when we have, for example, satisfactorily stated the conditions of some particular perceptual reaction, we have no more right to pronounce magisterially upon a complex problem of reasoning than a physiologist who has studied respiratory functions has to pretend at once to clear up the secrets of spinal reflexes. No doubt the physiologist would never for a moment attempt to do this, but unfortunately it is not so easy to answer for the pretensions of the experimental psychologist in a like case. It may even be that all our specific studies will lay bare common broad principles of the determination of response. Even so, the broad principles are not the explanation of the specific problem, and for whatever they may be worth, before we erect them into a comprehensive system, we must have the specific problems widely and patiently worked out.

Obituary.

Sir E. Ray Lankester, K.C.B., F.R.S.

EARLY in the year 1879 I received a letter from the eminent comparative anatomist, Kitchen Parker, advising me to come over to Cambridge to take Francis Balfour's course of lectures in comparative embryology. I sailed from New York two days later, and by far the leading personal impression of my life was in meeting Francis Balfour in the great court of Trinity College, Cambridge. At this first moment he seemed to me a superman, and the impression was continually strengthened during the frequent and ever memorable contacts in lecture room, laboratory, afternoon bicycling trips, and evening dinners in Balfour's rooms. On these weekly occasions he was wont to invite two or three of his students, including William B. Scott and myself, to meet sympathetic colleagues of his from London, Cambridge, and Oxford. Among the latter I recall especially young Oscar Wilde, who was just beginning to attract attention; Henry N. Moseley, fresh from the *Challenger* voyage; and E. Ray Lankester, then professor of zoology and comparative anatomy at University College, London.

This fortunate early acquaintance with Lankester ripened into a lifelong friendship, sustained in more recent years by active correspondence and interchange of ideas. I was never able to induce Lankester to visit America, because, as he freely confessed, there was one thing in the world which he hated and dreaded, and that was a sea voyage—probably from unhappy experiences in crossing the English Channel which undoubtedly hurt his pride as a physiologist and anatomist! But on every occasion when I returned to England I eagerly refreshed my personal acquaintance with him, spending delightful hours in his rooms in Chelsea, partly recalling our Cambridge days but more frequently discussing the newer phases of our knowledge of the ascent of man revealed by the discovery of the rostro-carinate flints along the shores of East Anglia. It was probably Lankester who suggested this highly appropriate name for these 'beak-keeled' implements found by J. Reid Moir of Ipswich.

I consider Lankester's warm support of Reid Moir's excavations and his courageous advocacy of the *human origin and manufacture* of these primordial flints, against the incredulous and indifferent attitude of the reigning archæologists of the day, one of the most striking evidences of his independence of judgment and of his powers of observation. He loved to handle the few specimens of these flints of East Anglia and of Piltdown, Sussex, which he kept in his home, and he forcibly and often vehemently championed their authenticity. On one very salient point we always differed; namely, on the geological age of the rostro-carinates. He steadily insisted that they were Pleistocene, while I maintained that they were Pliocene, a distinction with a very important difference.

As the last survivor of the great group of Victorian zoologists and a veteran of many scientific and geological contests, Lankester represented all the ardent convictions and intensities of feeling which have now given way to the placid contemplation of past controversies and a lack of intense conviction and even personal animosity over differences of scientific opinion and interpretation. On the occasion of my last visit to Chelsea, in the summer of 1926, he flared up on a theological question and vividly recalled to my mind the heated arguments of the period when I first had the privilege of meeting him in Cambridge. Overcoming his advancing physical infirmity with characteristic courage, Lankester gave up attendance at gatherings in which he was wont to be a gladiatorial leader, but the fires of his intellectual, scientific, and moral intensity burned as brightly as ever. Next to Huxley he was the most combative zoologist of his age, and next to Huxley the most ardent disseminator of the truths of Nature. While violent and even uncompromising in controversy and in his opinions and estimates of other men, on the other side of his nature was a delightful spirit of romance, tenderness, and warmth of affection which endeared him to all his closer friends.

In the passing of Sir E. Ray Lankester we have lost one of the great figures and forces in the zoology and biology of the nineteenth century.

Henry Fairfield Osborn.

University College, London, celebrated its centenary last year, yet Sir Ray Lankester succeeded the first professor of zoology—Robert Grant of Edinburgh. Grant had many pupils of eminence, including Sir Michael Foster, but his brilliant early promise was not fulfilled, and waned before his death into insignificance. Ray Lankester suddenly and swiftly made the zoological lecture-room one of the most noted places in the College. It was said that he was the only man in London who could hold his lectures at one o'clock, the sacred luncheon-hour, and have them crowded. His lecture-room, and Balfour's at Cambridge, were the two foci from which the new views on morphology and evolution were spread through the academic world, and his *Quarterly Journal of Microscopical Science* was the organ of publication for the researches—now classic —which were going so swiftly, and apparently so surely, to complete Darwin's work.

Lankester's lectures were astoundingly perfect. Three days a week, at one o'clock, the lecture-room was lined with wall-diagrams, made under Lankester's direction and often from his own drawings, and hung on the wall in appropriate order by his skilful coadjutor Jessop (happily still with us). Every seat was filled, and one or two women students were allowed to listen, unseen, in the gallery. The professor entered—a powerful, resolute, confident figure, with strong black hair and muscular torso. He looked round the diagrams, surveyed us (as we felt, somewhat as if we were cockroaches), and gave for an hour a clear consecutive account of forms and conceptions wholly new to us, with such skill that we were unconscious of the marvellous scope and concentration of his lectures, and unconscious of difficulty in the subject. At the same time, apparently without effort, he drew on his many blackboards with firm sweeps of wide lines clear diagrams, which were left untouched during the day for those who had been unable to copy as quickly as he drew. I have no recollection of seeing him refer to notes except to dictate the definitions of groups, or rarely for some drawing.

For us in 1881, Lankester was infallible, yet his lectures set us arguing and theorising and longing to advance knowledge. "The reproduction of *Euglena* is not known", he said in one lecture; "this is not because there is any impossibility of knowing it, but because it has not been observed. Any one of you may find it out by carefully watching and examining a glass of water containing *Euglena* for twenty or thirty hours, and if you write down your observations they will be read with interest by every zoologist in Europe". He told us of one important discovery by the patience of an unknown amateur and of another important discovery through accident, and breathed into us the passion for advance of knowledge which informed his life.

Geo. P. Bidder.

The influence of so prominent, so highly cultured, and so energetic a naturalist as Sir Edwin Ray Lankester could not fail to have an important effect in his day, especially as the value and extent of his own original labours covered so wide a field, namely, from Protozoa to Vertebrates. Since his early paper on the developmental history of the Mollusca, with its twelve quarto plates, zoologists felt that here was a brilliant colleague, and his subsequent career more than justified the opinion, not to allude to the able men such as Benham, Goodrich, Willey, Sydney Hickson, Robt. Gunther, and others trained under him.

In every field he entered Lankester left his mark; and with his facile pen and pencil extended our knowledge of Nature and her ways. To the last he resolutely fought for the early introduction of the study of Nature in the school curriculum, and for the liberal treatment of natural science and its workers by our legislators. No man had a wider influence in spreading the knowledge of biological science amongst the public; indeed, his labours in this respect—from first to last—call for grateful remembrance. His fascinating lectures, and his attractive popular articles in various channels, rendered him, perhaps, the best known zoologist of his day, whilst his familiarity with physics and chemistry enabled him to add breadth to his views. His influence spread to the medical profession by his suggestive papers on *Trypanosoma* and other dangerous tropical pests, on Pasteur and hydrophobia, and on centenarianism.

Lankester's life-long interest in marine zoology culminated in the establishment of the important Plymouth Marine Laboratory, and few know of the minute study he made previously of the only British Marine Laboratory and its surroundings along with Prof. Hubrecht and Mr. (now Sir) A. G. Bourne. Lastly, as Director of the Natural History Departments of the British Museum, chief editor of the *Journal of Microscopical Science*, and bearing other responsibilities, he worthily held the most prominent position of his day in biology, and the loss of so capable a man and so genial a friend is deeply felt. W. C. M'Intosh.

Sir W. Baldwin Spencer, K.C.M.G., F.R.S.

This is written away from books and other aids to memory, and must be taken for what it is, not a biographical sketch but rather an appreciation. Baldwin Spencer graduated at Exeter College, Oxford, and has for many years past been one of our honorary fellows; so I was in the way of seeing him whenever he was in England. Again, on a visit to Australia with the British Association in 1914 I had the chance of observing him at work among the countless treasures with which his explorations had enriched the Melbourne Museum.

About his personality I need say no more than that Spencer himself was more inspiring even than his books. He had all the traits of the first-rate man of science—faithfulness to fact, cool and penetrating judgment, hatred of humbug and half-truths, and, above all, a forcefulness and courage that made him not only conceive noble schemes of research but also carry them out at all costs to a finish. Alas! his own end among the rigours of Tierra del Fuego is proof enough of an intrepidity verging on recklessness. I had a letter from him written from that desolate spot very shortly before his death, in which there is not the slightest hint of danger ahead, and every word betrays the enthusiasm provoked by the prospect of good hunting. Though his voyage out in a cargo-boat (on which he had to sign on as purser to get a passage) cannot have been altogether luxurious, he makes light of it. Indeed, his only complaint, if it can be reckoned one, is that the Argentine authorities insisted on his maternal cognomen being tacked on to the paternal 'Spencer'—a fact that reminds him, he says, of the fact that the matrilineal system is not confined to aboriginal Australia.

Now as to the inspiration that all of us have received from Spencer's books. It is no exaggeration to say that "The Native Tribes of Central Australia", when it appeared in the late 'nineties, gave a new orientation to social anthropology. The biologist of the Horn Expedition of 1894 to the Central region had soon discovered that nothing among the rest of the fauna could compete in interest with man, and, fortified by the local knowledge of Mr. F. J. Gillen, had produced a monograph that exhibited Stone age mentality as something almost *sui generis*, so utterly did its processes differ from those of civilised humanity. Soon Sir James Frazer had got to work on the new facts, and it would scarcely be unfair to say that for him, henceforth, primitive man meant first and foremost the Arunta. So it was with the rest of us. I have numerous letters of that period from Andrew Lang which—though he by no means saw eye to eye with Sir James Frazer on questions of theory—are equally obsessed with the Central Australians as the real thing at last, the human prototype as near as we shall ever meet him in the flesh.

Spencer's further accounts of the North-Central tribes and of those of Northern Territory proved no less sound, if a little less startling, since they revealed what were essentially the same conditions—namely, totemism and a type of cult which some would call magic, others rudimentary religion, the two in close conjunction and permeating every department of the native life.

It may be added by way of testimony to the conscientiousness of Spencer as a man of science that recently he has revised his whole study of the Arunta, correcting linguistic slips and more especially seeking to make allowance for the fact that Gillen and he were in closer touch with one part of the tribe, or rather nation, than with the rest—the total result, however, being to confirm the fundamental accuracy of the original presentation. His works will survive alike on account of their unique contents and because they are models of scientific method. A great man has passed away suddenly, even tragically. But, mourning him, his many friends will be consoled to think that what he wrought will not pass away; for he wrought as a master. R. R. Marett.

We much regret to announce the death at Washington of Mr. Emile Berliner, one of the inventors of the microphone and the inventor of the gramophone. Born in Hanover on May 20, 1851, Berliner migrated to America in 1870 and became a salesman in Washington, and it was there in 1876 that he began experimenting with Bell's recently invented telephone. The following year, almost simultaneously with Edison, he brought out his device for varying the electric current by varying the pressure between two contact points, and many years later the Supreme Court of the United States declared Berliner to have been the original inventor of the transmitter. Berliner's next notable invention was the gramophone. Edison's phonograph, patented in 1878, included wax cylinder records cut by an engraving tool which rose and fell—the 'hill and dale' method. Berliner employed discs which were engraved by a tool which vibrated from side to side—the 'lateral cut' method. His patent was taken out in 1887, and his original machine was exhibited in the Franklin Institute on May 16, 1888; it is now in the National Museum, Washington. Berliner also devoted himself to the improvement of the acoustic properties of public buildings, and in 1907 brought out a revolving cylinder internal combustion engine for aircraft.

