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Education and Science.

THE beginnings of education have not hitherto seemed very relevant to the interests of scientific men. They have been anxious to make good the place of science in all the important later stages of education, not merely for professional training, but also as an essential part of any wide, civilised perspective appropriate to our time. They have offered their own contribution of method, in the heuristic form, as a valuable and typical educative experience. But whilst their professional demands have been more or less satisfied, the cultural assimilation of science makes slow progress. It is still treated as an alternative to the humanities. It still appears to many educated people as a form of specialism irrelevant to general education.

Perhaps it is the belated and limited introduction of science which perpetuates this disjunctive view and prevents the true value of science for liberal education from being seen. If it is thus made to appear as a new and separate beginning in knowledge, leading away into a special field, it can scarcely do otherwise than disconnect this field, and the limited number who enter it, from the general body of future educated opinion which stays outside and indifferent.

If, however, the world of science is only the common world greatly enlarged and much more adequately known, and if its methods are the methods by which such more adequate knowledge is achieved, then guidance to some understanding of this would clearly need to be recognised as a major aim for any humane education. If that aim were defeated by any late and separate beginning in science, that would be a serious limitation, not of the educative value of science, left unused, but of the prevailing order and method of education which kept it so. It would then be necessary to trace the disjunction between science and the common world back to its source in the current educational process and to seek to remedy it there. The earliest stages would thus become very important and the question would arise whether they could not be so ordered from the beginning that this false disjunction could never arise at all.

Specialisation would come at its due late time, as now, for those whose interest led them to it, but it would be continuous with a liberal general education which aimed at making some representative sense of the scope, aims, and methods of scientific knowledge a common possession for all.

It is this representativeness that would be aimed

at, graded from the first beginnings of concrete knowledge in the common world to its typical highly developed and organised forms. The value of science for education would then lie in the continuity of its character and history being made available for a parallel continuity of development in knowledge of the child. The approved method of starting science learning at some rudimentary concrete beginning, at whatever age it is begun, which can easily be made to seem highly artificial, would receive its natural meaning if it set out from the age where the simplest kind of direct knowledge-learning actually began.

We should thus be proposing not another fixed programme or schedule, but a difficult and important problem in liberal education. It would become a matter for careful and scientific study what was the best manner and sequence of procedure, in order to preserve the continuity of method and perspective at which we should aim. We should have a valuable initial advantage over formal subject-knowledge and subject-teaching because we should be working with a powerful native educative interest in the child, but it would be a part of our problem, and a very central one, to preserve this interest and to carry it on.

The first direct knowledge-learning from which we should start would thus be that which emanates from the child itself, spontaneously and usually actively. Most normal children of, let us say, 4-5 years of age show a lively, inquiring curiosity in the world around them, and want to know how things work, what they are, how they are made. Their curiosity seeks knowledge and takes pleasure in finding it. We should be endeavouring so to guide, reinforce, and develop this curiosity of the normal child in the world around him that it could pass continuously by its own activity into the same interest, informed and organised, in the world—not different but greater—of science.

We should, of course, not assume that this could be done, but should be content with not laying down in advance that it could not be done. A critical examination of all the *avoidable* ways of preventing, restricting, discouraging, misdirecting, or confusing the advance of knowledge, familiar to us in the history of knowledge of the race, but not all and always avoided in that of the individual, would show the evidence against us to be at least inconclusive. It would be possible that the interlocking quality of the older system of formal knowledge, formal teaching, and enforced receptivity gave rise to what evidence there was; and whilst this system would have to continue in some partly mitigated form so

long as we knew no other way, it would be important to try any way in which we might conceivably learn better. To endeavour to establish a high road from natural curiosity to representative scientific knowledge would at any rate be to test one possible way.

In the meantime we should have this initial interest in the child to work upon, to stimulate and encourage, to refer to active, direct inquiry, to provide with graduated experience of the relation between such inquiry and discovery, and to carry on to a more and more developed sense of the terms on which knowledge could be gained, tested, and enlarged in an enlarging world.

This would then make a formidable problem for highly skilled research. It would, of course, only be a part of the problem of progressive education, since for the point of view here adopted, scientific knowledge is far from being the only kind of knowledge, or knowledge the only aim of education. Thus, for example, taking knowledge alone, a historical perspective upon science itself, and this in turn set in some just proportion in a larger historical whole, would clearly be a like condition and eventual aim for the process of scientific education itself. But there would be reason for suggesting that the scientific way would be the first, easiest, and most natural way of beginning education and establishing some foundation of direct experienced knowledge and its way of increase, for later indirect knowledge to be built upon.

That would be in full accord of principle with the recent trend of enlightened educational theory, which, coming more and more under the influence of psychological knowledge, itself advancing, aims at grading the processes of education from the start so that they should flow easily and naturally out of the child's development. In practical progress it has inevitably remained conditioned by the powerful tradition which it has sought to change but within which it has had to work; and its scope has thus been rather to liberalise old methods and subjects and gradually to bring them closer to the child, than to consider any more radical possibilities of theory. For the further advance of education, however, it is necessary that these more radical possibilities should be fully worked out, and, according to their promise, practically tested.

Given now the aim of adaptive grading and psychological integration, and given also the inherent limits of a vast deal of traditional knowledge which can only be communicated verbally and by methods more or less unrelated and arbitrary, it is a crucial problem for psycho-

logical education whether there is no *other* knowledge, which can be developed *first*, from natural roots; and carried on continuously by the same methods to a high integration, as a pattern and framework of what knowledge can be. The natural continuity of science provides a possible solution alike for a first beginning of education in knowledge and for its organic development later.

To make this solution actual, however, there is needed practical research of a high order, fundamental in character, by many investigators, bringing wide resources and high qualifications to bear. But if education is important, research in it is important, and its pre-conditions must be fulfilled. We must assume that education *may* technically only be at its beginnings in order to look for definite ways of verifying this and to press for adequate and multiple research.

Some interesting commencements have been made in recent years, though still somewhat entangled in general programmes of practical education. Thus the Maison des Petits attached to the Institut Rousseau at Geneva, and the Walden School in New York, may be instanced. Perhaps more directly relevant is the Malting House School at Cambridge which specially aims at exploring the educative use of introductory science from the outset of education. During three years, the response of children of 4-7 years of age under free conditions to opportunity and stimulus for the direct discovery of many kinds of natural knowledge—mechanical, physical, biological—has been observed and studied. As, however, this remains an unseparated element in the general plan of humane education of the school, and the number of children is small, any encouraging results obtained can so far only be suggestive. A recent prominent advertisement of this school has set very high standards for a more specific investigation in the same field, and the result should prove significant; but since scientific work is nothing if not cumulative, it must eventually be judged less by what it does than by what it begins. What is important, therefore, is continuance, and a sustained movement of similar work. The simple, obvious principle on which the research attitude is based, that facts are only as unalterable as all the conditions on which they depend, and beliefs only as valid as all the assumptions on which they rest, is as applicable to education as to engineering. It should become as much a commonplace in the former as in the latter field that no *a priori* assumptions, but only the quality, extent, and co-ordination of actual research done, can determine how much progress is—or is not—possible.

A Complete Catalogue of Scientific Periodicals.

A World List of Scientific Periodicals published in the Years 1900-1921. Vol. 2: Abbreviated Titles and Locations of Sets. Pp. xii+344. (London: Oxford University Press, 1927.) 45s. net.

THIS second volume of the "World List of Scientific Periodicals" contains the abbreviations proposed for the titles of the 24,028 periodicals the full titles of which were given in the first volume, a notice of which appeared in NATURE of Sept. 19, 1925, p. 419. There is a supplement containing 658 further titles as to which information has been received since the publication of Vol. 1. There is also a list of abbreviations proposed for the titles of the reports of some 140 international congresses.

The titles in the previous volume were numbered. In this volume the same numbers appear, followed by the proposed abbreviations. We think, however, that the reader will find, in most cases, that the abbreviations are full enough to make it unnecessary to refer to Vol. 1. Thus the meaning of such an abbreviation as "*Bull. Soc. Sci. Nat. Phys., Montpellier,*" would appear fairly obvious, though, if the reader should wish to quote the exact wording of the title, he would do well to make certain by looking at Vol. 1, for it is explained that such an abbreviation as 'Sci.' may mean science, sciences, or scientific, while 'Bl.' may stand for Blatt or Blätter.

For the convenience of those who may wish to make a card catalogue, the volume is printed on one side only of the paper, so that it can be cut up and pasted on cards.

The outstanding feature of this volume, and that for which British science will be most grateful, is the information showing the libraries in which a periodical can be consulted. Those who possess this volume need not fear to be told by a librarian that the journal they wish to consult is not in his library, for they will know beforehand which library to visit. The libraries which have furnished lists of the periodicals on their shelves are in the cities of Aberdeen, Aberystwyth, Birmingham, Bristol, Cambridge, Cardiff, Dublin, Dundee, Edinburgh, Glasgow, Leeds, Liverpool, London, Manchester, Nottingham, Newcastle, Oxford, Rothamsted, St. Andrews, Sheffield, and Swansea. In London 27 libraries have given full information as to the scientific periodicals they possess, in Cambridge 27 libraries, in Edinburgh 21, in Oxford

19, in Glasgow 9, in Manchester 7, and in Birmingham and Sheffield 6 each. Altogether there are 112 libraries in the list, and against every periodical in the "World List" there is a note showing in which, if any, of these libraries it is available.

It may happen that in some library the series of a particular periodical is incomplete. In the "World List" an attempt is made to give full information as to gaps in the sets. Knowledge that volumes are missing from a series in a library is not only valuable to those who use that library, but also will remind the custodians of the institution that these missing volumes should be supplied as soon as possible.

While it is satisfactory to note the large number of periodicals that are to be found in one or other of the British libraries, there remain very many which, according to this list, cannot be consulted in Great Britain. It would be worth while to make a close study of the entries to see whether some of these missing journals might not take the place of others of which there may be an unnecessary number of copies.

The origin of the "World List of Scientific Periodicals" was explained in the notice of the first volume. At the suggestion of Sir Sidney F. Harmer, until recently Director of the Natural History Departments of the British Museum, and Dr. P. Chalmers Mitchell, secretary to the Zoological Society, the Conjoint Board of Scientific Societies appointed as a Committee Sir Sidney Harmer, Mr. F. W. Clifford, Sir Richard Gregory, Dr. P. Chalmers Mitchell, Dr. A. W. Pollard, and Prof. W. W. Watts to consider the possibility of preparing a list of the chief scientific periodicals, with an indication of the libraries in which they might be consulted. This Committee decided to index scientific periodicals in existence from Jan. 1, 1900. Details as to the sets of these periodicals before 1900 may also be given. It was soon found that the cost of preparation and publication of a work of this magnitude could not be covered by subscriptions and sales. Help was given by Sir Robert Hadfield, Mr. Robert Mond, and the trustees of the Carnegie United Kingdom Trust.

In 1923 the Conjoint Board came to an end, but it had previously entrusted the "World List" to Sir Arthur Schuster, Mr. Robert Mond, and Dr. P. Chalmers Mitchell, who formed a company limited by guarantee to complete, own, and conduct the "World List of Scientific Periodicals." This company was incorporated with a council of management consisting of Dr. P. Chalmers Mitchell (chairman), Sir A. Schuster, and Mr. R. Mond.

Miss Joan B. Procter became secretary. The work of the council is voluntary, and by the articles of association no benefit can be distributed to the members of the company. The company holds the copyright of the "World List" and, at a future date, if funds should permit, it will arrange for the issue of reprints and supplements. It is also provided in the memorandum of association that if some stronger body were willing to take over the duties and responsibilities of the company, then any surplus funds which may have accrued should be handed over to some "other institution or institutions the objects whereof shall be certified by the President of the Royal Society of London for the time being to tend to the advancement of science." It is therefore quite clear that any one wishing to advance the interests of scientific research by helping to make its published results accessible, may contribute to the funds of this company, confident that his money will not be used otherwise than in the interests of science.

Much skill and an enormous amount of labour have been required in collecting and arranging the titles of 25,000 periodicals, preparing abbreviations, and indicating where the periodicals may be found.

The trustees of the British Museum, on the recommendation of Dr. Pollard, then Keeper of Printed Books at the Museum, supported by Sir Frederic Kenyon, Director and Principal Librarian at the Museum, allowed the compilation of the list to be undertaken by the staff of the Museum as part of their official duties.