We regret to announce the following deaths:

Dr. T. J. I'A. Bromwich, F.R.S., formerly fellow and prælector in mathematical science at St. John's College, Cambridge, and University lecturer in mathematics, on Aug. 24, aged fifty-four years.

Prof. S. B. Schryver, F.R.S., professor of biochemistry at the Imperial College of Science and Technology, on Aug. 21, aged sixty years.

News and Views.

There appears to be no end to the difficulties which beset zoological nomenclature. No sooner has one set of decisions been issued than zoologists are invited to send to the International Commission their opinions regarding a new batch of recommendations. The most recent recommendations are proposals made for changes in the International Rules for Zoological Nomenclature, but the proposals are so numerous that they cannot all be circulated, and zoologists must, if they so desire, consult many of them either in scientific journals in which they have appeared, or in manuscript at the office of any of the Commissioners. The circular issued by the Secretary to the Commission gives no hint as to the weight laid upon the opinions of zoological societies or private zoologists by the Commissioners who receive them, but the general impression made by the propositions for revisal is that there is a fairly widespread dissatisfaction with the rules as they stand or as they have been applied.

It is impossible even to indicate here all the suggestions that have been put forward for the revision of zoological nomenclature, but two of very general interest may be referred to. The proposal is made that the starting-point of zoological nomenclature should be the twelfth edition of Linnæus, and not the tenth edition as at present. In our opinion, the adoption of the tenth edition was a blunder, but whether it is possible now to undo the evils that have arisen from that false step and the acceptance of many papers printed in the transitional stage from 1758 to 1766 which it made necessary, is a question demanding the most careful consideration. A second proposition of great significance paves the way for a more strict definition of papers which may be accepted for purposes of priority in zoological nomenclature. It is essential that no dubiety should exist as to what constitutes acceptable 'publication', and that freak publications should be ruthlessly barred. If the recommendations here made have the effect of confining attention to genuine papers of scientific intention and import, they will help to clear the somewhat cloudy air of zoological naming.

In view of complaints which we understand have been made by fishermen in Scotland regarding the damage caused to fishing gear and to food fishes by seals, the "Report on the Seals and Sea Lions of California", issued by the Californian Division of Fish and Game (1928), is of more than usual interest. The complaints made in California are similar to those made in Scotland: that the animals are very numerous, that they are increasing in numbers, and that they take enormous quantities of fish of economic value and cause considerable damage to gear. The very extensive investigation made by the Division of Fish and Game shows that the complaints are, to say the least, much exaggerated. The only satisfactory method of deciding the exact nature of the food is by examination of stomach contents, and this has shown that the food consists of great variety, some of the animals containing only squids and octopods, while the great bulk of the food of the others consisted of coarse fish not used commercially. Of thirty-five seals examined in one instance, only two "contained food items in kind or quantity worth considering with respect to their direct bearing on the fishing industry". With regard to the damage to gear the evidence was also unsatisfactory, most of it being vague and circumstantial. The conclusion reached here was that although a certain amount of damage appears to be done to gear, it did not appear to be very extensive, and a good deal of the damage credited to sea-lions and seals may well have been caused by other creatures.

The full scientific staff for the British, Australian, New Zealand Antarctic Research Expedition under the leadership of Sir Douglas Mawson has now been selected. Counting the leader the number will be 13, making with the master and crew of the *Discovery* a total of 40 souls. Dr. W. Wilson Ingram (Sydney) an 'old contemptible' with a distinguished war record, has been appointed medical officer. Mr. Marr, who has been on the *Discovery* in a former expedition, and Prof. Harvey Johnston, of the University of Adelaide, will be senior zoologists, assisted by Mr. H. O. Fletcher of the Australian Museum, Sydney, and Mr. Falla of New Zealand. The two latter will specialise in taxidermy. Mr. A. Howard, of the University of Melbourne, will be responsible for chemical work, and Mr. R. G. Simmers of the Meteorological Office, Wellington, New Zealand, for meteorological observations. Instructor Commander H. Moyes has been seconded by the Australian Navy to act as survey officer, while the Australian Air Force is providing two aviators in Pilot S. Campbell of H.M.A.S. *Albatross* and Sergeant Douglas of the Flying School, Point Cook. Petty Officer Williams has been appointed in England as echo-sounding and wireless expert, and Mr. Frank Hurley, well known for his work in the War zone, in the Antarctic, New Guinea, and elsewhere, will be official photographer and kinematographer. The master of the vessel is Captain J. K. Davis, and the crew has been selected almost entirely in England. The whole Expedition, therefore, is a fine example of British team work. Besides the contributing governments and the many firms which have donated gifts of food and clothing, Mr. MacPherson Robertson of Melbourne has made £10,000 available to meet the costs of the Expedition. It is anticipated that the *Discovery* will reach Cape Town early in October and take on board the contingent from Australia which will arrive in the s.s. *Nestor*. The vessel will then proceed to Kerguelen and, after coaling, sail to the Antarctic.

On more than one occasion we have directed attention to the fine progress made by the museums of the United States in catering for the needs of youth. The Field Museum of Chicago, founded in 1893 by a donation of 1,000,000 dollars from Marshall Field, afterwards supplemented by a further 8,000,000 dollars bequeathed on his death, has always kept the interests of children in the foreground, and now publishes a pamphlet, "Field Museum and the Child", dealing with these activities. Free admission to the museum is granted to children and their teachers on all days, but this passive policy is supplemented by many extramural efforts. Portable exhibits, numbering 1000, on natural history and economic subjects, are sent into the class-rooms. Lecturers are sent to the schools to give illustrated talks on subjects studied by the children in their classes, and to direct attention to exhibits in the museum which further illustrate these subjects. Still other work of this nature is carried on within the museum building itself, and includes the direction of the child's explorations in the treasure house of knowledge, the correlation of museum studies with schoolroom work, and the supplementing of museum exhibits with lectures, moving pictures, and lantern slides. Attractive printed stories in souvenir form, based on the lectures and pictures, and on related material in the museum, are distributed to child visitors.

The paragraphs in our issue of Aug. 17 (p. 274) on museum co-operation have brought a letter from Dr. Marie C. Stopes referring to the Portland Island Museum, of which she is honorary director. This museum is now being established on the island of Portland to preserve specimens of the biological and the palæontological riches of the island, and also records of the island's history. The museum is already housed in the oldest cottage on the island, the freehold of this and some land adjacent having been given; the money for its restoration to its original appearance has been collected almost entirely by the islanders themselves, and the local urban district council has made the necessary arrangements to take over the Museum when complete. The Museum is badly in need of exhibition cases, and Dr. Stopes asks the authorities of the larger museums where wooden cases are being replaced by metal ones to bear in mind the needs of the Portland Island Museum.

The Empire Marketing Board has approved a capital grant not exceeding £30,000 to be devoted to research on Empire timbers at the Forest Products Research Laboratory at Princes' Risborough, under the Department of Scientific and Industrial Research. This grant arises out of a recommendation made by the Imperial Economic Committee in its report on timber, in which it was suggested that the marketing of Empire timbers might be considerably furthered if the Princes' Risborough station could be enlarged so as to include the testing of woods from the Dominions and Colonies as part of its normal routine. Although the Empire can supply an unrivalled variety of fine timbers suited to almost every purpose from its two million square miles of forest land, at present nine-tenths of our imported woods come from foreign sources. A lack of exact information concerning the technical qualities of the various Empire timbers and their potential uses is, it is felt, largely to blame for their restricted use and it is with the object of assisting to fill in this gap that the grant has been made. The station will, when so enlarged, undertake the examination of new Empire timbers to obtain an indication of their possible uses. It will further test their seasoning characteristics, determine their strength values, carry out woodworking trials to ascertain their machining and finishing qualities, and, in general, carry out both routine and special work on woods from Empire sources. An Empire Timbers Committee is also being set up under the Department to advise the Princes' Risborough Laboratory on the priority to be given in the choice of timbers for test and in other calls on its services.

The question of the standardisation of the voltage of supply for electric lighting and power is at present being seriously considered by electrical engineers. It is found that the householder hesitates to purchase domestic electric appliances, thinking that if he ever wants to change his neighbourhood the new pressure of supply will probably be different, and so the appliances he is thinking of purchasing would have to be scrapped. Some years ago, the British Electrical Standards Association (BESA) fixed the standard voltage of supply in Great Britain as 230, a voltage which was approved by the Electricity Commissioners. Unfortunately, the number of stations that supply at 230 volts is still in a minority, and the cost of changing over the pressure of supply of all the stations in the country would be greater than 20 million pounds. All kinds of pressures are in use, varying between 100 and 250 volts, but most of the stations supply at pressures not less than 200 volts. The lack of standardisation in the early days of the industry, when each consulting engineer paid little attention to the pressures already in use, is now beginning to hamper progress, and consumers supplied at freak voltages pay more for their lamps. Other nations have the same trouble. In a recent journey abroad we noted that the pressures of supply marked on the lamps in the bedrooms of the hotels at which we stayed were as follows: Chantilly, 250; Avignon, 210; Cavalière, 230; Aosta, 150; Locarno, 135; Geneva, 130; Troyes, 125; Le Touquet, 110; and at Calais the lamps were marked 125-130. Apparently, therefore, the need for standardising pressures is also urgent abroad.

A leaflet recently published describes the "Scientific and Technical Positions in the National Bureau of Standards of the United States" and how they are obtained (Washington, D.C., U.S. Government Printing Office). All positions on the staff are subject to the competitive requirements of the civil service regulations. Every candidate, therefore, must qualify through a civil service examination. Applicants, however, for higher grades are not subjected to a written examination, but are rated on their education, experience, and writings. They must be citizens of the United States. The advanced courses at the Bureau are accepted by several universities as credits towards a higher degree. Junior assistants are offered the opportunity of continuing their college work at local universities; in fact, employees in the lower grades are expected to prepare themselves by study for higher grade positions.

Educational facilities are also afforded by the weekly meetings of the staff, co-operative courses of study, and by lectures from visiting scientific workers. The salaries range from 600 dollars, that of a junior messenger, to 9000 dollars, which is the annual salary of the heads of the professional and administrative departments respectively. Stress is laid on the amenities of the site of the laboratory. The buildings are arranged like a university "on a natural hill amidst beautiful country surroundings" and only about 3½ miles from the centre of Washington. To show how attractive the life is, the facilities for many outdoor sports, including polo and skating, are mentioned. We are told also that the Potomac River is much used for canoeing and swimming, and that its banks are suitable for camping and 'hiking'.

ACCORDING to the Report of the United States National Research Council for the year July 1927–June 1928, which forms part of the Report of the National Academy of Sciences for the same period, the expenses for the year were £170,000, 35 per cent of this being for the support of research fellows, 33 per cent for research in charge of committees of the Council, 13 per cent for research in charge of other organisations, and 19 per cent for general maintenance and charges. The funds for the fellows come from the Rockefeller Foundation and the General and International Education Boards, those for general maintenance from the Carnegie Corporation, and the rest from other sources outside the Council as set out in detail. The fellows number 18 in physics, 25 in chemistry, 15 in mathematics, 25 in medicine, 43 in biological sciences, and 49 in child development. The Report extends to 95 pages, and 20 pages of it are devoted to short accounts of the work done in each of these divisions and 4 pages to details of expenditure.

WE have received the annual programme of the Belfast Naturalists' Field Club, together with some additional information, and have been impressed by the liveliness of this field club, which has celebrated its sixty-seventh session by electing its first lady president, Miss W. J. Sayers, and by reaching a membership of one hundred in its well-conducted Junior Section. The total membership having reached 585, a limitation has been put upon the number of new members; the new rule provides for the election of twenty-five new members in each half-year and elections only at the two specified meetings. Although still a very long way from the 180,000 membership of the Gesellschaft der Naturfreunde in Stuttgart, the Belfast Field Club appears to be one of the most active naturalists' clubs in the British Isles.

THE Gorgas Memorial Institute of Tropical and Preventive Medicine, initiated in memory of General Gorgas, who did so much for the eradication of yellow fever in Cuba and Panama, is now in operation. The object of the Institute is to conduct an intensive campaign against unnecessary sickness and premature death, and to carry on research in tropical diseases at the Gorgas Memorial Laboratory established in Panama. The United States Congress has voted 50,000 dollars annually for maintenance, and it is expected that the countries of Latin America will also contribute.

THE Minister of Health having considered the report of a Committee appointed to inquire into vaccination in Great Britain, has decided to amend the Vaccination Orders so as to give effect to some of the recommendations, which are briefly as follows: (1) In place of the officially advocated four insertions, trial to be made of vaccination and re-vaccination in one insertion, with a minimum of scarification; (2) primary vaccination to be performed in infancy as at present, and re-vaccination to be offered at school-entering and school-leaving ages; (3) vaccination in multiple insertions to be still available for persons who may desire it; and (4) in public vaccination, if after-treatment be required as a consequence, it is the duty of the public vaccinator to provide such attention without cost to the parents. (Ministry of Health: Circular 1025a, and "Statutory Rules and Orders", 1929, No. 640, London: H.M. Stationery Office.) The new order comes into operation on Oct. 1.

THE Secretary of State for Scotland and the Minister of Agriculture and Fisheries have appointed the following committee "to investigate the origin, predisposing causes, and mode of dissemination of furunculosis and similar infectious diseases among salmon, trout, and other freshwater fish in England and Scotland, and to conduct experiments with a view to ascertaining methods of combating the diseases": Prof. T. J. Mackie (chairman), Prof. J. A. Arkwright, Mr. T. E. Pryce-Tannatt, Mr. J. C. Mottram, Mr. Douglas Johnston, Mr. W. J. M. Menzies. The secretary of the Committee is Mr. William Martin, of the Fishery Board for Scotland, 101 George Street, Edinburgh, to whom communications should be addressed. A series of epizootics of furunculosis among salmon and trout in Great Britain in recent years has been sufficiently extensive to occasion considerable damage to valuable fisheries in the rivers affected. A smaller committee has already made preliminary investigations, and several reports have been issued on the scientific work which has been undertaken and on the specimens which have been taken in the areas of infection and examined. A most important result which has been established is that apparently healthy fish may act as carriers of furunculosis, and the relationship of this fact to the incidence and spread of the disease among home and imported fish will form one of the considerations to be investigated by the new Committee.

THE tenth Annual Report of the Ministry of Health, 1928–1929, has been issued. The subjects dealt with fall under the main heads of public health, local government and finance, administration of the Poor Law, and administration of National Health Insurance and Contributory Pensions. The report of the Chief Medical Officer of the Department is issued separately. The remarks on canal boats by the Inspector, Mr. Owen J. Llewellyn, are of some general interest. Few boats now make short journeys, and individually owned and worked boats are to-day the exception. Mr. Llewellyn's experience is that canal boat-people are solicitous for their children's welfare and look after them properly; the schools are far better attended than once was the case, and parents and children are increasingly anxious to take advantage of them. He sees no reason why children and families should not live on the boats, and the decent, kindly, and healthy status of the boat-people as a whole is a proof that there can be little wrong with their mode of living.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chief lecturer in pharmacy and an assistant lecturer in pharmacy at the Swansea Municipal Technical College—The Director of Education, Education Offices, Dynevor Place, Swansea (Sept. 3). An officer in the Mechanical Engineering Department and one in the Transportation (Power) Department of the Indian State Railways—The Secretary, Services and General Department, India Office, Whitehall, S.W.1 (Sept. 14). An assistant professor in mechanics and mathematics at the City and Guilds (Engineering) College—The Secretary to the Delegacy, City and Guilds (Engineering) College, Exhibition Road, S.W.7 (Sept. 30). A director of the Agricultural Research Institute, Pusa, India—The Under Secretary of State, Economic and Overseas Department, India Office, Whitehall, S.W.1 (Nov. 29). An expert adviser in animal husbandry under the Government of India—The Under Secretary of State, Economic and Overseas Department, India Office, Whitehall, S.W.1 (Nov. 29). A junior scientific officer in the Admiralty Scientific Pool at the Experimental Establishment, Portsmouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. A road engineer for the Public Works Department of the Government of Cyprus—The Crown Agents for the Colonies, 4 Millbank, S.W.1. A water engineer for the Public Works Department of the Government of the Tanganyika Territory—The Crown Agents for the Colonies, 4 Millbank, S.W.1. Teachers for evening instruction in chemistry and physics, mechanics, mechanics and heat, engineering calculations, and machine drawing at the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon. An assistant physicist under the Research Association of British Paint, Colour, and Varnish Manufacturers—The Director, Paint Research Station, Waldegrave Road, Teddington.

Our Astronomical Column.

Orbits of Neujmin's and Forbes's Comets, *b* 1929 and *c* 1929.—The following orbits have been computed of Neujmin's comet *b* 1929, and Forbes's comet *c* 1929. The equinox is 1929·0, T is in U.T. The second and third are parabolic orbits.

	Neujmin.	Neujmin.	Forbes.
T	1929 July 3·57	1929 April 16·64	1929 May 26·149
ω	144° 21′·73	116° 29′	234° 32′
Ω	157 17·64	154 29	29 34
i	3 56·57	5 9	5 37
ϕ	36 39·76	—	—
log q	0·32426	0·3312	0·18927
Period	11·983 years	—	—
Computer	M. Ebell	Bower and Willis	H. E. Wood.

The small inclination of Forbes's comet suggests that it may be periodic. The calculated position of this comet from Wood's elements for Aug. 3·75 is R.A. $20^h\ 53^m\ 40^s$, S. Decl. 30° 26′. The position telegraphed for that date was $20^h\ 0^m\ 52^s$, S. 30° 26′. The telegraphed R.A. appears to be in error.

Ephemerides for 0^h U.T. from the first and third orbits:

NEUJMIN'S COMET.

	R.A.	S. Decl.	log r.	log Δ.
Aug. 27.	$21^h\ 8^m\ 2^s$	14° 36′	0·3357	0·0732
Sept. 2.	21 7 10	15 0	0·3382	0·0863
8.	21 7 1	15 19	0·3410	0·1014
14.	21 7 41	15 35	0·3441	0·1186
20.	21 9 16	15 44	0·3474	0·1369

FORBES'S COMET.

	R.A.	S. Decl.	log r.	log Δ.
Aug. 29.	$20^h\ 54^m\ 6^s$	27° 45′	0·3025	0·0258
Sept. 2.	20 55 6	27 15	0·3097	0·0462
6.	20 56 24	26 44	0·3172	0·0671
10.	20 58 0	26 13	0·3244	0·0877
14.	20 59 54	25 42	0·3312	0·1084
18.	21 2 5	25 10	0·3382	0·1288

It will be seen that the two comets are fairly near each other. Their magnitudes are about 14½ and 12 respectively.

The Puzzle of the Major Planets.—The above is the title of an article by Prof. H. N. Russell in the *Scientific American* for August. He refers to the change of view as to the condition of the four outer planets that has taken place in recent years. It was previously believed by many astronomers that their low densities indicated high temperatures; but the radiometric measures at Flagstaff and Mount Wilson indicate that their outer layers are very cold, probably at least 100° C. below zero. The difficulty is to identify the gases forming these outer layers. We have the two clues of the rich and varied colours that are visible on the disc of Jupiter, and the series of bands in the spectrum which grow stronger in proportion to the distance from the sun, being weak in Jupiter's spectrum and very pronounced in that of Neptune. Menzel's suggestion that they are due to some compound or allotropic form which is stable only at very low temperatures, is mentioned with approval. The temperature of the outer layers may be presumed to decrease as the distance from the sun increases; this would account for the increasing prominence of the bands for the more distant planets. A suggestion by Prof. Moulton is quoted that the low density of the giant planets is due to their having retained great quantities of lighter materials which the smaller planets lost through their weaker gravitational attraction. It is natural to postulate the presence of large quantities of hydrogen and helium in their outer envelopes. The suggestion is also quoted that Jupiter and Saturn may be covered with frozen oceans 11,000 miles in depth. It is difficult to reconcile this hypothesis with the evidence for the presence of energetic action at great depths in their atmospheres, which is afforded by telescopic study of their discs.

Argon in the Solar Corona.—A suggestion was recently made by I. M. Freeman attributing many of the unidentified coronal lines to argon (see also NATURE, Jan. 19, p. 106). This theory is criticised by Prof. H. N. Russell and Dr. I. S. Bowen, who show, in the *Astrophysical Journal* (vol. 69, p. 196), that the number of coincidences is very little larger than might be expected from pure chance (within the wide limits of error allowed by Freeman). Also, discordances for some of the better-measured lines exceed the limits of observational error. It is concluded that "the attribution of the coronal lines to Argon is without foundation".

Research Items.

Garo Ethnology.—Dr. Biren Bonnerjea publishes in the *Indian Antiquary* for July a study of the Garo, an aboriginal tribe of Assam who inhabit the Garo Hills, which are named after them. Their ethnical affinities are doubtful; their customs peculiar. They are probably a section of the great Bodo tribe which at one time occupied a large part of Assam. They speak a language of the Bodo group of the Tibeto-Chinese family. They have small round faces, are platyrrhine, and have blue eyes and dark skins. Language and physical features suggest Mongolian stock, a view supported by the frequent occurrence of the blue Mongolian patch on the sacral region. They are essentially agriculturists, but are omnivorous. It is suggested that fire has only recently been introduced among them, as they eat their food raw or only slightly warmed. Each family has two habitations, one in the village and one in a tree. They believe in a supreme anthropomorphic god who dwells, with wife and children, in heaven. The children were born on earth before the god and his consort took up residence in heaven, and the Garos are descended from one of three granddaughters. This legend must be connected with the prevalence of mother kin. The Garos worship a number of minor deities and are animists. Hence all grave goods buried with the dead are broken, that they, too, may be dead and their 'souls' may serve the dead in the next world. The cult of the heavenly bodies, especially of the sun and moon, is practised. Periodically the sins of the community, which have accumulated throughout the year, are expelled by means of a scapegoat—an animal. The great sacrifice of the year takes place after the harvest, when the headman supplies all taking part with a pig and an abundance of liquor. The central figure is a 'horse' of straw borne by a man, which is the centre of the dance lasting all night. At the end of the ceremony the body of the horse is thrown into a stream and the head is preserved until next year. A meal is then taken by the side of the water. Mother-right prevails and the people are exogamous. The marriage ceremony is unusual, as it is the bridegroom who is captured. Polyandry is unknown; polygyny exists in theory but is rare.