The co-operation of the librarians of a large number of libraries in the United Kingdom has made it possible to state the libraries, if any, in which each periodical is to be found.

The original editor of the "World List" was Dr. A. W. Pollard, who was assisted by Mr. W. A. Smith. Mr. Smith, with advice from Dr. Pollard and Dr. P. Chalmers Mitchell, has undertaken the chief burden of editing this second volume. Among difficult problems with which the editors have had to deal were those arising from changes in the titles of periodicals. In the reports from the various libraries there was found a want of agreement as to the date on which a change of title had taken place. Much labour was required before these dates could be fixed. The problem was not confined to changes of title during the period 1900-1921 covered by the "World List," for libraries possessing sets of periodicals which started before 1900 and continued beyond that date, were allowed to give details of earlier years. It has therefore been necessary to decide as to the identity of a periodical

under the different names it has borne during its existence.

The date at which a periodical ceased to exist has been denoted by an asterisk. The editors found that very few library catalogues give accurate information on this point. They have taken great pains to discover the exact date of the 'death' of all periodicals which have ceased publication to be found in libraries in Great Britain, but they are not able to guarantee that the information on this point regarding periodicals of which no set is preserved in the country is always correct.

Much importance attaches to the choice of the abbreviations, for these are intended to be used by authors in referring to articles in the journals. The rule that the order of the words on the title-page of a journal should be followed in the abbreviation has been adopted. Thus the *Journal of the Chemical Society* of London is abbreviated "J. Chem. Soc. Lond." and not "Chem. Soc. J." It is true that this method separates the different publications (*Proceedings, Reports, Transactions*) of the same Society, but it makes it much easier for the reader to reconstruct the full title. It is greatly to be hoped, for the sake of uniformity, that the abbreviations used in the "World List" will be accepted as the standard of general practice.

The place of imprint is omitted except when needed to distinguish periodicals with the same title; but when the abbreviated form would leave the language of the original uncertain, the imprint is added for all except the best-known language of those between which confusion could arise, the order of familiarity being fixed as English, French, German, Italian, or Spanish. This strikes one as a rather curious rule. We think it would have been better to give the town of publication in all cases except those in which that town is mentioned in the title.

One cannot help asking whether it is really necessary that there should be so many periodicals dealing with science. Perhaps the publication of this list may suggest that some of these journals might amalgamate and so lessen the number which the scientific worker may be called upon to consult.

The two volumes of the "World List" will be of very great value not only to librarians but also to all who have an interest in science. Those who have taken part in their preparation and the Oxford University Press are to be heartily congratulated. All scientific workers will thank Dr. P. Chalmers Mitchell for the resolute way in which he has guided the enterprise through its difficulties and finally brought it to a successful conclusion.

Physiological Genetics.

Physiologische Theorie der Vererbung. By Prof. Dr. Richard Goldschmidt. Pp. vi + 247. (Berlin: Julius Springer, 1927.) 15 gold marks.

PROF. GOLDSCHMIDT has given biologists a very stimulating book. It may be incorrect or incomplete in a number of individual points, but the author will not, we suspect, mind this so long as the book is widely read, and read in the spirit in which it is clearly intended, namely, as a pioneering venture into the new and almost uncharted sea lying between genetics and *Entwicklungsmechanik*, which, with our author, we may call physiological genetics.

It is now fifteen years ago that Goldschmidt published his first paper on the problem, which will be as classical to students of physiological genetics as is Mendel's work on the pea to students of simple (or distributional) genetics—the problem of intersexuality in *Lymantria*. There, as is well known, he was able to show, first, that intersexuality was produced by a lack of balance between definite genetic factors for maleness and for femaleness; secondly, that this imbalance revealed itself in the time-sequences of development—the intersexes were animals which began their development of the 'right' sex, but later became switched over to the development proper to the other sex; and thirdly, that the greater the upset of balance, the earlier did the 'wrong' sex come to have the upper hand. From these facts Goldschmidt drew the conclusion, which appears as unassailable in its broad outline as is Mendel's conclusion of purely-segregating unit-factors, that the male- and female-determining factors exist in a number of related forms (presumably multiple allelomorphs) differing, *inter alia*, in their quantitative potency; and that the more potent differ from the less potent in effecting the same reaction more rapidly.

In the present volume Goldschmidt seeks to universalise this view, and advances the theory that all Mendelian genes are concerned fundamentally with the *rates of developmental processes*, and that the differences between allelomorphs can always be reduced to, and indeed best thought of as, differences in such rates of action.

Let us say emphatically at the outset that this is an extremely fruitful view-point. Most geneticists, so long as their experiments led to the discovery of definable gene-units, have been perfectly content to note the mere fact of relationship between gene and character-effect, without attempting to think out how that relationship was brought about.

'The gene for bar-eye,' 'the factor for wrinkled seeds,' 'the gene which produces reduplicated legs in *Drosophila* kept at low temperature,' 'lethal factors,'—for the most part geneticists have been content with such purely descriptive statements. There have been honourable exceptions. Sewall Wright, following Onslow, has given a most illuminating analysis of all the coat-colour genes of mammals, which is based upon the idea of the interaction of two or three quantitatively-controlled pigmentary reactions; Miss Wheldale has attempted to analyse the relationship between the biochemistry and the genetics of anthocyan pigmentation in plants: the recent beautiful work of Plunkett (*J. Exp. Zool.*, 1926) on the mode of action of bristle-inhibition in *Drosophila* is one of the greatest value; and there are other examples. But they are all exceptions.

Goldschmidt attempts to generalise. Let us give a few examples. He himself has worked out the larval coloration of *Lymantria dispar*. The older geneticists would have said that there existed a number of multiple factors for melanin production, several of which show reversal of dominance. Goldschmidt shows that all the factors affect the rate of production of melanin (or other time-relations: see later), and that the so-called reversal of dominance occurs only when factors are present, the major part of whose effect in increasing the amount of melanin falls in the larval period; for only then will the original condition of little or no pigment and the final condition of much pigment both be visible, together with all intermediate conditions. Quicker acting genes will hurry the pigment up and make the larva already dark at hatching, slower acting ones will leave it pale right up to pupation.

In *Drosophila*, dozens of eye-colour and eye-shape genes are known, and their linkage-relations have been ascertained, but the *how* of their action has scarcely been thought of. Goldschmidt, without pretending to advance more than a formal explanation in terms of physiological genetics, points out that we have in any case to consider the following time-reactions: (1) that of the process which determines the differentiation of the eye-rudiment. (2) As with other differentiations, if the eye-determination does not take place by a certain time, other processes are at work which irrevocably determine the cells in some other way—in this case as ordinary epidermis. If (1) is too slow, or (2) too speedy, an eyeless animal is the result. (3) The number of facets depends on the number of cell-divisions taking place in the 'eye-determined' material.

Goldschmidt assumes that these cell-divisions are inhibited when the end-products of some process, also with its specific rate, have reached a certain concentration. Changes in the rate of either (1) or (3) will therefore bring about changes in facet-number, as in bar-eye, etc. Finally, he treats the colour-mutations from the same point of view as in his *Lymantria* larvæ. Now it is clear that many assumptions have been made, some of which, such as (3), may very likely be replaced by better. None the less, it is equally clear that new ways of thinking and new methods of experimental attack are at once suggested by this treatment.

One further example, this time of fact rather than theory. Goldschmidt and his pupils have been able to show that the wing-pigmentation of Lepidoptera is brought about by a curious interrelation of developmental processes. The scale rudiments develop at different rates, so that before any pigment exists in the wing, the future pigmentation can be read off as a structural shadow-pattern. The various pigments appear to be produced in the body at different times, and to be shot out into the wings when ready. In the wings they can only be deposited in scales which are at a certain stage of their development: they pass over the rest. Thus the relative rates of scale differentiation and of pigment production both contribute to the actual pattern. Goldschmidt has further been able to show that the melanic form of *Lymantria monacha* differs from the normal, *not* in an excess production of melanin, but in a greater development (brought about by a greater rapidity of action of the corresponding genes) of the scales which are in the sensitive stage when the melanin-flood is generated.

In a number of other points Goldschmidt is very suggestive. The phenotypic identity of two conditions, one of which can be shown to have been brought about by altering the organism's environment, the other by altering its genetic constitution, has often been regarded as a grave stumbling-block. Goldschmidt points out, however, that if all visible characters depend upon gene-controlled rates of developmental processes, then this identity is what should be expected.

Valuable as the book is, however, it calls for one or two criticisms and caveats. Goldschmidt has not entirely rid himself of the habit, familiar to students of his earlier works, of providing illustrations which appear to represent curves of accurate quantitative processes without sufficiently warning the reader that they are in reality nothing of the sort, but merely very useful diagrams of possibilities to assist the visualist.

In his earlier works the curves for production of male- and female-determining substances in *Lymantria*—now copied into all the text-books—fell into this category. In the present book, although it is true that warning has often been given, this is by no means always so. The theoretical curves for the larval pigmentation of *Lymantria* (pp. 56-57) are a case in point. That on p. 57 is a chemical impossibility. As a matter of fact, the actual experimental curves obtained (p. 55) can readily be interpreted by adopting two subsidiary hypotheses—that not only the rate of pigment-production is controlled by genes, but also (1) the final density of pigment (equilibrium-level) obtained, and (2) its time of onset. Both these statements actually hold good for the pigmentation of the eye of *Gammarus*, and probably in general (Ford and Huxley, *Brit. J. Exp. Biol.*, in press).

Even where at first sight quantitative accuracy appears to have been attained, this may not turn out to be really the case. Goldschmidt, for example, has a very able discussion on the whole problem of bar-eye in *Drosophila* (p. 59 *et seq.*), which at first sight seems demonstrative. Certain assumptions, however, turn out not to be justified; and as a matter of fact, a careful analysis of the figures which I undertook, with the able assistance of Dr. C. F. Pantin, has convinced me that Goldschmidt's explanation will not work quantitatively in its present form. On the other hand, I am perfectly convinced that it is on the right general lines, and that if systematic experiments and embryological studies on bar-eye, based on Goldschmidt's ideas, were undertaken, we should soon find ourselves in possession of really accurate quantitative laws bearing on the action of genes in development, and of general application.

This brings me round to my starting-point, and I will merely conclude by recommending the book to the notice of all interested in genetics, developmental physiology, and, indeed, general biology.

J. S. HUXLEY.

Ectoplasmic Matter.

Clairvoyance and Materialisation: a Record of Experiments. By Dr. Gustave Geley. Translated by Stanley de Brath. Pp. xvi + 401 + 51 plates. (London: T. Fisher Unwin, Ltd. (Ernest Benn, Ltd.), 1927.) 30s. net.

THE late director of the International Metapsychic Institute, Paris, was an enthusiastic exponent of what he and his associates termed

'metapsychic science.' Although this large volume contains nothing new in principle for the student of mediumistic phenomena, the collected results and studies of Dr. Geley's researches mark the end of many decades of controversy as to the reality of the phenomena.

It must now be admitted that the various kinds of lucidity and of ectoplasmic formation are facts of experience as actual, though as sporadic, as hypnotism, insanity, or physical deformity. Geley had the qualifications for research work such as are required for observations 'in the field' and for recording the states and behaviour of pathological and mental cases. He was an experienced and capable investigator and his introductory explanations of the conditions requisite for metapsychic research should be read by all those engaged in it. If his precepts were followed there would be fewer than there are at present.

The incentive to devote one's life to these investigations must be either a fixed idea or a temperamental interest in abnormal and degenerate human types. Geley's temperament probably led him into this work, for his only prepossession seems to have been a harmless attachment to a word—"dynamo-psychism"—from which he sought in an earlier work, "From the Unconscious to the Conscious," to evolve a philosophy. In the annals of science it is usually the innovator who enunciates the principles or laws operating in new fields of investigation; others further confirm, elaborate, and tabulate. Geley was not an innovator, but he and other men of science have about completed the survey as regards terminology and classification of evidence and material. There is no scientific or ethical justification, however, for the repetition of these experiments by others. Flourney, Joiré, Schrenck-Notzing, Morselli, Richet, Osty, Geley, and others have established the facts without any religious or spiritualistic implications. On the Continent spiritism and metapsychics are not synonymous, as the layman, and even some men of science, in Great Britain, believe. These facts can be accepted, just as we acknowledge those guaranteed by specialists in any other research work where the novice and layman do not feel called upon to confirm them by personal investigation. They concern chiefly physicians, large numbers of whom have taken part in the experiments described in this and many other books.