Fertility Figures.—Two examples of the remarkable carved stone human figures known as Sheela-na-Gig are described and figured in *Man* for August. The Sheela-na-Gig has been regarded as a fertility figure, a relic of paganism surviving into Christian times. Of the two here mentioned one, described by Miss M. A. Murray, is from the Priory Church, Hexham. It is one of a number of sculptured figures on the north side of the screen of the chantry of Prior Rowland Leschman, and is dated at about 1480. The figure, which is at the centre of the lower of two rows of sculptures, is a three-headed phallic personage with hairy legs, riding on a creature with cloven feet, lion's ears, human features, and a large protruding tongue. One of the three heads is a human skull. The second figure described is from the church of St. Michael-at-the-North-Gate, Oxford. Until recently it was one of the stones of the tower, but it has now been removed to the interior of the church to protect it from the effects of a smoky atmosphere. The stone, which is some twelve inches square, is hollowed out to form in relief the rudely carved figure of a woman, a typical Sheela-na-Gig. There is no known record of the figure nor of its position in the tower. The age of the tower is disputed, though for certain reasons about 1071 is suggested. The figure may be much older, though no settlement at Oxford before the eighth century is known.

Codling of the North Sea.—Mr. Michael Graham, in his paper "A Study of the Growth-Rate of Codling (*Gadus callarias* L.) on the Inner Herring-Trawling Ground" (Ministry of Agriculture and Fisheries, Series 2, Vol. 11, Nos. 2-3, 1928: Studies of Age Determination in Fish, Parts 1 and 2. London: H.M. Stationery Office, 1929. Part 1, 6*s*. net; Part 2, 3*s*. 6*d*. net.), continues his researches on the cod. This work, which is part of a general scheme of research on the North Sea cod, was undertaken in order to ascertain the age at which the codling enter commercial catches. The method employed was based almost entirely on scale reading and length of fish. Reproductions of all scale tracings are included in an appendix with the serial number and length of fish. For the scale readings the author's precise method relating to the first winter ring, described in his former paper (1926), is used. Assuming that the first narrow ring and the second wide band, as defined by him, are the first winter ring and second summer ring respectively, and also assuming that the fish investigated were hatched in the middle of March (the height of the spawning season in these regions), such assumptions being justified by the facts shown, it is concluded that the modal length of the codling in the Inner Herring-Trawling Ground was 20 cm. at two years and 29 cm. at three years of age. The present research only applies to the first three years of the cod's life, when it is still immature. The value of scale reading and all its difficulties are fully discussed, and the fact is accentuated that although the scales for the most part record the true age of the fish, there is usually a certain number of misleading scales which are, however, always in the minority. A correct majority is almost certain, and the author is of the opinion that the method is valuable provided that there is a majority of fish of one year class, or, in a mixed sample, if one is justified in assuming that the apparent year classes are real. In Part 2 a detailed survey is given of the literature, embodying all the most important work on the subject, with summaries and criticisms. This is a most helpful guide to the large amount of matter which has accumulated during the last thirty years.

Keeping and Rearing Marine Invertebrates.—Lieferung 278 of Dr. Emil Abderhalden's "Handbuch der biologischen Arbeitsmethoden", Abt. 9, "Methoden der Erforschung der Leistungen des tierischen Organismus", Teil 5, Heft 3, 1928, treats of the methods of rearing, of management in captivity and in research of the Cephalopoda, Echinodermata, Bryozoa, and of *Bonellia*, *Thalassema* and *Echiurus*. Dr. Georg Grimpe gives an account of the care, management and breeding of various cephalopods for zoological and physiological purposes. These mollusks are specially useful to the naturalist and physiologist, many of them occurring in large quantities. They are, however, usually extremely difficult to keep alive, especially the deep sea forms, although *Sepia*, *Octopus* and *Eledone* can be kept for some time in aquaria, *Sepia* feeding mainly on prawns and shrimps, *Octopus* and *Eledone* on crabs. Although the eggs of most species are well known, they are difficult to rear and no instance is as yet known of one being reared from egg to adult. It is, moreover, still uncertain what is the natural food of the young *Loligo*. A table of breeding seasons of the commoner species from various localities is given, which in the light of further knowledge could be much extended, at any rate from the Plymouth district. John Runnström deals with the rearing of echinoderms; he discusses the methods of fertilisation and of rearing the larvæ of many forms, in most cases successfully carried on until after metamorphosis, methods with which the names of Mortensen, MacBride and many others mainly connected with the Plymouth Marine Laboratory are associated, including the feeding of the larvæ with *Nitzschia* cultures devised by Allen and Nelson. A short account of keeping Bryozoa by Heinz Graupner includes the feeding of adults and larvæ; and finally there is an interesting chapter by F. Baltzer on *Bonellia*, *Thalassema* and *Echiurus*, in which researches, chiefly by the author on *Bonellia*, are described, relating to the small male which lives inside the uterus of the female, and the rearing from the egg of both sexes.

Studies on Tadpoles.—Dr. G. K. Noble (*Bull. Amer. Mus. Nat. Hist.*, vol. 58, art. 7, 1929) describes the eggs and tadpoles of the toad *Hoplophryne uluguruensis* from the Uluguru Mountains of East Africa. The eggs are laid within the stems of bamboos which have been split sufficiently to permit the entrance of the toad. The tadpoles produced from the eggs live either in the bamboo stems or between leaf and stalk of banana plants, and are either exposed to the air or crowded into small basins of water. Lungs are functional at the time of hatching; no external gills ever appear, and the internal gills are reduced to a few minute villosities on a single branchial arch. A pair of cutaneous flaps—apparently locomotor—moved by special branchial muscles, develops in the hyoid region. The epidermis of these flaps is thickened and its surface is toothed—like that of the adhesive discs of tree frogs. The tadpoles agree with those of *Hyla* in Jamaica in feeding on frogs' eggs, insects, and vegetable matter, in having comparatively large and powerful jaws and a short digestive tract. Dr. Noble has also examined a large series of well-preserved tadpoles of the frog *Staurois ricketti* from Fukien, China. These stream-dwelling tadpoles have just behind the mouth a suctorial disc bearing along its posterior edge a crescentic area of tuberculated epidermis which functions as a friction surface. The muscles attached to the disc may be readily homologised with those found in the tadpoles of *Rana*. Mature tadpoles of *Staurois*, unlike certain other mountain brook tadpoles, have reduced lungs. Increased oxygen content of mountain-stream water is one of the factors permitting lung reduction in the Amphibia which live in these waters.

Leeches from Sarawak.—J. Percy Moore (*Proc. Acad. Nat. Sciences*, Philadelphia, vol. 81, 1929) describes a small collection of leeches made in the mountainous interior of Sarawak, British Borneo. The collection is chiefly of land and tree leeches; only one aquatic leech, *Hirudinaria*, is included. A new genus, *Gastrostomobdella*, is established for one of the terrestrial or amphibious Erpobdellidæ which has a large ventral pore opening into the stomach at segment xiv/xv. The pore leads into a Y-shaped canal, the median limb of which extends vertically for about a third of the body thickness and then bifurcates symmetrically. The branches diverge widely and open into the floor of the stomach at its anterior end and its extreme lateral margins. The author suggests two possible functions of this canal: (1) that at the time of copulation a spermatophore is implanted in the pore and the sperms pass through the epithelium lining the canal to the ovisacs where fertilisation takes place; (2) that the pore acts as a sort of preliminary anus for the elimination of earth from swallowed earthworms after these have been crushed in the pharynx. The gut pore is entirely undeveloped in small specimens. The presence of chætæ of earthworms in the rectum indicates that this leech is a burrowing predaceous form. Three species of land leeches of the genus *Hæmadipsa* are recorded—two are subspecies of the dull-coloured *H. zeylanica*; the third has a yellow stripe along each side of the body and is described as a new species—*H. picta*. Its bite is said to be painful and difficult to heal.

Resistance of Limnæidæ and their Allies to Desiccation.—The periodical drying up of pools is one of the natural ways in which the destruction of disease-carrying mollusca is effected, and Dr. Cawston in 1927 appears to have advocated its artificial adoption as a means of controlling bilharzia infection. He has since conducted a series of experiments with the view of ascertaining for what length of time molluscan carriers can resist desiccation or burial (*Trans. Roy. Soc. Trop. Med. and Hyg.*, vol. 22, No. 4). These investigations took place at Durban in the winter months under conditions representing the greatest degree of drought which these freshwater snails would be likely to experience in Nature. Experiments in drying confirmed experience that the animals of closely coiled shells like *Planorbis* can survive desiccation for several days, thus showing greater resistance than those occupying more loosely coiled shells like *Limnœa*, *Physopsis*, or *Bulinus* [=*Isidora*]. One of the Ancylidæ survived a whole winter without water, apparently attached to a rush. The effect of light varies: *Limnœa* prefers light to darkness; *Bulinus* and *Physopsis* are indifferent; whilst *Planorbis* prefers the dark. Burial offered some interesting results. *Limnœa natalensis*, Krauss, the common carrier of *Fasciola gigantica*, soon dies if buried in garden soil at a depth of two to twelve inches. *Physopsis africana*, Krauss, the common carrier of the Natal schistosomes, can survive for at least twelve days at a depth of two inches, but dies after being buried twenty-five days. *Planorbis pfeifferi*, Krauss, an occasional carrier, will live for at least thirty days at a depth of twelve inches and probably will survive the whole winter in the dried mud of pools. *Bulinus tropica*, Krauss, readily survives thirty days buried at a depth of twelve inches, and is thus well able to resist the periodic drying of South African vleis. *Tiara tuberculata*, Müller, being an operculate, survived burial for thirty-seven days. The author concludes that the complete drying up of pools for short periods is of limited value only.

Effect of X-Rays on Living Cells.—The researches undertaken by Strangeways on methods of tissue culture and on the effects of X-rays upon the living cells in such cultures, were really an offshoot from his original aim, the investigation of the problems of rheumatoid arthritis, but have now assumed great importance as a technique for the investigation of the effects of radium and X-rays upon living tissues. A summary of the work already carried out and in progress has recently been given by S. F. Cox and F. G. Spear (*Brit. Jour. Radiol.*, vol. 2, p. 222; 1929). Strangeways and Oakley found that after exposure to X-rays there was a latent period during which no change in the cells was observed: this was followed by a decrease in the number of mitoses—an observation confirmed by Strangeways and Hopwood—with, later, granular changes and breaking down of the cells. In the case of fowl embryos, X-rays produced death by arrest of the circulation owing to blocking of the vessels with clotted blood; the tissues could recover when cultivated *in vitro*. In very young embryos, however, before establishment of the circulation, exposure was not lethal, recovery occurring on further incubation. Canti, working with Donaldson and Spear, found that radium also inhibited mitoses provided that the intensity of radiation was above a certain threshold. So long as the dose was not lethal, recovery occurred with a rise in the number of mitoses above that in the control cultures, the increase compensating exactly for the fall originally observed. The bearing of these researches upon the problems of the treatment of malignant disease by radium and X-rays need not be emphasised, quite apart from the light shed upon questions of cell physiology.

Chromosomes and Magnets.—The similarity between the arrangement of chromosomes during cell division and the arrangements of magnets floating in a confined space has long been noticed. The rather scanty data on this subject have been considerably extended by Yoshinari Kuwada and his co-workers in a series of nine papers (*Mem. Coll. Sci., Kyoto Imper. Univ.*, B, **4**, pp. 199-369). The arrangements of different numbers of floating magnets and the effect of using magnets of different sizes are described, while the nature of the complicating factors is discussed. Cytological data as to the nuclear figures in various plants and the albino rat are given for comparison. In general, about two-thirds of the division figures agree with those observed on magnets.