Scientific deductions from these facts are now wanted. Nothing new can be learned and no exact knowledge will be obtained regarding the human constitution until the laws governing hypersensible

cognition and ectoplasmic matter are formulated. Morselli used analogies from radioactive phenomena to describe certain aspects of ectoplasm. Geley records interesting observations connecting ectoplasmic forms and micro-organisms, especially in regard to the action of light and the production of cold physiological light. Richet suggested that clairvoyance dealing with things was due rather to excessive tactile sensitiveness to emanations with which the article had been charged, unconsciously, by the owner. Others have made the obvious comparisons of radio-telegraphy and television with clairaudience, mental telepathy and clairvoyance.

These comparisons are merely suggestive; they may be true, but they are not scientific analogies. Since human nature is a complexity of many kinds of matter, said to be the crown of creation on this earth, we must find analogies that will run right through all the levels of matter, so far known, and correlate these levels in man before the results of metapsychic experiments will have true scientific significance. It is possible that a synthesis of all the sciences relating to man might be achieved could such a scientific correlation be made. A generalisation that includes all the facts of psychic phenomena is necessary; but it must be a principle or law—not a mere word or phrase which may be variously interpreted according to temperament.

We know something of the protean possibilities of matter, and this characteristic of ectoplasmic formation is shown by the reproductions of photographs in the book, several of which were published in smaller size in Geley's previous work. The plates also include John Tissot's drawing of the lovely apparition named "Katie King" with her Indian guardian, obtained through the mediumship of Eglinton in the early 'seventies, and photographs of the revolting animal and bird forms materialised through the mediumship of Mr. Kluski during experiments conducted by the Polish Society for Psychical Research in 1920. Fifty years of Europe! Could we explain merely this degeneration in the types of materialised forms, the whole subject and its dangers would be understood.

Geley inferred from his experiments and believed that there is no essential difference between animals and man; he concluded also that creative genius and mediumship cannot be distinguished in essence, nor can self-conscious clairvoyance and ectoplasmic formation operating during trance. There were no gods, angels, or supermen in his cosmos! Psychodynamic matter is tending to a vague

divinity! What difference this from the 'materialism' for which 'orthodox' science is arraigned? When we leave the solid ground of Nature, unable to understand its operations, word-spinning and idols of the mind masquerade as law.

W. W. L.

Lorentz's Theoretical Physics.

Lectures on Theoretical Physics: delivered at the University of Leiden. By H. A. Lorentz. Authorised translation by Dr. L. Silberstein and A. P. Trivelli. Vol. 1: Aether Theories and Aether Models, edited by Dr. H. Bremekamp; Kinetical Problems, edited by Dr. E. D. Bruins and Dr. J. Reudler. Pp. xi+195. (London: Macmillan and Co., Ltd., 1927.) 12s. 6d. net.

DURING the last twenty years of his tenure of the chair of theoretical physics at Leyden, Prof. Lorentz delivered short courses of lectures analysing—in the incomparable manner we have learnt to associate with his name—the various aspects of his subject which, during that period, came in for critical examination by the scientific world. As a result of the energy and enthusiasm of his pupils, these lectures have been preserved in book form, and the present volume is a translation (the originals are in Dutch) of the first of the series. It deals with such subjects as (we quote the titles of the separate lectures) aberration of light; mechanical ether theories; Kelvin's model of the ether; attraction and repulsion of pulsating spheres; inner friction and sliding, treated hydrodynamically; friction and sliding, treated kinetically; Knudsen's investigations on rarefied gases; remarks on Lesage's theory of gravitation; friction and heat conduction in the propagation of sound; kinetic theory of systems of electrons, Richardson's investigations; vacuum contact of plates of different metals; problems in which the motion of electrons plays a part.

As these titles suggest, the first section deals with the possibilities and probable hidden secrets of a mechanical radiation-carrying ether and is on lines which were familiar to all physicists twenty years ago. These discussions are now somewhat out of fashion, although a recent attempt—arising out of a complete misunderstanding of certain positive results obtained by Miller in a repetition of the Michelson-Morley experiment—has been made to revive interest in them. They lead almost inevitably to the conclusion which we find here stated so concisely by Lorentz. "To a certain extent these theories are successful, but it must be

admitted that they give but little satisfaction." Actually they can be made more impressive than Lorentz shows, because so many of the difficulties so clearly discussed by him really arise from an attempt to make the ethers explain not only themselves but also *matter* as well. If we adopt the more reasonable attitude and accept *matter* as being something over and above the ether—the ribbon tying the knots—then, as Larmor so ably shows in his review of these problems,¹ we are not involved in a large number of the paradoxes which otherwise present themselves. Even then, however, it is difficult to avoid the troubles involved mainly in the possibility of the coexistence of two independent statical conditions—electric and magnetic—so we cannot but subscribe to Lorentz's final conclusion.

In the other sections of his lectures Lorentz deals with less speculative problems. But his treatment of such familiar matters as viscosity and internal friction, the flow of rarefied gases through tubes and orifices, the propagation of sound in gases, and certain problems in the electron theory of metals, are exceptionally lucid and satisfying. Like the rest of Lorentz's work, it combines a most exceptional blend of physical intuition and analytical skill which carries conviction with it at every stage. His concluding lectures on the statistical problems of the electron theory of metals contain an elaboration of an important point which should be noted. The usual simpler forms of the theory lead to a number for the electron content which is at least 1000 times too large. If, however, an internal potential for each electron and characteristic of the metal—suggested by Lorentz in his original memoirs on this subject—is included, this fundamental difficulty disappears and so also do some of the difficulties in the further development of the subject not dealt with by Lorentz in these lectures.

The translators—and publishers—have carried out their task very satisfactorily. Here and there, owing to an obviously too strict adherence to the order of words in the original, an awkwardly constructed sentence holds up the reader, and a few words like *parallelepipedon* and *generatrix* are given an unfamiliar—but not misleading—form. These slight blemishes are, however, few and far between, and the book is on the whole worthy of the author whose name appears on the outside; it can in consequence be specially commended to those who are—and were—interested in the subjects with which it deals.

G. H. L.

Our Bookshelf.

- The Principles and Practice of Mine Ventilation: being a Treatise on Modern Methods of Mine Ventilation and Machinery, with a Consideration of Deep Mine Problems, Explosions, Fires, Rescue and Recovery Work, and Cognate Subjects.* By Prof. David Penman and Dr. J. S. Penman. Pp. viii + 303. (London: Charles Griffin and Co., Ltd., 1927.) 21s. net.
- Ventilation of Mines.* By Prof. Walter S. Weeks. Pp. x + 228. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15s. net.

For some time past considerable attention has been given to the principles of mine ventilation; institutions, committees, and individuals have been hard at work for some years trying to render our knowledge of this complex subject more accurate, and at the same time to express that knowledge by means of readily intelligible formulæ. It is beginning to be generally admitted that no single formula can quite accurately express all the facts, but there are strong hopes that a reasonably simple formula giving results near enough for all practical purposes may be the outcome. The two books now before us are evidence of the widespread interest that is being taken in the subject; both are fairly satisfactory works within their own spheres, but, curiously enough, these spheres are entirely different. The British book is addressed essentially to students, the American book essentially to mining engineers. Thus it is that in the former it is thought necessary to give such elementary information as that "inversely means in the opposite direction," and to conclude each chapter with a series of questions, adapted apparently to the capacity of elementary students, whilst in the latter attempts are made to discuss such advanced problems as the economics of ventilation, and to solve such problems as, for example, "What is the most economic size of an airway under given conditions?" It must unfortunately be admitted that the author's solution of the problem is neither complete nor correct, but the fact that he attempts to solve it indicates the stage to which the work is carried.

Necessarily there is very much that is common to the two books, and indeed there is a mass of material available which may fairly be said to be the common property of all mining engineers interested in the subject. The British work, however, devotes much more attention to the details of fan construction, which the American writer takes for granted; the former is aware that students must be taught the construction of different types of fan on the market, but the latter assumes that the engineer will be sufficiently familiar with these to require but little additional information. Furthermore, it may be pointed out that whilst the British work practically limits itself to the consideration of the ventilation of collieries, the American work, hailing as it does from California, naturally devotes as much attention to the ventilation of metalliferous mines as to that of collieries. The weakest point

¹ "Ether and Matter." This book should be read in conjunction with these lectures of Lorentz.

in both books is their failure to treat adequately the practically important subject of the testing of fans, although, as might be supposed, this is rather more fully considered by the American than by the British author.

Geschichte der Physik. Von Edmund Hoppe. Pp. viii + 536. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1926.) 30 gold marks.

WE can scarcely imagine a more difficult task than the writing of a trustworthy and adequate history of physics. The field is so extensive and the work of reference so enormous that we can readily appreciate that Prof. Hoppe has spent several decades on his undertaking, and in this admirable book he has given the pith of his researches. The treatment is brief but delightfully clear, and in these days of turmoil, when the spirit of revolution has invaded even the realms of physics, it is refreshing to read of the gradual evolution of ideas, based on experiment, from the time of the Greeks through the Middle Ages to the end of last century.

The greater part of the book, almost five hundred pages, is devoted to physics of the *Neuzeit*, beginning with the close of the sixteenth century, and the book deals in turn with mechanics, heat, optics, and electricity and magnetism, whereby each section is prefaced by a brief statement of the earlier work in that branch of the subject. No attempt is made to deal with the discoveries of the present century, but the continuity of development of the subject is amply portrayed, and we are made to feel that there would have been no 'new physics' but for the classical physics which preceded it. In these days of relativity and quanta, students are perhaps inclined to look askance at the earlier work, and yet much of the remarkable development of our own day is a direct outcome of the discoveries of the end of last century and earlier.

The numerous and comprehensive references to the literature in the text are a valuable feature of the book. The omission of the initials before the names of authors has in a few cases resulted in a certain amount of confusion. Thus in the index (p. 524) there are two entries under the name of Rutherford, but they refer to different persons. The first is the Rutherford (1753-1819) of the maximum and minimum thermometer, whereas the second is Sir Ernest Rutherford. On p. 177 the names Negrette and Zumbra should surely be Negretti and Zambra, and on p. 505 few people will realise that the 'de Smolan' referred to is in reality Smoluchowski.

The Wilderness of Sinai: a Record of Two Years' Recent Exploration. By H. J. Llewellyn Beadnell. With a Foreword by Dr. D. G. Hogarth. Pp. xvi + 180 + 16 plates. (London: Edward Arnold and Co., 1927.) 10s. 6d. net.

MR. H. J. L. BEADNELL, during his service in the Geological Survey of Egypt, enjoyed the privilege of two years' survey of the mountains of Sinai. In this book he gives an interesting narrative of his experiences and records, his observations on the country and people, and especially on its

geology and physical geography. The country is of popular interest from its connexion with the wanderings of the Children of Israel on their way from Egypt to Palestine; and the author's account indicates that the physical conditions of this region were the same then as now, and that no large body of people could have crossed the mountains of southern Sinai. Moses probably followed a route across the northern plains.

The scientific interest of Sinai depends largely on the light it throws on the nature of the gulfs on either side. According to Dr. Ball, of the Egyptian Geological Survey, the Gulf of Suez is a normal valley of erosion and was excavated by a river along the summit of an arch. According to the alternative explanation, the Gulf is a rift valley due to the subsidence of a strip of country between parallel faults; the actual dislocation of the rocks may be seen from passing steamers, but according to Dr. Ball these disturbances are merely landslips. Mr. Beadnell declares that the evidence that the Gulf of Suez is a fault-made valley is irresistible. His new information also supports the conclusion drawn from W. F. Holland's map of 1869—to which there is no reference in the text—that the angular parallel-sided valleys of Sinai are also tectonic and are due to the rifting of the country by the earth movements that made the adjacent gulfs.

The photographic illustrations are of especial interest, for they show the topography and structure with almost diagrammatic clearness. An interesting introduction by Dr. Hogarth refers to the historic associations and attractions of this country which he describes as looking, when seen from the eastern Gulf, as alluring as a Gustav Doré vision of hell.

A Year among the Persians: Impressions as to the Life, Character, and Thought of the People of Persia, received during Twelve Months' Residence in that Country in the Years 1887-1888. By Edward Granville Browne. With a Memoir by Sir E. Denison Ross. New edition. Pp. xxiii + 650. (Cambridge: At the University Press, 1926.) 25s. net.

SIR DENISON ROSS, who contributes a memoir of the author to this volume, points out that it is a remarkable fact that one of the most fascinating and instructive books of travel ever written should have remained out-of-print for a long period of years. Not only did Browne's valuable work cover a very interesting and important period in the political relations of East and West, as well as in the internal history of Persia, but also he covered ground in his journey which is still very little known. Where it is more familiar, a comparison with present-day conditions, especially, for example, in Asiatic Turkey, is highly instructive.

Browne wrote with a peculiar charm, his style was lively, and, thanks to his marvellous memory, always realistic. The fascination which Persia, and its literature and philosophy, held for him ensured a sympathy with his subject which he never fails to pass on to his readers. Sir Denison

Ross's memoir, which is instinct with the intimate touch of a friendship of long standing, is a faithful picture of a personality full of charm, if not without its peculiarities, and a life of disinterested devotion to the advancement of learning. The thanks of the reading public are due to the Cambridge University Press for their re-issue of a notable and enduring work in a form which is as handsome as it deserves.

(1) *Myth in Primitive Psychology*. By Dr. Bronislaw Malinowski. (Psyche Miniatures: General Series, No. 6.) Pp. 128. 2s. 6d. net. (2) *Fee, Fi, Fo, Fum: or, The Giants in England*. By H. J. Massingham. (Psyche Miniatures: General Series, No. 5.) Pp. 175+4 plates. 2s. 6d. net. (London: Kegan Paul and Co., Ltd., 1926.)

Of these two volumes in this attractively got up little series, Dr. Malinowski's contribution is written on lines with which what may be called his 'occasional' writings have made us familiar. It is his method to take some aspect of primitive culture—magic, jurisprudence, or, as on this occasion, myth—and, instead of dealing with it *in vacuo*, putting it in its context as a live element in the everyday life of primitive man as he himself has known him. In this case he shows what the legend, tradition, or story means to the native of the Trobriands by telling us not only of the matter with which it deals, but also of the manner in which it is told, the occasion, and by whom. It is, as he says, a reality lived, a hard-worked active force, a pragmatic charter of primitive faith and moral wisdom.

Mr. Massingham, on the other hand, belongs to another school and deals with matter that is no longer alive except as the stuff from which theory is made. His giants and dragons carved in the English hill-sides with their traditions and the stories of Arthur, the heroes of the Mabinogion and of Merlin, are the relics of a forgotten age which has to be painfully pieced together in a process of reconstruction. The author being a whole-hearted 'diffusionist,' this reconstruction is based on an interpretation of the material in terms of the 'megalithic culture' and the 'children of the sun' and their derivation from Egypt.

Naturalist's Guide to the Americas. Prepared by the Committee on the Preservation of Natural Conditions of the Ecological Society of America, with assistance from numerous Organisations and Individuals. Assembled and edited by the Chairman, Victor E. Shelford. Pp. xv + 761 + 16 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 45s. net.

THIS important volume, which indicates the strength of the movement towards the ecological study of the problems of biology in America, will be an invaluable tool in the establishing of Nature reserves from the Amazon to the Arctic Circle. As a result of many years' labour, an enthusiastic band of scientific workers has catalogued all preserved and preservable areas in North America in which natural conditions persist, the ultimate

object being the reservation of all such areas in order that there, so far as possible, the primitive balance of Nature may be maintained. This preliminary study indicates, for each of the United States and Canadian provinces, the leading physical features, meteorological conditions, biological zones, summarises the associated flora and fauna, and mentions the areas suitable for Nature reserves. An introductory section discusses from many points of view the uses, values, and management of natural areas, and an effort is made to trace the original biota of North America. Ecological study demands a much more intensive investigation than could be compassed in this extensive monograph, but it sets the framework within which the future worker must build in detail. J. R.

Ancient Persia and Iranian Civilisation. By Clément Huart. Translated by M. R. Dobie. (The History of Civilisation Series.) Pp. xix + 249 + 4 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1927.) 12s. 6d. net.

MR. HUART'S book on ancient Persia contains a very good account of the cultural history of old Iran. A vivid picture of the country, and an account of the scripts in which Persian texts have been written, is followed by the history of the three great dynasties, the Achæmenids, Arsacids, and the Sassanids. The real value of the book consists in the excellent analyses of the cultural data referring to each epoch; the social organisation, the religious cults and beliefs, and the artistic productions. The powerful character sketches of the various monarchs and heroes, starting with the legendary Cyrus, receive new life from the cultural background in which they are set. The author makes us feel the scenery, through his descriptions drawn from personal experience and by the many pictures which enliven the book. The chronological table and bibliography add to the value of the book, while the excellent index facilitates its use for reference.

Prehistoric Man. Written and Illustrated by Keith Henderson. (The Simple Guide Series.) Pp. xv + 276. (London: Chatto and Windus, 1927.) 7s. 6d. net.

As a stimulating introduction to prehistoric man, his haunts, habits, and arts of life, this volume in "The Simple Guide Series" will prove very useful. It is written vividly and without any surface pedantry though it condenses a good deal of information into a small space. It will succeed in sweeping from the picture of our stone age ancestors some of the dry dust with which the learning of specialists, as well as the centuries, have covered it. It leads us from lemurs, monkeys, and apes up to the man of the bronze age. Needless to say, no specialist in prehistory will completely agree with any other author's conclusions, whether these be put in popular or learned language, but, on the whole, Mr. Henderson succeeds in giving a fair and well-balanced summary of the sound and established results of modern prehistoric science.

Letters to the Editor.

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Experiments on Sex in Rust Fungi.

THE phenomenon of heterothallism (the separation of sex in different individuals) is known to occur in the Phycomyces (*Mucor*), in the Ascomycetes (*Ascobolus*, *Penicillium*), in a large number of Hymenomycetes (mushrooms and toadstools), and in the Smut fungi. Therefore the question arises: Does heterothallism occur in the Rust fungi? An attempt to solve this problem, which is of considerable theoretical and perhaps practical interest, has been made by the author by sowing the sporidia of *Puccinia helianthi* on leaves of young Sunflower plants and observing whether or not aecia are produced: (1) when a single sporidium is sown by itself, and (2) when two sporidia are sown close together.

Sporidia produced on promycelia developed by teleutospores attached to old dead Sunflower leaves were allowed to fall on to the green leaves of young Sunflower plants in such a way that, as a rule, they settled at some distance apart but so that, sometimes, two sporidia settled close to one another. The sporidia were not actually seen on a leaf after they had settled there. When a sporidium infects a leaf, the pustule at its first appearance is a tiny reddish dot no larger than the dot of an *i* in this letter. Altogether more than 1200 monosporidial and about 200 bisporidial pustules have been under observation.

The facts observed during the investigation upon *Puccinia helianthi* may be thus summarised.

A. Within two weeks the following happens, and usually within three weeks nothing more happens:

1. Each isolated pustule derived from a monosporidial infection usually becomes 0.6-1.2 cm. in diameter and develops pycnia which excrete nectar, but it does not give rise to any aecia (Fig. 1, pustule to the left). The pycnia appear about 8 days after the sowing of the sporidia.

2. In a compound pustule formed by the coalescence of two simple pustules, each simple pustule owing its origin to a monosporidial infection, when the distance between the two centres of infection is not more than about 1 mm., either: (a) aecia appear in the compound pustule 10-11 days after the sowing of the spores (Fig. 1, pustule to the right), or (b) no aecia appear.

3. When two simple pustules, each derived from a monosporidial infection, arise near to one another, coalesce, and produce aecia: the nearer they are and the sooner they coalesce, the sooner are aecia developed; while the farther apart they are and the later they coalesce, the later are aecia developed.

4. Where in compound pustules, each derived from two monosporidial infections, the centres of infection are not more than 2 mm. apart, the number of compound pustules producing aecia is about 50 per cent. of the whole. This conclusion is based on observations made upon about 175 compound pustules.

B. At the end of three weeks or more rarely less, in respect to pustules both simple and compound which hitherto have not produced any aecia, the following happens:

1. A majority of the pustules (about 60 per cent.) never produce aecia, even when the pustules persist for so long as six weeks.

2. A minority of the pustules (about 40 per cent.)

produce aecia of normal form and colour. In at least some of these aecia the aeciospores are uninucleate, whereas in aecia produced in a compound pustule 10-11 days after the sowing of the sporidia (*vide* A, 2, above) the aeciospores are all binucleate.

The following theoretical deductions may be drawn from the series of facts just recorded.

1. Since pycnosporos appear on every mycelium of monosporidial origin, it is clear that, if the pycnosporos are really nothing but non-functional male gametes (spermatia), *Puccinia helianthi* is not dioecious. In other words, the monosporidial mycelia of the Sunflower Rust fungus are *not* of two kinds: (a) male, bearing spermatia, and (b) female, not bearing spermatia.

2. The pycnosporos are not functionless male gametes but are simply conidia corresponding to the uninucleate oidia which appear on the monosporous

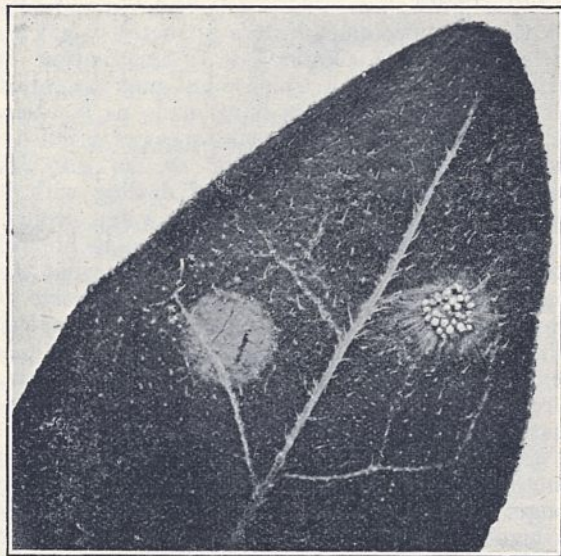


FIG. 1.—Underside of a Sunflower leaf which was inoculated on its upper side with sporidia of *Puccinia helianthi*, photographed twenty-three days after inoculation. To the left, a pustule derived from a monosporidial mycelium showing absence of aecia (it had numerous pycnia on its upper side). To the right, a compound pustule formed by the coalescence of two simple pustules each derived from a monosporidial mycelium. The compound pustule has developed typical aecia. Magnified two and one-half times the natural size.

mycelia of such heterothallic Hymenomycetes as *Coprinus lagopus*, *C. niveus*, *Stropharia semiglobata*, and *Collybia velutipes*.

3. The pycnosporos produced on (+) monosporidial mycelia are (+) in their sexual nature, while pycnosporos produced on (-) monosporidial mycelia are (-) in their sexual nature.

4. The sporidia are unisexual and produce unisexual mycelia. The (+) and (-) monosporidial mycelia, and therefore the (+) and (-) sporidia from which they originate, appear to be about equal in numbers. This suggests that segregation of the (+) and (-) factors takes place in the promycelium during nuclear division in the same manner as it takes place in the basidium of *Coprinus Rostrupianus* and of *C. radians* (= *C. domesticus*).

5. When two sporidia of opposite sex, (+) and (-), are sown close together on a Sunflower leaf so that the pustules arising from the two infections soon coalesce, the two monosporous mycelia come into contact, fuse together, and give rise to normal binucleate aeciospores, each conjugate pair of nuclei formed in the spore-bed consisting of a (+) and of a (-) nucleus

F. Whitt.

derived from a (+) and from a (-) mycelium respectively.

6. When two sporidia of the same sex—that is, two (+) sporidia or two (-) sporidia—are sown close together on a Sunflower leaf so that the two pustules arising from the two infections soon coalesce, the two monosporous mycelia come into contact but do not interact sexually, and therefore do not give rise to any aecia.

7. The belated aecia, which appear at the end of about three weeks on pustules of monosporidial origin or on pustules of bisporidial origin where presumably the two sporidia are of one and the same sex, probably arise without any hyphal fusions.