Serpentine in Southern Rhodesia.—*Bulletin* No. 12 of the Geological Survey of Southern Rhodesia (" The Shabani Mineral Belt ", by F. E. Keep, 1929) is of more than local interest, for it contains discussions on the origin of serpentine, of chrysotile asbestos and of the other associated fibrous minerals, with an explanation of the remarkable alteration of all these minerals to talc. The area is one of Basement Schists, south-east of the Wezda Platinum Mine on the ' Great Dyke ', penetrated by a dunite-serpentine complex which in turn was followed by intrusions of gneissic granite. The magmatic gases and vapours which were emitted from the granitic magma in the later stages of its consolidation entered the joint planes of the dunite and caused serpentinisation. After cooling, serpentine in solution continued to be deposited, forming chrysotile asbestos in the fracture planes through which the solvent made its way. Afterwards, intense shearing took place accompanied by the emission from the granite of siliceous waters charged with carbon dioxide. In these circumstances, serpentine became converted into talc and talc-carbonate rocks. Success has already been achieved in applying these theoretical results to the location of workable chrysotile lodes.

Chart of Wave-lengths.—Mr. J. A. Vogelmann, 165 Broadway, New York City, has published a chart showing the immense range of wave-lengths of various forms of radiation that have now been brought within the scope of observation. He gives it an extension of 170 octaves, of which only a single octave is appreciable by the eye in the form of light. The longest waves used in wireless telegraphy are near one end of the scale, and the very short ' Millikan ' cosmic rays are at the other. The wave-lengths are arranged in the form of a spiral on the diagram, but the latter is so crowded with figures and letterpress that it is not too easy to follow. The author has made the mistake of giving uselessly long sequences of significant figures for the number of vibrations per second for different rays. The method of giving a few figures multiplied by a power of ten is far more convenient. He has included earthquake and sound waves, though these belong to different series, also the waves supposed by some writers to be the cause of gravitation, a theory that is far from being generally accepted. In a second edition of the chart the descriptive portions have been rewritten and extended; but it still has the defect that much space is occupied by long rows of useless and meaningless digits. Where the wave-length is only given to two significant figures there is no point in giving the number of vibrations per second to 25 figures.

Raman Spectra of Sulphates.—Part 4 of volume 3 of the *Indian Journal of Physics* contains a short paper by Messrs. S. K. Mukerjee and P. N. Sen Gupta, of the University of Dacca, on the Raman spectra of sulphuric acid and the sulphates. The method used is that of Wood, which allows good photographs to be obtained in an hour, with a Cooper-Hewitt lamp of 2000 candle power and a Hilger spectrograph. In the case of the sulphates of magnesium, sodium, and copper in solution in water, the mercury line 4047 A. excited a line 4214 A., and the line 4358 A. a line 4552 A. The two excited lines imply an absorption line for sulphates at 102,000, while Coblenz found it at 92,000. For sulphuric acid the same mercury lines excite lines at 4140 A., 4203 A., 4433 A., and at 4464 A., 4538 A. respectively. These correspond to absorption lines at 46,500, 110,000, and 182,000, while Coblenz found 95,500 and 113,500 only. Other salts are to be investigated.

Neon Isotopes.—The May issue of the *Proceedings of the Imperial Academy of Japan* contains a paper by Prof. Nagaoka and T. Mishima on the fine structure of the line spectrum of neon. On cooling a neon tube in liquid air, to reduce the thermal broadening of the lines by the Doppler effect, and then analysing the light from it by an interferometer used in conjunction with a prism spectrometer, the fringes were found to be doubled. One set, which was strong, presumably came from the abundant isotope of neon of mass 20, and the other, a feeble set, from the rarer isotope of mass 22. The separation of the lines is greater than would be expected from the simple theory of the difference in Rydberg constant for isotopes, although the discrepancy is less than with other isotopic elements. Prof. Nagaoka makes the interesting suggestion that the addition of two protons and two electrons to the Ne^{20} nucleus to produce the Ne^{22} nucleus may have made an important difference to its magnetic properties, basing his remark upon a certain similarity between the isotopic displacements of various lines and their Zeeman effects.

Asphalts.—The complex hydrocarbon called asphalt, used in road construction, is, when it is natural and not a residue of petroleum distillation, obtained from certain lakes, the most important being Trinidad Lake, on the Island of Trinidad in the British West Indies, and the Bermudez Lake, near Guanoco, on the eastern coast of Venezuela. Asphalt was obtained from lakes and used by the ancient Babylonians, and Herodotus describes a lake in Zacynthus from which he himself saw pitch obtained by means of bundles of twigs. In the issue of *Chemistry and Industry* for Aug. 9, J. S. Miller contributes an interesting illustrated article on the production and refining of native asphalt. The lakes are full of asphalt, that at Trinidad being probably the crater of an extinct mud volcano. The asphalt is dug out with mattocks, refined by heating to drive off the water which it contains, and then drawn off into barrels. It may be ' fluxed ' by mixing with petroleum residue to make it suitable for road work, refined asphalt being too hard for this purpose. All asphalts contain sulphur in a combined condition, and sometimes an asphalt is heated with sulphur to remove some hydrogen as hydrogen sulphide. This sulphur treatment raises the melting-point and lowers the ductility. The article indicates that the chemical composition of asphalt and even its physical properties are still only imperfectly known.

The British and French Associations at Havre.

In connexion with the annual congress of L'Association Française pour l'Avancement des Sciences, held at Havre towards the end of July, the members of the British Association not taking part in the South Africa meeting were invited to attend. In addition, facilities were given for the Conference of Delegates from Corresponding Societies of the British Association to be held, the president for the meeting being Dr. F. A. Bather. Sir Henry Lyons and Mr. T. Sheppard were elected by the Council officially to represent the British Association, and in the absence of Dr. Tierney, Mr. Sheppard acted as secretary for the Conference for the Havre meeting.

The French Association, though on a smaller scale, is organised on similar lines to that of the British Association, and has its sections, though the numbers attending the sectional meetings suggest that probably papers of more general interest to a larger audience would have been more desirable to the French Association in view of its present membership.

Our French confrères issued a Bulletin in connexion with the Association's fifty-eighth year, containing various items of information; also a journal with particulars of the excursions, list of officers, etc. A volume entitled "Le Havre", and another "Normandy", were presented to each delegate, and facilities for visiting different places were given.

The sections were devoted to mechanics, astronomy, geodesy, mathematics, navigation, aeronautics, civil and military engineering, physics, physical and general meteorology, geology and mineralogy, botany, anthropology, medical sciences, radiology and medical electrology, pharmaceutical sciences, experimental psychology, biogeography, agronomy, geography, political and statistical economy, pedagogy, hygiene and public health. In addition to papers read under these various headings there were conferences on "Le Problème de l'Hérédité tuberculeuse", and "L'Orientation professionnelle et l'Apprentissage". Excursions were arranged to Honfleur. Sunday was devoted to an excursion to Fécamp, where a monument to Dr. Leon Dufour was unveiled, and at the conclusion of the meeting excursions were made to Grouville, Lisieux, Caen, Bayeux, Mont St. Michel; and to Rouen and its neighbourhood.

The conference commenced with the presidental address of General Perrier, and in the evening a reception was given by the Municipality of Havre at the Hôtel de Ville. There was a visit to the port, showing its facilities for dealing with traffic, and the members were shown round one of the large liners. There was an official visit to the Museum at Havre, the specimens being described by the Curator, Dr. Loir; also a ceremony at the French War Memorial, when a wreath was placed thereon by Sir Henry Lyons on behalf of the British Association, and another at the cemetery occupied by English soldiers, when General Perrier presented a wreath on behalf of the French Association.

With regard to the British section, rooms had been placed at the disposal of the Conference of Delegates in the Hôtel des Sociétés Savantes. This was originally intended to be the meeting place of the Conference of Delegates, but on account of the difficulty in darkening the rooms the actual conference was held at the Lycée de Garçons. In the former rooms, however, were exhibited a collection of photographs of archæological interest taken from the air, kindly lent by Mr. O. G. S. Crawford of the Ordnance Survey, and a representative series of maps illustrating regional survey, showing various aspects of the Croydon district, kindly supplied by Mr. C. C. Fagg. The room was also decorated with a selection of the British Association banners which were sent at the special request of our French friends. The banners had been selected on account of their historical interest, and were as follows: York 1831, Edinburgh 1850, Aberdeen 1859, Bath 1864, Norwich 1868, Liverpool 1870, Edinburgh 1871, Montreal 1884, Liverpool 1896, Bristol 1898, Manchester 1915.

There were nearly a hundred representatives at the Conference of Delegates, including both French and English members. Dr. Bather was in the chair, and there were delegates from fifteen British societies. The chairman regretted the death during the year of Sir George Fordham, who was well known in Havre, and had originally been proposed as president for the Conference. The chairman then called upon Mr. T. Sheppard, who referred to the assistance received from Dr. A. Loir at the previous conference at Havre in 1914, and to the honour conferred upon Dr. Loir by the University of Glasgow at the British Association meeting last year, when he received the degree of doctor of law, and Mr. Sheppard asked Dr. Loir to accept on behalf of some of his friends, members of the British Association, the cap, hood, and gown which he was entitled to wear. Dr. Loir returned suitable thanks for the mark of esteem.

On the suggestion of the French Association, the principal subject for discussion at the Conference was the scientific aspects of the Channel tunnel, a paper illustrated with slides being read by Mr. E. O. Forster-Brown on the subject. After carefully reviewing the question, Mr. Forster-Brown concluded that: (1) The existing geological evidence is favourable; (2) further geological evidence should be secured preparatory to designing the work and estimating its cost; (3) the construction of the tunnel is likely to result not only in material benefit to the parties constructing it, but it will strengthen still further the amicable relations existing between England and France. Mr. Forster-Brown's paper appears *in extenso* in the *Colliery Guardian* of Aug. 16 and 23.

A communication was received from Prof. P. F. Kendall, the last survivor of the many British geologists who in the eighties of the last century were consulted as to the possibility of a tunnel under the Channel. Prof. Kendall has kept in touch with the subject, and his observations were made partly in the way of encouragement and partly as a warning. Having reviewed the percentage of days of rough weather on the Channel, and the questions of air transport, a train ferry, and a bridge, respectively, he concluded that a tunnel seems to be the only form of transit likely to be satisfactory. He is satisfied that the engineers will be able to overcome any difficulties provided they keep in touch with the geologists, who have a knowledge of the strata and the peculiar conditions which obtain. Prof. Kendall urged further soundings. He pointed out that "On the English side the official geological map is at present undergoing revision, during which it may be expected that attention will be paid to the tectonic structure. The existing map, however, shows that the Cretaceous rocks are subject to such changes of level between the coast at Folkestone and the great breach of the escarpment at Wye as to show that it must be affected by considerable folds; not only so, but at Beachborough, 5 miles from the coast, a fault occurs which completely severs the Gault outcrop and must consequently have a displacement of more than 100 feet. There is no reason, as far as can be seen, why the 30 miles of submarine outcrop should differ materially from comparable lengths of outcrop in France and England respectively, and it behoves those upon whom the duty falls of laying down the line of the tunnel, to take these probabilities into account." Generally speaking, Prof. Kendall seemed to think that there are more difficulties than had been assumed by most of his predecessors, but that they are not unsurmountable, and in any case he is strongly opposed to the suggestion that a tunnel might be made in the Gault under the chalk. This paper will appear *in extenso* in the *Naturalist*.

Afterwards the chairman, Dr. Bather, addressed the delegates as to the value of their annual conference and asked for opinions to be expressed with regard to its future working. He called upon Mr. T. Sheppard, the vice-chairman of the Corresponding Societies' Committee, who has been associated with the Conference for many years, to give his views on the matter, after which many of the delegates spoke.

At the final session of the French Association, under the presidency of General Perrier, medals which had been specially struck were presented to those who had been conspicuous in assisting the Congress, the names of the recipients being in relief. Sir Henry Lyons, director of the Science Museum, London, and Mr. T. Sheppard, who acted as local secretary for the Havre meeting on behalf of the British Association, each received one of these medals.

At the concluding banquet, held at the Hôtel Frascati, representatives of the different countries sending delegates were 'toasted', and members from Belgium, Portugal, Spain, and Great Britain each spoke in turn, Mr. Sheppard representing the British Association.

Welsh Bygones.

IN view of the plea for the institution of a national folk-museum for England which appeared in Nature of Aug. 24, p. 289, it may not be out of place to describe here briefly what has already been done in the National Museum of Wales at Cardiff on similar lines to preserve the evidences of the arts and industries of the Welsh people in post-Reformation times.

The collections for the most part are at present housed temporarily in a gallery which was specially built for the purpose in 1925; but adequate and permanent accommodation will be available when the eastern range of galleries now in course of erection is completed. At the moment 1294 objects are actually on exhibition, but a number are still in store. The exhibits cover a very wide range; and they also include a certain amount of material from England and Ireland. This has been judged necessary not only for purposes of comparison, but also because England for centuries has supplied Wales with such articles as her pottery and most of her cutlery. Many of the articles are dated, and thus, in illustrating the history of the arts and crafts in Wales, they also provide a basis for a systematic chronology for Welsh bygones.

The arrangement of the exhibits has been carried out so far as possible with due regard to their original purpose, but the limited space available makes complete logical arrangement difficult and in some cases impossible. So far as may be, groups have been kept together. Thus, on passing from the entrance hall of the Museum, where are the Eisteddfod chairs, the stocks, pottery, folklore objects and other exhibits of special interest, the first cases in the Bygones Gallery contains kitchen appliances, followed by table ware and then laundry appliances. Then comes a block of exhibits showing dairy appliances and agricultural implements. These are succeeded by the implements and appliances of various industries, such as mining, spinning and weaving, lace-making and knitting, trapping and fishing and transport. Then follow exhibits relating to the horse and the various crafts. Furniture, costumes and personal ornaments, important sections, necessarily occupy a considerable amount of space. The ecclesiastical, economic, and social life are well illustrated by a varied and wide range of objects. Dress, in particular, includes a valuable collection of richly ornamented eighteenth-century costumes from Tredegar Park. These, of course, are additional to the well-represented peasants' costumes. Objects related to the Eisteddfod naturally figure largely. They include manuscripts, Druid's chairs, and the 'wooden book'—squared wooden sticks in a frame, invented by the Glamorgan druids—harps, etc., and other musical instruments.

Among the objects illustrative of Welsh folklore are rags from wishing wells and a large and valuable collection of 'love-spoons'. The 'love spoon', it may be explained, was a carved wooden spoon which was presented by the lover to the object of his affections. Originally it was merely a wooden copy of a metal spoon, but it became highly elaborated. Another folklore object of great interest which the Museum is fortunate enough to possess is a 'Mari Llwyd' from Llangwynyd, Glamorgan. The 'Mari Llwyd' corresponds to the 'hooden horse' of Thanet and elsewhere. The 'Mari Llwyd', like the 'hooden horse', is a horse's skull and jaws sheeted and adorned with coloured ribbon, streamers, etc. The sheet completely covered a man who carried it at the head of a procession at the Christmas and New Year festivities. In Wales its use was afterwards transferred to May Day. It would be out of place to discuss its origin and meaning here; but though the authorities of the National Museum accept the derivation that it was a substitute for the ass of the medieval miracle and mystery plays, it is more probably a fertility symbol of much older date.

Owing to considerations of space, the collections with two exceptions have to be exhibited under museum conditions, that is, in cases and on walls. The exceptions are the kitchen and bedroom furniture and appliances. Two recesses in the galleries have been utilised to give these objects their natural setting in a typical Welsh kitchen and a typical Welsh bedroom. Here are the fireplace, turnspit, cooking utensils, dressers with crockery, clocks, chairs, etc., the bed, mattress and bedding, the coffer, press, Bible and deed boxes, candles and so forth, in the conditions in which they were actually in use.

A well-illustrated guide to the collections, with an introductory account of Welsh life and culture by Mr. Iorwerth C. Peate, assistant curator, has recently been published by the National Museum of Wales, Cardiff (price 1*s*. 6*d*.).

University and Educational Intelligence.

Cambridge.—The Appointments Committee of the Faculty of Agriculture and Forestry has appointed Mr. F. H. Garner, of Clare College, to be University lecturer in agriculture, and Mr. A. S. Watt to be University lecturer (Gurney lecturer) in forestry.

The following University lecturers have resigned their offices: Mr. P. Sergeant Florence, Caius (economics); Mr. S. Lees, St. John's (engineering); Mr. R. V. Southwell, Trinity (mathematics); Dr. D. R. Hartree, St. John's (physics); Mr. A. Amos, Downing (agriculture); Mr. R. L. Manning, Jesus (geography).

Mr. W. S. Mansfield, Emmanuel, has been appointed Director of the University Farm.

An industrial bursary has been awarded by the Royal Commissioners for the Exhibition of 1851 to Mr. H. V. Rose, Jesus College, to enable him to undertake an apprenticeship with the British Thomson-Houston Company, Limited.

The Trustees of the Busk Studentship in Aeronautics have awarded the studentship for the year 1929–30 to Mr. S. G. Hooker, of the Royal College of Science, London.

THE City and Guilds of London Institute's report for 1928 shows a further small decrease in the number of students in the City and Guilds (Engineering) College, which reached its maximum in 1921–22. Since that date there has been a continuous decline in the enrolments in the mechanical engineering and motive power department, and this has been only partially counterbalanced by an increase in the electrical engineering department. The number of students from India (28) has increased largely in the past two years. A noteworthy event of the year was the establishment of a Maybury chair of highway engineering as a result of an offer made by a joint committee of the Paviors' Company and of the Institution of Municipal and County Engineers. The Institute's Department of Technology reports an increase in the number of candidates examined from 14,205 to 16,048, including an increase in the number of those examined at centres overseas from 1788, the previous maximum, to 1878. The new scheme of handicraft examinations (metal and woodwork) lately brought into force led to the entry of more than double the former number of candidates for the First, while the entries for the Second Handicraft Examination, held for the last time under the old scheme, also nearly doubled.

THE report of the United States Commissioner of Education for the year 1927–28 (Washington, D.C.: Government Printing Office, pp. 42, price 5 cents) is by Dr. J. J. Tigert, an old Rhodes scholar, who held the office of Commissioner for the seven years 1921–28. It comprises (1) a review of recent events in public education, and (2) a report on the work of the Bureau of Education, of which the Commissioner is the head. In the field of higher education, prominence is given to a recent judicial decision declaring to be unconstitutional an act of the legislature of the State of Minnesota which would have usurped the rights and powers of the governing body (Board of Regents) of the University of Minnesota. This decision ensures a professional rather than a political development of the educational policies of the University. Attention is also directed to events indicative of "an awakened consciousness of the supreme value of the library in modern methods of college instruction", of increasing systematisation of research and graduate work, and a tendency towards the affiliation of small or junior colleges with larger institutions or with groups. Investigations have shown anew the neglect of the teaching of physiology and hygiene in secondary schools and colleges. There has been a steady increase, however, in the number of high schools giving instruction in sex hygiene, the tendency being to make it a part of more general courses, such as biology or physiology, and to give less emphasis to disease. The Bureau's work is essentially an intelligence service, and in no country in the world is education better served in this respect. The list of educational researches and surveys by its staff is impressive. Its library division maintains useful bibliographies, indexed and cross-referenced, of research studies in education throughout the United States.

Calendar of Patent Records.

September 1, 1585.—The patent granted by Queen Elizabeth to Thomas Wilkes for twenty-one years on Sept. 1, 1585, for the manufacture and importation of salt, which conferred on the patentee a virtual monopoly of the salt trade on the east coast of England, was one of the chief grievances raised in the monopoly debates in the Parliament of 1601. In spite of the terms of the grant, which provided for an adequate supply of salt at a cost not exceeding that prevailing in London, John Smith, to whom the patent was assigned in 1599, raised the price from 14 pence to 14 shillings a bushel, and thus provided a case for the House of Commons that could not be ignored. The patent was voided with other similar grants by Royal Proclamation.

September 3, 1893.—Otto Lilienthal, an aeronautical pioneer to whose enthusiasm and perseverance the successful evolution of the aeroplane owes a great deal, patented his glider machine in Germany on Sept. 3, 1893. Lilienthal made more than two thousand attempts at flight with his various machines, and finally succeeded in gliding for distances of 200-300 yards. In his earliest gliders, stability was obtained by movements of his own body, but later he added steering gear to the machine, and it was while experimenting with this in the air in 1896 that he met his death.

September 4, 1841.—The chain-grate mechanical stoker, practically in the form in which it is known to-day, was introduced by John Juckes, who obtained an English patent for the invention on Sept. 4, 1841. The first installation was erected the following year at the works of Messrs. Easton and Amos in Southwark, and not only showed a saving in the consumption of coal of about 10 per cent, but also, by enabling a poorer quality of fuel to be used, permitted a still greater reduction in the cost. Though the invention was extensively adopted, Juckes died in poverty. (Cf. Calendar of Patent Records, May 24.)

September 5, 1877.—The successful application of compressed air for working a system of secondary clocks from a standard clock was the invention of the Viennese engineer, Carl Albert Mayrhofer, who applied for his German patent on Sept. 5, 1877. In his earliest arrangements, the controlled clocks received impulses, through small leather bellows, once every minute from the standard clock, but in later forms they had ordinary going trains, and the positions of the hands were corrected and the main springs re-wound at set hours. The invention attracted a good deal of notice at the Paris Exhibition of 1878, and the systems were installed in public buildings in Vienna and Berlin, and on a larger scale in the streets and shops of Paris.

September 6, 1831.—The 'miners' safety fuse' of William Bickford was patented on Sept. 6, 1831. The fuse was almost at once adopted by the British Government for military purposes, and by the mining industry, and resulted in a very large reduction in the number of blasting accidents.

September 6, 1834.—Of the many inventions made by General Henry Shrapnel, the best known is the artillery shell to which his name has been given. Shrapnel shell was first used at the capture of Surinam in 1804, and its success was immediate, the range being four or five times that of the case-shot which it replaced. No patent was taken out for the invention, but Shrapnel received an annuity of £1200 from the Government and one of £200 from the East India Company, and would have received a baronetcy if William IV. had not died before he could confer it. Shrapnel's only patent is dated Sept. 6, 1834, for improvements in the sighting apparatus and other parts of fire-arms.

Societies and Academies.

PARIS.