8. In any heterothallic Rust fungus that behaves like *Puccinia helianthi* there is a possibility of two strains of the same species being crossed by means of the union of their monosporidial mycelia within the tissues of one and the same host-plant.

A few experiments have already been made by sowing the sporidia of *Puccinia graminis* on the leaves of the Barberry. The results, so far as they have gone, appear to be similar to those already described for *Puccinia helianthi*.

In conclusion, I desire to acknowledge valuable assistance derived from consultation with Prof. A. H. Reginald Buller. J. H. CRAIGIE.

The Dominion Rust Research Laboratory,
Winnipeg, May 25.

Eigenvalues and Whittaker's Function.

AMONG those who are trying to acquire a general acquaintance with Schrödinger's wave-mechanics there must be many who find their mathematical equipment insufficient to follow his first great problem—to determine the eigenvalues and eigenfunctions for the hydrogen atom. I do not think it is generally realised that Schrödinger's differential equation for this problem is one which is fully treated in a standard text-book, Whittaker and Watson's "Modern Analysis," Chapter xvi. (I quote from the second edition). It would seem that advantage may be taken of this to make the treatment easier for English readers. I realise that the following is only a slight re-dressing of Schrödinger's method; but I think it will be intelligible to some who have been unable to appreciate the original, and that it gives a useful idea of the genesis of eigenvalues.

Having set $\psi = \chi(r)S_n$, where S_n is a spherical harmonic of integral order n , Schrödinger shows that his wave-equation gives:

$$\frac{d^2\chi}{dr^2} + \frac{2}{r} \frac{d\chi}{dr} + \left(\frac{8\pi^2mE}{h^2} + \frac{8\pi^2me^2}{h^2r} - \frac{n(n+1)}{r^2} \right) \chi = 0, \quad (1)$$

and he seeks solutions which shall be finite for all values of r including 0 and ∞ .

Writing $u = r\chi$, this becomes:

$$\frac{d^2u}{dr^2} + \left(\frac{8\pi^2mE}{h^2} + \frac{8\pi^2me^2}{h^2r} - \frac{n(n+1)}{r^2} \right) u = 0.$$

Change the unit of r by writing:

$$r_1 = r \sqrt{\left(\frac{-32\pi^2mE}{h^2} \right)}.$$

The equation then takes the standard form:

$$\frac{d^2u}{dr_1^2} + \left(-\frac{1}{4} + \frac{l}{r_1} + \frac{\frac{1}{4} - (n + \frac{1}{2})^2}{r_1^2} \right) u = 0, \quad (2)$$

where $l = \sqrt{\left(\frac{-2\pi^2me^4}{h^2E} \right)} \dots \dots (3)$

The general solution of (2) is (W. and W., § 16.31):

$$u = AW_{l, n+\frac{1}{2}}(r_1) + BW_{-l, n+\frac{1}{2}}(r_1),$$

where W is Whittaker's function. It is here sufficient to consider the solution $u = W_{l, n+\frac{1}{2}}(r_1)$. The asymptotic expansion for W (*loc. cit.* § 16.3) gives:

$$u \sim e^{-\frac{1}{2}r_1} r_1^l \left\{ 1 + \sum_{p=1}^{\infty} \frac{\{(n+\frac{1}{2})^2 - (l-\frac{1}{2})^2\} \{(n+\frac{1}{2})^2 - (l-\frac{3}{2})^2\} \dots \{(n+\frac{1}{2})^2 - (l-p+\frac{1}{2})^2\}}{p! r_1^p} \right\}. \quad (4)$$

We see at once that u vanishes at $r_1 = \infty$, and the only danger of divergence is at $r_1 = 0$. We notice further that the cases in which

$$n + \frac{1}{2} = l - \frac{1}{2}, \quad l - \frac{3}{2}, \quad l - \frac{5}{2}, \dots$$

i.e. when

$$l = n + 1, \quad n + 2, \quad n + 3, \dots \dots (5)$$

present an exceptional feature. For if $n + \frac{1}{2} = l - p + \frac{1}{2}$, the last factor in the numerator of $1/r_1^p$ vanishes, and this zero factor is repeated in every succeeding term. The series thus terminates; and the expansion accordingly becomes exact. The final term in u is then $e^{-\frac{1}{2}r_1} r_1^{l-p+1}$ or $e^{-\frac{1}{2}r_1} r_1^{n+1}$, so that the final term in χ is $e^{-\frac{1}{2}r_1} r_1^n$. Hence χ is finite at the origin, and the values (5) are the required eigenvalues. The corresponding energy values $-E$ are then given by (3). The expression (4) gives the eigenfunctions.

A. S. EDDINGTON.

Use of Carbon Dioxide in a Mercury Interrupter.

It is customary to use coal gas as a dielectric in the mercury interrupter and it has generally been found to be quite satisfactory in action. There are, however, places in the country where coal gas is not available, and the following experiments were undertaken with the view of examining the possibility of employing carbonic acid gas used in connexion with X-ray work carried out in hospitals at such places.

Carbonic acid gas is available in cylinders at many places, and, being an inert gas, it naturally suggests itself as a very useful substitute for coal gas. It is, however, necessary to examine the efficiency of the interrupter using carbonic acid gas by comparing it with that using coal gas and also hydrogen. Since the most important function of the dielectric is to extinguish the flame, it is necessary to examine its action when it is employed in an interrupter in two different circumstances; in one case, when the primary of the induction coil is connected up straight to the source of electric power which gives just sufficient potential difference in the primary to obtain the desired E.M.F. in the secondary, and in the second case, when the primary draws current from the supply mains through a large rheostat which regulates the current in the primary to yield the desired E.M.F. in the secondary.

It is obvious that the two cases are different. In the first case, the sparking inside the interrupter is considerably less than in the second case, where the whole potential difference of the supply mains is effective in producing the spark at the break.

The experimental work for each gas was consequently divided up into two parts. In the first part the power to the primary was supplied from a potentiometer device connected up to the 230 volts D.C. mains, and in the second, the primary was connected to the mains through a rheostat.

The length of the spark-gap was taken to indicate the magnitude of the voltage generated in the secondary. The current drawn by the primary could be read off from an ammeter placed in series with it (see Fig. 1). The same experiments were repeated with an X-ray tube connected up with the secondary with a milliammeter in series (see Fig. 2).

In the second part of the experiment the primary

and the interrupter were connected up to the main supply of 230 volts and the current was suitably cut down by means of an adjustable rheostat and measured by means of an ammeter (see Fig. 3). The same experiments were then repeated, using an X-ray tube (see Fig. 4).

It can be seen from the results that in either case, when hydrogen or carbonic acid gas is used, the efficiency of the interrupter is greater than when coal gas is used. Hydrogen gives the longest spark-gap, that is, the highest value of the secondary E.M.F. with the smallest potential difference in the primary. The difference between the working of the gas-mercury-interrupter using coal gas and carbonic acid gas is less in the case when the full 230 volts are allowed to play across the break than when the potential difference at that point is carefully adjusted

These results should prove useful in places where coal gas is not available but where carbonic acid gas can be carried in steel containers.

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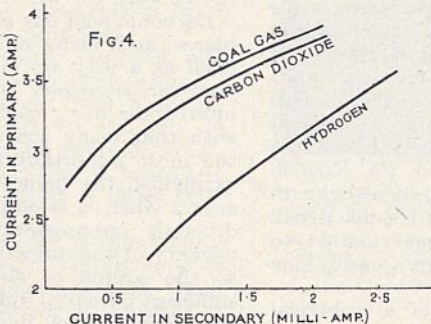
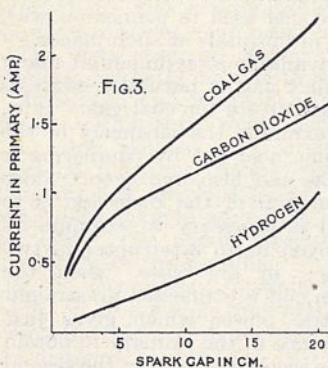
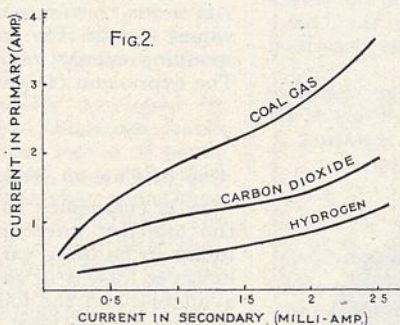
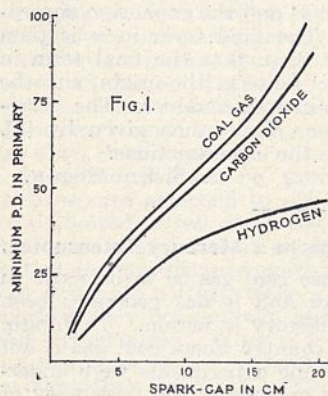
Biological Fact and Theory.

"I've often thought that headstrong youths
Of decent education,
Determine all-important truths,
With strange precipitation."

("The Periwinkle Girl," W. S. Gilbert's
"Bab Ballads.")

IF, instead of attributing to me a certain skill in controversy, Prof. J. S. Dunkerley (July 2, p. 12) had paid my intelligence the greater compliment of reading carefully what I had written, I might have been saved from begging for more space in which to refute what I believe are mistaken ideas. I had hoped that I had so expressed myself that my meaning was quite clear even to the casual reader. As Prof. Dunkerley has missed all my important points, I have apparently failed in his case and may have done so in others. May I give a variant of what is perhaps the most important argument I have used, which I hope will be intelligible to him?

The very evidence that favours the hypothesis that units representing Mendelian characters are present in individual chromosomes, is absolutely against the probability of such units representing those characters that are common to all individuals comprised in an indefinite number of successive generations in a large group of organisms. The 'Neo-Mendelian theory' assumes that *all* characters are dependent upon 'genes' and that *all* 'genes' are units arranged in regular order, each in its particular chromosome. The cell phenomena that precede fertilisation, according to presently accepted observations, seem to provide for an alternative distribution of the chromosomes to the daughter cells. As, however, only half the somatic number of whole chromosomes go to each sperm or mature ovum, only a proportion of the organisms of the next generation can contain any given paternal or maternal chromosome. This agrees with the Mendelian breeding experiments, but is incompatible with the reappearance of those characters common to all individuals in successive generations, if every character is represented by a unit which has an assigned place in a particular chromosome. The hypothesis that the capacity for reproducing recent variations is conveyed by the chromosomes, while common racial characters are dependent upon something else in the cell, does not appear so utterly incompatible with recorded breeding experiments and cytological observations as the 'Neo-Mendelian theory' of 'genes.' The Mendelian characters are probably recent variations and may be represented in the chromosomes; racial characters



to the minimum to yield the required E.M.F. in the secondary as indicated by the length of the spark-gap. The curve for carbonic acid gas being lower than the curve for coal gas, it is also clear that it would be more economical to use carbonic acid gas, since to obtain equal E.M.F.'s in the secondary, less electric power is required in the primary.

There is next the question of safety in handling the gas. Carbonic acid gas, being heavier than air, is capable of easily displacing the air from the interrupter, and the fact that the interrupter is full of the gas can be easily tested. The gas itself is of course harmless.

Further points in connexion with this gas are that it has no action on the electrodes and the gas remains unaltered after long use. In order to ascertain that the gas remained unaffected by constant sparkings inside the interrupter, the gas was tested after half an hour's continuous run. Samples of the gas-filling were drawn off from the interrupter, and on analysing them it was found that the gas had not undergone any appreciable change. The electrodes also were not affected.

cannot. If Prof. Dunkerley will again read my previous letters to NATURE (Jan. 29 and June 4) he will realise that the 'exceptions' to the 'Neo-Mendelian' views of the functions of the chromosomes were given in the hope of elucidating this interpretation of generally accepted observations, and not with the incomprehensible objective which he attributes to me.

Prof. Dunkerley writes: "The transmission of paternal characters by the spermatozoon is not denied by Dr. Walker, and if he doubts the transmission of these characters in some way through the chromatin material of the male sperm cell, there is very little left in the sperm." This is an example of those loose methods of thought and expression which have led to much misunderstanding of biological problems. What are "the paternal characters"? Are those peculiar to the male parent only implied? Godlewski fertilised enucleated eggs of sea-urchins with the sperms of crinoids, and these developed into gastrulæ possessing only maternal characters, though apparently all the chromosomes present were of paternal origin (*Archiv für Entwicklungsmechanik*, Bd. 20; 1906). There are records of many other experiments bearing upon this point (Driesch, H., *Arch. f. Entwickl.*, Bd. 16; 1903. Boveri, Th., *ibid.* Loeb, J., *Arch. f. d. gesam. Physiol.*, Bd. 99; 1903. Bataillon, E., *Arch. d. Zool. Expér.*, Tom. 6; 1910).

I do doubt the transmission of paternal or any other characters in any way by the chromatin of any cell, even including the "male sperm cell," whatever that may be. So long ago as 1907 ("Essentials of Cytology") I pointed out that in all probability the chromatin is merely a secretion of the linin, and that if there are permanent and individual constituents of the cell handed on from one generation to another, they are to be found in the linin and not in the chromatin. Doubtless the little regular rows of chromatin granules of the cytological preparation are tempting to the 'Neo-Mendelian,' but the evidence against their permanent nature is strong.

I fail to see the point of the remark as to the proportion of the sperm left when the chromatin is eliminated.

Having admitted the difficulty of imagining all or half the potentialities "for the development of an animal" being contained in the "microscopic spermatozoon," Prof. Dunkerley goes on: "Then is it much more difficult to believe that these potentialities are arranged in some sort of order in the individual chromosomes?"

"I can't believe that!" said Alice.
 "Can't you?" the Queen said in a pitying tone. "Try again: draw a long breath, and shut your eyes." . . . "I dare say you haven't had much practice," said the Queen. "When I was your age, I always did it for half an hour a day. Why, sometimes I've believed as many as six impossible things before breakfast." ("Through the Looking-Glass," Lewis Carroll. London: Macmillan and Co., 1873.)

CHARLES WALKER.

University of Liverpool, July 3.

On X-ray Diffraction Patterns from Liquids and Colloidal Gels.

ON account of the present great interest in the interpretation of X-ray patterns for amorphous substances (broad haloes) it seems desirable to present in a preliminary way a few of the observations made in the present writer's laboratory. These tend to show that very important information of practical bearing can be obtained on rubber and its substitutes, nitro-cellulose, gelatine, linseed oil, china wood oil, resins,

varnishes, etc. In all cases the films have been measured photometrically so that on the curves the exact centres of the broad bands are easily located.

For unstretched rubber latex films the spacings calculated by the Ehrenfest formula ($a = 7.72\lambda/4\pi \sin \theta$, where 2θ is the diffraction angle) from the two principal rings (second order faint rings appear in addition) are 6.03 Å.U. and 14.76 Å.U., in fair agreement with Hauser and Rosbaud (*Kautschuk*, Jan. 1927, p. 17). When, however, the rubber is very carefully purified by a process of fractional solution and evacuation to constant weight, the spacings are 5.97 Å.U. and 11.15 Å.U., a profound change in the inner ring. Intermediate values up to 14.76 Å.U. have been observed with solvent swelling. On account of the excellent proof by Zernicke and Prins (*Zeit. Physik*, 41, 184; 1927) that the broad rings are indicative of the natural distance of nearest approach of molecules, the classical Bragg formula $n\lambda = 2d \sin \theta$ seems preferable to the Ehrenfest expression, which was derived for regular spacing of atoms within molecules.

With nitrocellulose of the same composition the following quantitative results are typical for the spacings of the inner and outer rings respectively calculated by the Bragg formula:

	Fresh.	Aged (light).	Aged (heat).
Untreated, dry	{7.18 Å.U. {4.02	{7.17 Å.U. {4.05	{6.98 Å.U. {3.92
Dry, residual solvent present	{9.30 {4.47	{9.32 {4.47	{7.86 {4.31
Oil softener added	{7.34 {4.31	{— {4.39	{— {4.39

The swelling or combination of molecules with solvent or oil has a much greater effect than aging, even though the film may become very brittle.

Contrary to the results of Katz (*Zeit. physik. Chem.*, 125, 321; 1927), distinct though usually small differences in spacings are observed with china wood oil and linseed oil during polymerisation and drying. The following remarkable results on china wood oil were obtained by careful measurement of the photometric curves; they are expressed as percentage change related to the spacings of the raw liquid oil calculated by the Bragg formula:

	Inner Ring.	Outer Ring.
Raw liquid	8.5 Å.U.	4.4 Å.U.
Raw dry film (oxidation at room temperature)	+ 6 per cent.	+ 1 per cent.
Raw gel (polymerised by heat) + 3	+ 3	+ 2
Prepared liquid	+ 12	+ 16
Prepared dry film	+ 13	+ 6

The prepared liquid in this case consisted of china wood oil heated with Venice turpentine and thinned with pure turpentine. The film dries with a crystalline finish, which is, however, only a pseudo-crystalline wrinkled skin. The increase in spacings (decrease in ring diameters) in every case, including drying, over those of the raw oil is remarkable. Combination with solvent molecules and polymerisation are both definitely indicated. No indication has been found in these patterns of long spacings such as are obtained with solid carbon chain compounds, and such as have been observed for liquid primary normal alcohols by Stewart and Morrow (*Proc. Nat. Acad. Sci.*, 13, 222; 1927). It is possible that diffraction rings corresponding to these long spacings may be so close to the central direct-beam trace on the photographic films that they are not defined. This is particularly true where molybdenum $K\alpha$ rays have been used instead of rays from a copper target.

Similar results have been obtained with cumar, resins, varnishes, etc. In all cases it is clear that the 'amorphous' ring diagrams may yield very important

theoretical and practical results in terms of fundamental space array of molecules or aggregates acting as units, polymerisation, the swelling of gels, and changes during aging. X-ray science has apparently reached the stage wherein it may analyse all matter in any form whatsoever. GEORGE L. CLARK.

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Potentials during the Solar Eclipse.

OWING to adverse weather conditions we were unable to take any photographs of the solar eclipse at Bangor. Certain other observations which were made may be of interest. A thermometer mounted on a stand in the open and viewed through a telescope recorded a drop in temperature of only $0^{\circ}.5$ C., the

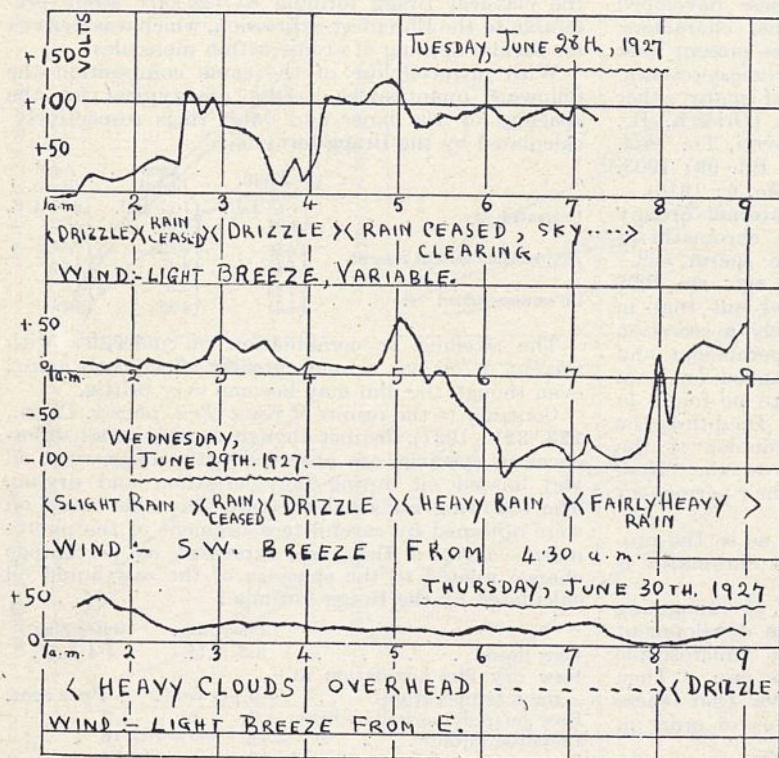


FIG. 1.

actual temperature at the time of totality being $8^{\circ}.5$ C.

Readings were taken by the water-drop method of the variation of the potential at a point 215 cm. above the ground before, during, and after the eclipse. The potentials recorded on June 28, 29, and 30 are shown in the accompanying diagram (Fig. 1). It will be noticed that during the eclipse there was a change from a positive to a negative potential, this change being probably due to the heavy rain which fell at the time.

The darkness and fall of temperature during totality were not so marked as they would have been had there been no cloud, and the whole phenomenon was disappointing in this part of the country.

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No. 3012, VOL. 120]

Series in the First Spark Spectrum of Tin.

FOLLOWING the work of one of the authors on regularities in the spark spectrum of tin (Sn III, *Proc. Phys. Soc.*, **39**, 161; 1927; and Sn IV, in the course of publication), the spectrum of the element in the singly-ionised stage (Sn II) has been investigated.

According to the theory of spectra recently developed by Hund, the first spark spectrum of tin must arise from transitions of one electron successively through the $O_2, P_1, O_3, P_2, Q_1, O_4 \dots$ shells which result respectively in the usual doublet terms in the order of value, $1^2P, 1^2S, 1^2D, 2^2P, 2^2S, 1^2F$, etc. All these terms have been found, the largest being $1^2P_1 = 117684$, giving the second ionisation potential of tin to be about 14.5 volts.

Besides these, the configuration of one O_1 and two O_2 electrons gives $4^1P, a^2D, 2^2P, a^2S$ terms. Combination pairs between this a^2D term (found to be identical with the x_{12} terms mentioned in the paper referred to above) and the regular 2^2P and 2^2F terms are detected, the latter forming a characteristic series, very prominently seen in the spark spectrum of the element, and there is probably an indication of the existence of the 4^1P term also. As a result of the analysis, about thirty lines of the first spark spectrum of the element have been classified, which include a large number of the strong lines observed in the ordinary spark and the vacuum arc in the visible and the fluorite region.

The first doublet P separation is found to be 4247 cm.^{-1} which is in agreement with the value inferred from the probable limiting difference $\infty^3P_1 - \infty^3P_2$ of the arc spectrum of tin. The second separation $2^2P_1 - 2^2P_2 = 886.2$ and the second principal pair $1^2S - 2^2P_{12}$, with the aid of the relative doublet laws, have led to the two following pairs in the spectrum of Sb III (which is under investigation by us). These pairs probably form the con-

secutive members of the second sharp series of the spectrum.

λ .	Int.	ν .	$\Delta\nu$.
4591.89	(5)	21771.5	1668.1
4265.089	(6)	23439.6	
4693.09	(5)	21302.0	1668.2
4352.25	(6)	22970.2	

In general features the first spark spectrum of tin is found to resemble closely the spectrum of Si II, analysed by Fowler. Details of the analysis will be published shortly.

A. L. NARAYAN.
K. R. RAO.

Vizianagram,
May 29.

The Leeds Meeting of the British Association.

LOCAL ARRANGEMENTS.

AFTER an interval of thirty-seven years the British Association is again meeting at Leeds. The City and University joined in a cordial invitation to the Association, and are working hard to live up to Yorkshire traditions of hospitality in connexion with the meeting. The president, Sir Arthur Keith, has already made himself known to many citizens of Leeds when he addressed the Luncheon Club earlier in this year upon the subject of science and civilisation. His visit was much appreciated and increased the interest of many citizens in the coming visit of the great scientific Association over which he will preside.

As in 1890, the Reception Rooms are in the Town Hall, which is centrally placed for all the stations upon the main railway lines serving Leeds. A special room will be put aside in the Town Hall for the convenience of members wishing to obtain information or tickets for the various excursions. The ample accommodation available permits of the usual facilities for writing-rooms, refreshments, post office, etc. As usual, the Meteorological Office will have an exhibit, whilst a new feature will be a room put aside for the purpose of demonstrations by the British Broadcasting Corporation. In the crypt of the Town Hall an exhibition of scientific apparatus is being arranged, to which a number of well-known apparatus firms are contributing. The general officers will occupy rooms in the City Education Offices, which face the Town Hall across Calverley Street. Meetings of the general committee and council will probably also be held in the Education Offices.