Academy of Sciences, July 22.—**Ch. Gravier** and **J. L. Dantan**: New observations on the sexual stolons of *Syllis* (*Haplosyllis*) *spongicola*, a polychætal annelid. The sexual organs are not really acepalous, but the stolons are often broken off. The antennæ are not rudimentary, but are very long.—**T. Buscheguennce** and **S. Rossinski**: The deformation of stratifiable congruences.—**J. Haag**: Extension of the method of Résal-Caspari for the deformation of the spiral. The elastic suspension of pendulums: a rectification of priority.—**D. S. de Lavaud**: New possibilities of flight with one motor stopped on aeroplanes with two motors.—**G. Poivilliers**: Fitting negatives into apparatus of restitution.—**C. Marie** and **C. Haenny**: Study of the ammonia-oxygen gas battery. The element consisted of air–platinum–pyrex glass–platinum–ammonia, and was heated to temperatures of 500°-790° C. The e.m.f. observed was of the order of 1 volt, corresponding to the value calculated from thermochemical data, assuming the reaction to be $4NH_3 + 3O_2 = 2N_2 + 6H_2O$.—**A. Poirot**: The emission of anode rays of sodium and chromium. Statement of the conditions necessary for stability in the emission of anode rays of sodium and chromium from sodium bichromate.—**Albert Arnulf**: A method for the determination of angles by the utilisation of microscopic areas. The method described is capable of measuring the angle between the faces of a microscopic crystal, the dimensions of the faces not exceeding 0·001 mm.—**Josef Hrdlicka**: A method for the measurement of the effective clearness of photographic objectives.—**P. Lambert** and **J. Lecomte**: A recording spectrometer for the infra-red. A device for recording photographically the deviations of the galvanometer needle when actuated by a thermocouple moved across the spectrum: in twenty minutes an automatic record is obtained, giving results which would require half a day's work by the visual method.—**Paul Queney**: The spectra of phosphorus and arsenic in the extreme ultra-violet. Multiplets of As IV. and As V.—**V. Posejpal**: Fluorescence and infra-red absorption.—**Pierre Leroux**: Study of the absorption of a crystal of dialogite.—**Edgar Pierre Tawil**: The vibrations along the optic axis in an oscillating piezo-electric quartz. According to the laws given by Curie, the deformations of a quartz crystal placed in an electric field are produced along the electrical axis and in a direction normal to this axis and the optic axis. The dimension along the optic axis should remain unchanged. The results of the author's experiments appear to establish the existence of vibrations in the direction of the optic axis.—**A. Tian**: The heat of solidification and heat of solution of saccharose.—**J. Perreu**: The determination of the limiting heat of solution of some hydrated salts (direct method).—**J. Loiseleur**: The polarisation of membranes under the action of plates of metal.—**Louis Rapkine**: The potential of an inert electrode in a solution of acetaldehyde.—**Emile Rousseau**: The oxidising action of sunlight on an oil solution of zymosterol. The oxidation of zymosterol (extracted from yeast) under the influence of sunlight is progressive but slow, and less than was obtained in earlier experiments with ergosterol.—**M. Geloso** and **Mlle. L. S. Lévy**: The influence of ammonia on the adsorption of copper or nickel salts. The ammonia concentration has a considerable influence on the adsorption of soluble salts of copper and nickel by ferric hydroxide.—**M. Prettre** and **P. Laffitte**: The oxidation of carbon monoxide.—**Ch. Bedel**: The oxidisability of silicon and its solubility in hydrofluoric acid. It has not been found possible to repeat the experiments of M. Sanfourche proving the increased solubility of silicon in hydrofluoric acid by reason of oxidation to silica.—**A. Travers** and **Schnoutka**: The existence of monocalcium aluminate in solution. Evidence suggesting the existence of a calcium aluminate in solution, derived from the acid $HAlO_2$.—**J. Calvet**: The influence of various salts on the solution of pure aluminium in hydrochloric acid. Salts of platinum, gold, mercury, copper, and nickel were employed: compared with the other metals, the effect of platinum was very marked; 0·21 mgm. of platinum per litre caused immediate attack, and even at a dilution of one in 250 millions, the amount of aluminium dissolved was fifteen times that dissolved by the pure acid in the same time.—**J. Bougault** and **Mlle. L. Popovici**: The reduction of the semicarbazones of the α-ketonic acids.—**L. Palfray** and **B. Rothstein**: Some esters of the 1·4- and 1·3-cyclohexanediols (quinite and resorcite).—**H. Vincienne**: New researches on the structure of the southern part of the Vuache.—**J. Lambert**: The Eocene Echinideæ of Madagascar.—**Henri Piéron**: The laws of establishment of the chroma of light impressions.—**L. Lavauden**: A new Madagascan carnivore of the genus *Eupleres*.—**P. Vignon**: The morphology and evolution of the posterior wing in the Coleoptera.—**H. Gauthier**: The aquatic flora of the Central Sahara.—**Jacques Pellegrin**: An African cave fish with very small eyes. A description of a representative of a new genus of fish found in a shaft at Eil (Italian Migiurtina-Somalia), to which the name *Eilichthys microphthalmus* has been given. The eyes, although much reduced, are still visible externally. This fish is remarkable as being a transition form between the surface Cyprinideæ with normal eyes and the cave forms, completely blind, now known.—**Mlle. M. L. Verrier** and **A. Panu**: The pigment and the chromatic variations of some reptiles of the group of the Agamidæ.—**Jean Painlevé**, **Paul Wintrebert**, and **Yung-Ko-Ching**: The development of the stickleback (*Gasterosteus aculeatus*) analysed by chronophotography. Protoplasmic contractions and embryonic circulation.—**A. Paillot**: The infectious origin of the micro-organisms of the Aphides.—**R. Fosse**, **A. Brunel**, and **R. de Græve**: The diastatic transformation of uric acid into allantoic acid. Uric acid is attacked by the juice of various leguminous plants, allantoic acid being produced. It is suggested that this fermentation of uric acid is the result of the action of two ferments, one an oxydase producing allantoin, the other giving allantoic acid by simple hydrolysis.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 9).—**V. Romanovskii**: On the chain of Markoff.—**L. A. Portenko**: The geographic forms of *Prunella atrogularis* and *P. montanella*. Two new subspecies of *Prunella atrogularis* and one of *P. montanella* are described, re-discriptions of the previously known forms also being given.—**K. A. Rassadina**: The lichens of the Vologda province. A list of fifty-one species of lichens collected in the province.

Comptes rendus, No. 10.—**A. P. Vinogradov**: Manganese in insects. Ash of a number of species of insects was found to contain manganese, but ants are particularly rich in this element, the ash of *Formica rufa* containing up to 5 per cent of manganese.—**V. Barovskij**: Description of a new species of the genus *Macrolycus* Waterh. (Coleoptera, Lycidæ). *Macrolycus pubescens*, sp. n. is described from Vladivostok.—**A. Djakonov**: New starfishes from the Okhotsk Sea. (1) *Leptasterias fisheri*, sp. n.—**V. K. Soldatov** and **A. M. Popov**: The new genus *Cyclopteropsis* (Pisces, Cyclopteridæ) from the Okhotsk Sea. The new genus is allied to *Cyclopteroides* Garman and includes four species, namely, *C. macalpini* Paar, *C. cergi* Popov, *C. popovi* Soldatov, *C. jordani* Soldatov. — **A. M. Popov**: A preliminary revision of the Russian mullets. One species of *Mugil* and five species of *Liza* are distinguished from Russian waters.—**B. S. Vinogradov**: A new species of jumping mouse (*Scirtopoda ctenodactyla*, sp. n.) from Repetek (Turkmenistan).—**A. I. Argiropulo**: A new subspecies of *Micromys minutus* Pall. (Mammalia, Rodentia) from Central China.—**V. I. Bodylevskij**: The fauna of a bed at Mohn Bay, on the east coast of Spitsbergen. The discovery in phosphoritic conglomerates of Spitsbergen of *Pseudolisceras* cf. *Beyrichi* Schl. and *Lingula* cf. *Beani* Phil. indicate the affinity of the fauna to that of the Franz Joseph's Land.

ROME.

Royal National Academy of the Lincei, May 19.—**P. Vinassa**: Ions, electronic numbers and symmetry. —**V. Glivenko**: General forms of the law of high numbers in functional spaces.—**Maria Pastori**: The partially intrinsic representation of tensors.—**G. Vranceanu**: Certain problems of equivalence.—**E. Bompiani**: Hyperspatial surfaces with a double conjugated system (1).—**A. Tonolo**: Classification of surfaces of Hilbertian space the 2-tangent of which is of four dimensions (3).—**A. de Mira Fernandes**: Tensors associated with a vectorial ennuple.—**G. Viola**: Elliptical elements of the system of W. Ursae majoris. —**D. Graffi**: Some applications of adiabatic invariants to electricity. Various examples are given to show how adiabatic invariants, which are properties of mechanical systems, may be utilised in the treatment of questions relating to electric circuits, these being in various cases governed by differential equations analogous to those of mechanics.—**L. Tieri** and **V. Ricca**: Electronic emission in a vacuum tube (2). A recent study on the variation of the current serving an incandescent filament *in vacuo* with change in the electronic current between filament and plate has now been extended to the case of the pure tungsten filament of a Philips' *E* triode. The inversion of δI is confirmed, I being the filament current. The interpretation of this behaviour, and the definition of the conditions under which such inversion occurs, are to be discussed later.—**E. Amaldi**: The quantum theory of the Raman effect. The application of Dirac's methods of treating radiation problems to the theory of the Raman effect is demonstrated. Formulæ are obtained for the intensities of the Raman lines and the Tyndall light and their ratios.—**E. Fermi**: Quantistic electrodynamics. Electrodynamic equations are obtained in quantum form, in particular for the case in which there are electric corpuscles with low velocity in the field. The principal applications of these equations will be given in a subsequent communication.—**E. Segré**: The quantum theory of fluorescence. Dirac's methods, with slight modifications, are applicable to the phenomenon of fluorescence. —**M Federici**: Impedance of a quadripolar transductor.—**M. Lombardini**: Calculation of the turbulence in the lower strata of the atmosphere.—**G. R. Levi** and **A. Baroni**: Diethyl pentasulphides. Of the two isomeric diethyl pentasulphides recently described, one (I.) boiling at 130° under a pressure of 26 mm. is transformed into the other (II.) boiling at 119°, when heated above 200°. Form I. has the refractive index 1·59517 at 13° and the specific gravity 1·1620 at 16°, and form II. the refractive index 1·60269 at 13°, and the specific gravity 1·1687 at 16°. In bromoform solution, both modifications produce freezing-point depressions corresponding with the normal molecular weights.—**G. A. Barbieri**: A new type of rare earth salts. Tervalent rare earth elements, which give neither alums, fluoro-salts, nor cyanosalts, form such salt types as crystalline double nitrates, double carbonates, ferri- and cobalti-cyanides not encountered with common tervalent elements. It is now found that such rare earth elements form also argento- and auri-cyanides of the general formula, $M'''[Ag(CN)_2]_3$.—**Giambattista Dal Piaz**: New observations on the Italian Oligocene.

SYDNEY.

Royal Society of New South Wales, June 5.—**H. G. Raggatt** and **F. W. Booker**: Notes on the use of the aneroid barometer and plane table in geological mapping. A description of the methods adopted for the accurate employment of the plane table and the correlation of barometric readings during the geological survey of the Hunter River Coalfield, giving details as to geological and topographic features and the construction of a contour map.—**F. W. Booker**: Preliminary note on new subgenera of *Productus* and *Strophalosis* from the Branxton district. Descriptions are given of two new subgenera of Productides, *Wyndhamia* and *Branxtonia*, from the Branxton Beds of the Hunter River Coalfield. This group of fossils is of value for accurate zoning of beds which overlie and have a definite relation to the Greta Coal Measures. —**W. G. Arneman** and **J. C. Earl**: The celluloses of some Australian plants. In view of the abnormality of the cellulose of posidonia fibre, other celluloses from Australian sources have been examined. The standard of comparison used is the optical rotation of the triacetate. Most of the celluloses conform in this respect to the normal type of cotton cellulose. A water weed of *Potamogeton* sp. contains a cellulose which differs from both those of posidonia and cotton, while posidonia leaves contain the same cellulose as the fibre.

VICTORIA.

Royal Society, June 13.—**Mary D. Glynne**: A note on some experiments dealing with sulphur treatment of a soil and its effect on wheat yield. A plot of land on which wheat has been grown continuously for fourteen years has recently produced very poor crops. Treatment with sulphur, sulphuric acid, both alone and followed by lime, and with ammonium sulphate, resulted in surprisingly large increases in crop. That these results do not depend on pathological conditions is suggested by the small amount and by the distribution of disease organisms. Such possibilities as a sulphur deficiency in the soil or a setting free of compounds limiting growth through increased soil acidity are discussed.

Official Publications Received.

BRITISH.

Address on Dynamics of Development, delivered to the Public Questions Society, University of Melbourne, April 1929, by the Chairman of the Development and Migration Commission (Mr. H. W. Gepp). Pp. 18. (Canberra: H. J. Green.)