The secretariat will be at the Metropole Hotel, which is within two minutes of the Town Hall and of the Majestic Cinema, a fine building recently erected in the city, in which the presidential address will be delivered. The Majestic fronts upon City Square, in which Priestley's statue will be found, as also the Unitarian chapel of which he was at one time minister. The University is distant a short ride by tram along the Headingley route from City Square. All the meeting-rooms of the sections will be found either along this route or at the University. The meeting-rooms of the sections fall naturally into two groups: at the University will be found Sections A (Mathematical and Physical Sciences), B (Chemistry), C (Geology), D (Zoology), K (Forestry Sub-section), and M (Agriculture), whilst K (Botany) and G (Engineering) are in the immediate neighbourhood in the Trinity Congregational and Emmanuel Church School-rooms. Many of these sections will also have rooms in various University buildings for scientific exhibits, whilst luncheon and tea can be obtained at the University Refectory, at the Staff House and De Grey Road, or in the large Physics Laboratory. In the Engineering Lecture Theatre at the University several meetings are also to be held for the discussion of scientific problems connected with the textile industries. Of the other sections, I (Physiology) naturally finds

its home at the Medical School, whilst H (Anthropology) is appropriately housed in the Philosophical Hall, the headquarters of the long-established Leeds Philosophical and Literary Society.

These sections, as also E (Geography) in the Alexandra Hall, F (Economics) in the Y.W.C.A., J (Psychology) in the Masonic Hall, and L (Education) in the Albert Hall, are all close to the Reception Rooms and will amply be catered for, as regards lunch and tea, by the Reception Room and many restaurants in the shopping and Hotel quarters of the City in the immediate neighbourhood.

Many of the visitors will be staying in University hostels, or hostels of the Training College at Beckett's Park. Some of the University hostels are close to the University, and visitors staying at Lyddon Hall, College Hall, or University Hall will be able to lunch in hostel if they desire.

The president himself will be the guest of the City in the Judge's Lodgings, which are conveniently situated with regard to the meeting-places of the Association, all of which are within a very short distance of one another.

Leeds makes an excellent centre for those who wish to make themselves acquainted with the beauty spots of Yorkshire, and in consequence the local committee has arranged a wide field of excursions that should meet all needs. The more important abbeys in Yorkshire are to be visited under the leadership of well-known archaeologists. Mr. Peers, of H.M. Office of Works, will act as the leader of the excursion to Rievaulx and Byland Abbeys, while Prof. Hamilton Thompson will act in a similar capacity to the excursion to Bolton Abbey and Skipton Castle. The limestone country around Ingleborough is also to be visited, and opportunities for drives into Nidderdale and Wensleydale will be given. A local committee has been formed at York and Harrogate, and visitors to either of these places are assured of a hearty and interesting welcome. Probably a unique excursion is that to Gaping Ghyll where, thanks to the kind offices of the Yorkshire Ramblers' Club, a limited number of members will make the descent. In addition there will be a number of visits to works and factories in, and near, Leeds, and two visits to the Mines Rescue Station at Wakefield are included in the programme.

The Lord Mayor and Lady Mayoress are to give a reception to all members of the British Association in the Art Gallery on Thursday, Sept. 1, at 8 p.m., and on Tuesday evening, Sept. 6, the University of Leeds will entertain members at the University, when most of the scientific and technological departments will be exhibiting.

Garden parties are to be given by Major Fawkes, of Farnley Hall, on Friday, Sept. 2—an exceptional opportunity for members to inspect the fine collection of Turner pictures that he possesses—and by Col. C. H. Tetley of Foxhill, the Pro-Chancellor of the University. On Saturday, Sept. 3, Lady

Lawson Tancred will entertain at tea those members who take the excursion to Aldborough. Those who are interested in textiles are invited by the British Research Association for the Woollen and Worsted Industries to visit its laboratories at Torridon on Thursday, Sept. 1.

Through the courtesy of the Leeds Choral Union a concert will be given in the Town Hall on Sunday,

Sept. 4, at 8.15 p.m., and the items on the programme include Grieg's "Concerto," Elgar's "The Dream of Gerontius," and Parry's "Blest Pair of Sirens."

On Tuesday morning, Sept. 6, at 12 noon, a Congregation of the University will be held in the Great Hall, at which a number of honorary degrees will be conferred.

Science and Industry in Italy.

THE opening on May 28, by the King of Italy, of the Volta Centenary Exhibition at Como is a reminder to the world of the progress of

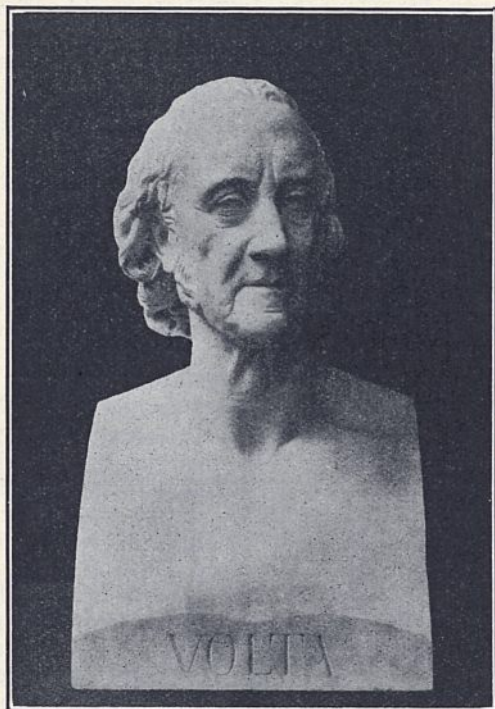


FIG. 1.—Copy of bust of Volta by Gio. Battista Comolli.

science and industry in Italy. The land of great poets and painters, of famous churches and universities, Italy was one of the first countries to witness the rebirth of scientific studies, and from the days of Leonardo da Vinci the lamp of science has been kept burning. Just as the labours of Galileo and Torricelli, of Boscovitch, Vesalius, and Malpighi, of Avogadro, Cannizzaro, Secchi, and Schiaparelli have added lustre to her schools, so has the work of a long line of eminent hydraulic engineers engaged in harnessing the rivers of the Alps and Apennines made Italy famous as a nation of constructors.

Inaugurated to commemorate the centenary of the death of Volta, who passed away at Como on Mar. 5, 1827, the Centenary Exhibition has among

its patrons Signor Benito Mussolini and Senatore Guglielmo Marconi. The site of the Exhibition is the spacious eighteenth-century mansion, Villa Olma, once the property of a great Milanese nobleman but now owned by the Commune of Como. It is in the fine ballroom of the villa, with its two-storied balconies, that many of the congresses will be held. In the villa itself is also displayed the collection of instruments illustrating Volta's own apparatus and his important inventions.

In 1899 another exhibition was held to celebrate the centenary of the discovery of the voltaic pile, but, as recorded in our columns at the time, on July 13 of that year practically the whole of the exhibition was destroyed by fire, and nearly all of the precious Volta relics perished—a loss to science only comparable with the destruction of Priestley's books, manuscripts, and apparatus in the Birmingham riots of 1791. Before the fire, however, photographs had been taken of the apparatus, and from these it has been possible to make replicas. The most interesting of these, perhaps, are the copies of the voltaic piles used by Volta in his demonstration in Paris when Napoleon attended a sitting of the National Institute, and the early forms of battery developed from the 'couronne des tasses.' As is generally known, Volta's invention of the pile was described in a letter written to Sir Joseph Banks on Mar. 20, 1800, from Como, and it was the information contained in the first part of the letter which led Carlisle and Nicholson to the experiment on the decomposition of water by the electric current.

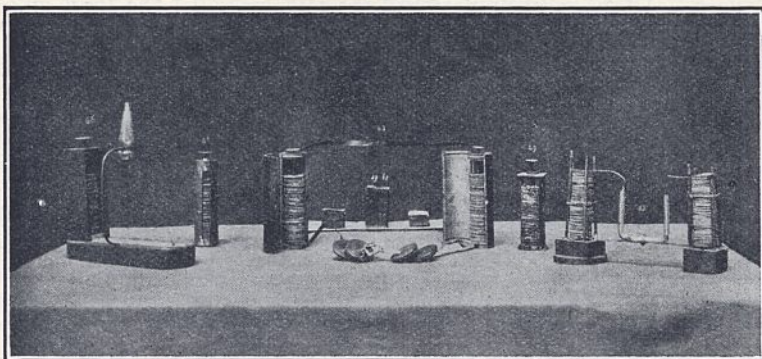


FIG. 2.—Examples of Volta's experimental piles.

In the grounds of the Villa, temporary buildings have been erected, and in these and the house itself are displayed the various exhibits. The two

most important sections of the exhibition are the International Exhibition of Electrical Communication and the National Electric Water Power Exhibition. To the former Senatore Marconi has lent a valuable collection of apparatus, some of which was used in his earliest experiments, together with a number of transmitting and receiving instruments which were used in the days before the advent of the thermionic valve. Among the apparatus is a copy of that employed by Senatore Marconi in his experiments at his father's house at Bologna in 1895. No fewer than thirty-five states, including Great Britain, have sent exhibits, while the Italian Government have installed a short-wave radio station of 25 kw. power which will be working.

Of the work of the Italian nation in the extension of hydro-electric power generation and transmission, much information is given by charts, photographs, etc., supplementing the review given by Prof. Emirico Vismara and others at the World Power Conference held at Wembley in 1924. Italy has taken a leading part in hydro-electric power development, and Prof. Vismara recalled

rainfall, but with no coalfields, hydro-electric plants are a necessity to Italy, and these are now linked together so as to cover almost completely large portions of the country. It is an interesting economic feature, however, that with the development of electric power from water the importation of coal tends to increase and not decrease.

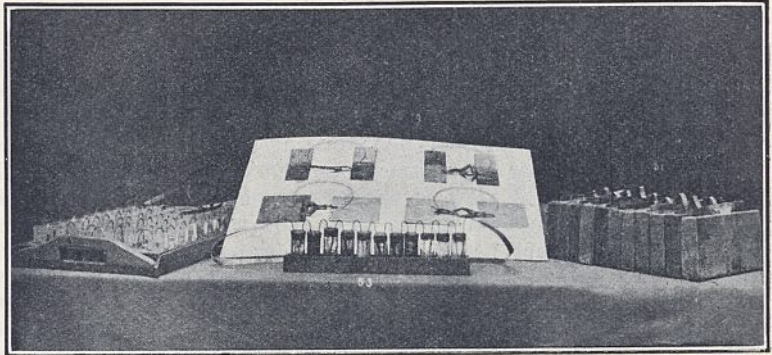


FIG. 3.—Early voltaic batteries and experiments on frogs' legs.

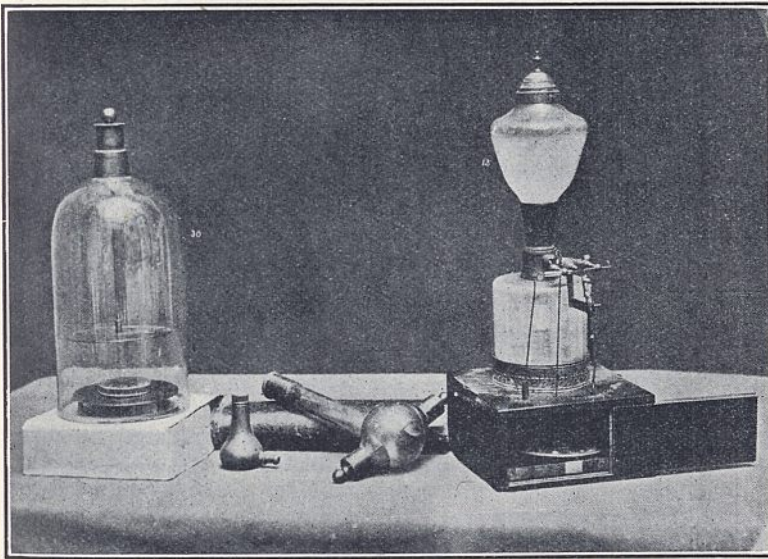


FIG. 4.—Volta's hydrogen lamp, electric pistol, and apparatus to test theory of hail formation.

how, on the completion of the transmission line from Tivoli to Rome, 25 kilometers at 5000 volts, in July 1892, Kelvin, Ayrton, Preece, Crookes, Swan, Crompton, and others telegraphed: "The English Electricians send greetings to Electricians of Italy on completion of splendid enterprise of Tivoli, and wish them every success." Another notable achievement was the line from Paderno to Milan, carrying current at 13,000 volts. With her great mountain chains, with an abundant

During the course of the Exhibition, which will be open from May until October, many congresses will be held, amongst which the most important will be the Congress of Physics and the International Congress of Electrotechnics. Distinguished scientific workers, many of them of international repute, from Austria, Canada, Denmark, France, Germany, Great Britain, Holland, Italy, Russia, Spain, Sweden, Switzerland, and the United States, will attend the Congress of Physics. The universities of Great Britain will be represented by Dr. F. W. Aston, Prof. W. L. Bragg, Prof. A. S. Eddington, Sir Ernest Rutherford, Sir J. J. Thomson, Dr. J. A. Fleming, and Prof. O. W. Richardson; Canada by Prof. J. C. McLennan; and India by Prof. M. Saha. At the conclusion of the Congresses the delegates will be conducted to Venice, Florence, and Rome, as the guests of the Italian Government, and the great national commemoration of Volta's centenary will take place at Rome in the Capitol on Sept. 19. The entire arrangements appear to have been planned on a scale worthy of the occasion, and worthy of the place science should take in the daily life of every progressive nation. Centenary celebrations nowadays follow each other with increasing rapidity, but the Volta centenary commemoration is one which does homage to an outstanding figure in Italian science, whose discoveries have led directly to the applications of science by which Italy has become a great industrial nation.