Development and Migration Commission. Summary of Reports. Lachlan River Scheme, New South Wales, 28th November 1928; Nowingi-Millewa South Railway and Public Works Scheme, North-western Victoria, 14th November 1928. Pp. 24. (Melbourne: Development and Migration Commission.)

Union of South Africa: Botanical Survey of South Africa. Memoir No. 13: The Vegetation of the Riversdale Area, Cape Province. By Dr. J. Muir. Pp. 82+1 plate. (Pretoria: Government Printer.)

Proceedings of the South International Congress of Photography, London, July 9-14, 1928. Editors: W. Clark, T. Slater Price and B. V. Storr. Pp. xiii+571+29 plates. (Cambridge: W. Heffer and Sons, Ltd.) 25s. net.

Discovery Investigations. Second Annual Report, January 1927–May 1928. Pp. 27+3 plates. (London: H.M. Stationery Office.) 1s. net.

Journal of the Chemical Society: containing Papers communicated to the Society. July. Pp. iv+1387-1622+x. (London.)

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1928. Pp. 24. (London: H.M. Stationery Office.) 9d. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1221 (M. 61): The Effect of Stress upon the X-ray Reflections from Tungsten Wire at Air Temperature. By H. L. Cox and I. Backhurst. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 225.) Pp. 4+4 plates. (London: H.M. Stationery Office.) 9d. net.

Home Office. Report on Conferences between Employers, Operatives and Inspectors concerning Fencing of Machinery, Prevention of Accidents, First Aid and Temperature in Cotton Spinning Mills. By Eliot F. May. Pp. 28. (London: H.M. Stationery Office.) 3d. net.

Tenth Annual Report of the Ministry of Health, 1928–1929. (Cmd. 3362.) Pp. xii+238. (London: H.M. Stationery Office.) 4s. net.

Ministry of Health. Maternal Mortality in Childbirth: Ante-Natal Clinics, their Conduct and Scope. (Memorandum 145/M.C.W.) Pp. 7. (London: H.M. Stationery Office.) 1d. net.

Technical College, Bradford. Diploma and Special Day Courses, Session 1929–1930. Pp. 218+26 plates. (Bradford.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 23: Report of the Irish Radium Committee for the Year 1928. By Dr. Walter C. Stevenson and M. R. J. Hayes. Pp. 277-293. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on July 30th, 1929. Pp. 7. (London.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 15: Studies in the Ectocarpaceae. 2: The Life-History and Cytology of *Ectocarpus siliculosus*, Dillw. By Dr. Margery Knight. Pp. 307-332+6 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5s. 6d.

City of Leicester Museum and Art Gallery. Twenty-fifth Report to the City Council, 1st April 1928 to 31st March 1929. Pp. 24. (Leicester.)

Transactions and Proceedings of the New Zealand Institute. Vol. 60, Part 1, March. Pp. iii+204+17 plates. (Wellington, N.Z.) 10s.

Canada. Department of Mines: Mines Branch. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories) 1927. (No. 695.) Pp. 186 (6 plates). (Ottawa: F. A. Acland.)

Legislative Assembly: New South Wales 1928 (Second Session). Report (together with Appendices) of the Minister of Public Instruction for the Year 1927. Pp. 36. (Sydney, N.S.W.: Alfred James Kent.) 2s. 6d.

South Australia. Annual Report of the Director of Mines and Government Geologist for 1928. Pp. 8. (Adelaide: Harrison Weir.)

FOREIGN.

United States Department of Agriculture. Farmer's Bulletin, No. 1596: Cattle Grubs or Heel Flies, with Suggestions for their Control. By F. C. Bishopp, E. W. Laake and R. W. Wells. Pp. ii+22. (Washington, D.C.: Government Printing Office.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 21. (New York City.)

Proceedings of the United States National Museum. Vol. 75, Art. 10: A Summary of the Earthworm Fauna of Burma, with Descriptions of Fourteen New Species. By G. E. Gates. (No. 2781.) Pp. 41. Vol. 75, Art. 14: Distribution and Key of the North American Copepods of the Genus Diaptomus, with the Description of a New Species. By C. Dwight Marsh. (No. 2785.) Pp. 27. (Washington, D.C.: Government Printing Office.)

Publikationer fra det Danske Meteorologiske Institut: Communications magnétiques, etc. No. 6: On the Influence on the Composition of the Air of a possible High Temperature in the Highest Strata of the Atmosphere. By Helge Petersen. Pp. 15. No. 7: The Departures of the Daily Means. By V. H. Ryd. Pp. 30. (København: G. E. C. Gad.)

Proceedings of the United States National Museum. Vol. 75, Art. 18: A Synopsis of the Trematode Family Schistosomidae, with Descriptions of New Genera and Species. By Emmett W. Price. (No. 2789.) Pp. 39+15 plates. Vol. 76, Art. 4: North American Species of the Weevils of the Otiorhynchid Genus Mesagroicus. By L. L. Buchanan. (No. 2801.) Pp. 14+2 plates. Vol. 75, Art. 25: Recent Foraminifera from the West Coast of South America. By Joseph A. Cushman and Betty Kellett. (No. 2796.) Pp. 16+5 plates. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 104: The Foraminifera of the Atlantic Ocean. Part 6: Miliolidae, Ophthalmidiidae and Fischerinidae. By Joseph Augustine Cushman. Pp. viii+129+22 plates. (Washington, D.C.: Government Printing Office.)

University of Illinois Engineering Experiment Station. Bulletin No. 193: An X-ray Study of Firebrick. By Albert E. R. Westman. Pp. 13+2 plates. (Urbana, Ill.)

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 64: Periodische Bahnen um L_4 (bezw. L_5) im Problème restreint bei beliebigen Verhältnis der zwei endlichen Massen: eine vorläufige Mitteilung. Von Elis Strömgren. Pp. 13. (København: Bianco Lunos Bogtrykkeri.)

Department of Commerce: Bureau of Mines. Coke and By-Products in 1927. By F. G. Tryon and H. L. Bennit. (Mineral Resources of the United States, 1927, Part 2.) Pp. viii+595-687. (Washington, D.C.: Government Printing Office.) 15 cents.

Proceedings of the Imperial Academy. Vol. 5, No. 6, June. Pp. xiii-xiv+223-262. (Tokyo.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 192: Experimental Studies on Form and Structure of Sparks. By Torahiko Terada, Ukitirô Nakaya and Ryuzo Yamamoto. Part 6: Long Sparks in Organic Vapours. Pp. 271-290+plates 28-34. 50 sen. No. 194: On the Oxidation of Sodium Sulphite by Air in the Presence of Ferrous Hydroxide, and a Theory of Negative Induced Reaction. By Susumu Miyamoto. Pp. 81-92. 20 sen. No. 195: Thermo-electricity of Nickel Wire. By Toshimasa Tsutsui. Pp. 93-110. 30 sen. Supplement, Vol. 11: Spectrophotometric Study of Micas. By Toyosumi Yoshimura. Pp. 4+1 plate. 10 sen. Table No. 3: Tables of $\frac{e^{-x}}{x}$ and $\int_x^\infty \frac{e^{-u}}{u}du$ from $x=20$ to $x=50$. By Takeo Akahira. Pp. 181-215. 55 sen. (Tokyo: Iwanami Shoten.)

Diary of Societies.

WEDNESDAY, September 4.

Institution of Municipal and County Engineers (South-Western District Meeting) (at Wimborne), at 11.30 A.M.

FRIDAY, September 6.

Philological Society (at University College), at 5.30.—Sir W. A. Craigie: Lexicography.

CONFERENCES.

August 31 to September 6.

National Veterinary Medical Association (at Ayr).—The papers to be read include the following:—Foot-and-mouth Disease, J. O. Powley; Lameness, Prof. J. J. O'Connor; The Mineral Requirements of Farm Animals, Dr. J. B. Orr; Johne's Disease, Major G. W. Dunkin; The Clinical and Epidemiological Aspect of the so-called Hysteria of the Dog, Prof. F. T. G. Hobday.

On Sept. 3 at 1.45 a Popular Public Lecture on Tuberculin Testing, by Prof. J. B. Buxton.

September 8 to 14.

International Congress of the World League for Sexual Reform on a Scientific Basis (at Wigmore Hall, Wigmore Street).

September 9 to 14.

Library Association (at Brighton).

Lord Balniel: Presidential Address.

Col. J. M. Mitchell: The Small Town in Relation to the County Library System.

A. Esdaile: The Student Reader and his Books.

Discussion on Cataloguing.

L. S. Jast, W. C. B. Sayers, Mrs. A. H. Radice, Miss Belle Rennie, J. W. H. Brown, and F. A. Hughes: Symposium on Children's Reading.

E. Davis and others: Discussion on Books in Elementary Schools.

September 9 to 12.

Institute of Metals (at Düsseldorf).

Monday, September 9, at 5.—Dr. A. G. C. Gwyer: Aluminium and its Alloys (Autumn Lecture—in German).

Tuesday, September 10, at 9.30 A.M.

Dr. W. Rosenhain: Some Methods of Research in Physical Metallurgy.

G. Masing: Methods of Research in Metallography.

P. Chevenard, A. M. Portevin, and X. F. Waché: A Dilatometric Study of Some Univariant Two-Phase Reactions.

M. Haas and D. Uno: An Improved Differential Dilatometer.

W. H. J. Vernon and L. Whitby: The Open-Air Corrosion and Surface Patina of Copper.

C. O. Bannister: Studies on the Crystallisation of Gold from the Liquid State.

A. G. Lobley: The Creep of 80:20 Nickel-Chromium Alloy at High Temperatures.

Wednesday, September 11, at 9.30 A.M.

W. J. P. Rohn: Reduction of Shrinkage Cavities and Vacuum Melting.

M. Tama: New Methods for Melting Non-Ferrous Metals in the Electric Furnace.

N. F. Budgen: Pinholes in Aluminium Alloy Castings.

O. F. Hudson, T. M. Herbert, F. E. Ball, and E. H. Bucknall: Properties of Locomotive Firebox Stays and Plates.

A. von Zeerleder and P. Bourgeois: Effect of Temperature Attained in Overhead Electric Transmission Cables.

Dr. J. Newton Friend: The Relative Corrodibilities of Ferrous and Non-Ferrous Metals and Alloys. Part II. The Results of Seven Years' Exposure to Air at Birmingham.

C. Blazey: Idiomorphic Crystals of Cuprous Oxide in Copper.

Thursday, September 12.—Excursions.

September 10 to 12.

Iron and Steel Institute (at Newcastle-upon-Tyne).

Tuesday, September 10, at 10.15 A.M.

C. S. Gill: Notes on the Damping-Down and Re-Starting of Blast-Furnaces.

A. T. Adam: Notes on Wire for Mining Ropes.

A. Hultgren: Crystallisation and Segregation Phenomena in 1·10 per cent Carbon Steel Ingots of Smaller Sizes.

J. A. Jones: High Elastic Limit Structural Steels.

Wednesday, September 11, at 10 A.M.

J. H. Whiteley: The Coalescence of Pearlite.

H. A. Dickie: The Solubility of Carbide in Ferrite.

T. D. Yensen: Iron-Silicon-Carbon Alloys. Constitutional Diagrams and Magnetic Properties.

T. A. Rickard: Iron in Antiquity.

Thursday, September 12, at 10 A.M.

E. G. Herbert: The Hardening of Superhardened Steel by Magnetism. The Lattice Resonance Hypothesis.

E. Diepschlag and F. Wulfestieg: Electrical Conductivity of Magnesite and some other Refractory Materials in Relation to the Temperature and their other Properties.

H. O'Neill: The Hardness of Vacuum-Annealed Crystals of Iron.

J. H. Smith, C. A. Connor, and F. H. Armstrong: The Correlation of Fatigue and Overstress.