Excavations at Ur of the Cha'dees, 1926-1927.¹

By C. LEONARD WOOLLEY.

THE excavations started last year on Oct. 28 and were closed down on Feb. 19. With the exception of Father Burrows, who replaced Dr. Legrain as epigraphist, my staff was the same as in the former season, Mrs. Keeling being responsible for the drawings, Mr. Whitburn for the architectural side, and Mr. Mallowan acting as general archaeological assistant; as foreman I had again Hamoudi from Jerablus, while his two sons were engaged, one as photographer, one as junior foreman. The number of workmen employed was smaller than usual, in view of the nature of our programme, and averaged about 130. The work fell into two distinct parts: the excavation of building sites, principally the houses of the Larsa period, and the examination of a large prehistoric cemetery.

The house site lay just outside the sacred Temenos, against its south-west wall. Here we cleared parts of five streets, laying bare the remains, for the most part very well preserved, of fifteen houses, enough to give us a fair idea of town-planning in the period between 2100 and 1900 B.C. Contrary to what excavations on other sites of later date had led us to expect, the houses proved to be remarkably well-built structures in burnt and crude brick, standing two storeys high, with an average for a moderate-sized house of twelve rooms. Of course the exigencies of ground space and of the owner's means introduced all sorts of variations, but throughout there was recognisable one general type. The house was built round a central courtyard on to which opened all the rooms; round this ran a wooden gallery reached by a staircase of brick below and of wood for the upper flight, giving access to the chambers of the top floor; the house roof extended over the gallery, sloping slightly inwards, and left in the centre a comparatively small opening which served as a light-well for the ground-floor: gutters round the edge of the opening led the rain water from the roof into a drain in the middle of the brick-paved court. It was possible to identify some of the rooms. The front door led into a small lobby communicating with the court; facing the entrance was the reception-room, on one side the kitchen, and below the stairs the lavatory, with a drain exactly like that of a modern Arab latrine. Altogether the arrangement and appearance of the house was precisely what one finds in the better quarters of Basra or Baghdad at the present day.

We knew already that it was the custom to bury the dead under the floors of the rooms in which they had lived; this year we found an extension of the custom in that some of the houses were provided with a regular funerary chapel designed as part of the original building; the chapel was a long chamber having at one end a

brick altar and a column of brickwork (the meaning of this is uncertain), and below the pavement of the 'nave' there was a vaulted brick tomb which acted as a family vault, some containing as many as ten bodies interred at different times. In one case, instead of the tomb there were grouped round the altar clay bowls and coffins containing the bodies of infants, more than thirty in number; it would look as if the chapel were dedicated to some goddess who was a patroness of children.

One of the most important discoveries made in the houses was that of a fallen brick arch in one of the doorways. This takes back the history of the arch as a feature of domestic architecture by several hundred years and enables us to work out reconstructions of buildings of this period (c. 2100 B.C.) in a manner for which there was before no justification in fact. We can now be sure that the arch and the vault were regularly employed in temples, and it is not unreasonable to suppose, in view of certain peculiarities of ground-plan, that in the next great building period, that of 1400 B.C., the dome also was used. The chief 'finds' made in the houses were of inscribed tablets. Many of these were ordinary business documents, but we have, besides a few religious texts, lists of the pious foundations of kings, grammatical texts and syllabaries, and mathematical tablets with such things as tables of square and cube roots, exercises in land mensuration, etc.

Work on building sites other than that of the Larsa houses threw much new light on the topography of the sacred Temenos, filling up what had been blanks on our general plan and leading to the identification of the great temple of the moon god Nannar in the time of Nebuchadnezzar; the discovery of a remarkable building set up by Sin-idinnam, king of Larsa (c. 2000 B.C.) about a mile to the east of the Temenos enclosure showed how widely scattered were the public buildings of the city and how much work remains to be done even after the excavation of the Temenos itself is complete. Further digging beneath the floors of the temple E-nun-makh, first excavated in 1922, brought to light new historical information and, amongst other objects, a set of ivory toilet instruments of fine Phœnician work and an ivory plaque bearing a remarkable Phœnician inscription.

The second part of our season was spent in the examination of a cemetery lying at the south-east end of the Temenos and inside its later walls. The graves, distinguished by their levels and contents, belonged to three periods, the uppermost to 2800-2600 B.C., the next to about 3100 B.C., the earliest to some five hundred years before that. The upper levels were dated by inscribed cylinder seals, two graves of the first series belonging to members of the household of the daughter of king Sargon of Akkad, while from the second series came the seal of the wife of Mesannipadda, first King of the First Dynasty of Ur; the date of the

¹ From a discourse delivered at the Royal Institution on Friday, June 10.

lowest graves was deduced from the very great amount of deposit separating them from the middle series and by the difference of script on the inscribed objects, this being semi-pictographic instead of fully developed cuneiform. In the lowest stratum the bodies are sometimes partly burnt, evidently a survival of an older practice of cremation; all signs of this disappear in the upper levels. The normal type of grave is a mere hole in the ground lined with matting in which the body was placed wrapped in a mat; the offerings were grouped about it and the whole covered with a second layer of matting before the earth was replaced. Later, wickerwork coffins might take the place of the simple mats, and two or three wooden coffins were found. From the earliest times clay coffins were occasionally used, and these became more common as time went on; it is curious that the clay coffins, which would seem to be the more costly form of burial, were in fact the poorest in their furniture.

The objects from the graves were such as no previous excavations in Mesopotamia have produced, and it was noteworthy that in richness, in quality, and in technique they were better in proportion as they went back earlier in time. Though we have touched the oldest dateable strata yet found (I except that of the painted pottery, about which virtually nothing is known), it is clear that we have to deal with a civilisation which if not already decadent had at least been in existence for many centuries.

Most striking are the gold objects. The wealth of precious metal found in the graves is proof of the prosperity of the age, but also it is in these things that we have best evidence of its high state of culture, for the gold was the material on which the workman lavished most skill and it alone has suffered no decay. Not only beads, pendants, and personal ornaments are of gold, but we find even tools and weapons of gold or of electrum; these must have been ceremonial rather than for practical use, but they reproduce the forms of implements

in copper and in silver. Far the finest is a dagger of gold and lapis lazuli in a sheath elaborately decorated with filigree; besides this we have a spear-head, an adze, and two chisels of electrum; the handles of such weapons were of wood covered with gesso painted red and bound with thin gold. Toilet utensils were made of the same metal—one set is in a finely decorated case—as well as in silver and copper; bowls, vases, and lamps were sometimes of silver, and one silver bowl is beautifully fluted and engraved.

Engraving on shell was fairly common: a set of plaques thus worked with animal subjects and framed in lapis lazuli and red stone was the most attractive, while a gaming-board with inlaid geometrical designs is perhaps of greater interest though of less artistic merit; a larger plaque showing a priest at sacrifice is an unusually fine example of the same technique. Ostrich eggs and sea-shells were sometimes encrusted with lapis, mother-of-pearl, and red paste. Stone vases in 'alabaster,' steatite, and limestone were very numerous, copper was astonishingly abundant, and we found one instrument of iron, this from a grave in the lowest stratum. The beads are of lapis and carnelian, very well cut and polished, and were set with others of silver and gold, the latter being often made with a thin plating over copper.

Only the pottery is disappointing in its quality. Sculpture is represented by some curious figures in unbaked clay and by a fragmentary but most important relief showing an empty chariot drawn by lions being led in procession, perhaps in the funeral procession of a king. Lastly, we have recovered a great number of engraved cylinder seals invaluable for the study of early art forms. Altogether the season's work has produced a mass of material, much of it entirely novel, the importance of which for the early history of Mesopotamia it would be difficult to exaggerate. I am glad to say that there is every reason to believe that discoveries of no less importance await us next winter.

Obituary.

WE regret to announce the following deaths:

Mr. Charles Ford, I.S.O., Superintendent of the Botanical and Afforestation Department, Hong-kong, from 1871 until 1902, on July 14, aged eighty-three years.

Prof. Chas. W. Hargitt, research professor of zoology in Syracuse University and vice-president of Section F of the American Association in 1903, distinguished for his work on the cœlenterates, on June 11, aged seventy-five years.

Prof. A. Kossel, emeritus professor of physiology in the University of Heidelberg and editor of the *Zeitschrift für physiologische Chemie*, who was Nobel laureate for physiology in 1910, on July 6, aged seventy-three years.

Mr. John Macleod, I.S.O., formerly professor of mathematics at King's College, Nova Scotia, and the author of numerous original theorems in pure geometry, aged eighty-six years.

Mr. Hudson Maxim, inventor and manufacturer of explosives, of Brooklyn, New York, aged seventy-four years.

Prof. M. G. Mittag-Leffler, For. Mem. R.S., formerly professor of pure mathematics in the University of Stockholm and founder and editor in chief of *Acta Mathematica*, aged eighty-one years.

Mr. J. H. Reynolds, formerly Principal of the Municipal School of Technology (now the College of Technology), Manchester, and Director of Higher Education, who was president in 1913-14 of the Association of Technical Institutions, on July 17, aged eighty-five years.

Mr. B. Lewis Rice, C.I.E., formerly Director of Archaeological Researches in Mysore and author of "Epigraphia Carnatica," on July 10, aged eighty-nine years.

Mr. G. B. Sudworth, for more than forty years dendrologist of the United States Forest Service and author of "Check List of Forest Trees of the United States, their Names and Ranges" (1898), on May 10, aged sixty-three years.

Mr. W. S. Valiant, curator of the Geological Museum at Rutgers College, known chiefly for his discovery of Ordovician trilobites in the Utica shales at Rome, New York, on Mar. 27, aged eighty-one years.

News and Views.

THE Wild Birds Protection Bill is dead, after the second reading had given promise of a safe passage through the House of Commons. In the opinion of those best competent to judge, it was a measure designed to give better protection to British birds than even the old and scattered Acts, which it was to supersede, had done. But it has been killed by slogans devised by well-intentioned but less well-informed propagandists. It was called a "Rare Birds Protection Bill," yet it protected every bird in the country; it was sneered at because it gave different degrees of protection to different birds, but so long as some birds are persecuted and some are not, it is reasonable that the degree of protection should vary; it was said that the birds would be better off without the Bill, but the statement betrays lack of knowledge of the operation of the present Acts and the particular points on which experience has proved them to be weakest; it was said that public opinion was against the Bill; on the contrary, the informed public were in favour of the Bill. The death of the Bill is to be regretted by all interested in the effective protection of birds in Great Britain, the more so as its disappearance is due to the blind faith of certain members of Parliament in the propaganda of malcontents.

WICKEN FEN, under the care of the National Trust and its local committee, promises to become one of the most instructive of the natural reserves in Great Britain. It can never possess the grandeur of scenery or of fauna of the wild mountain areas of Scotland, but it has many advantages. It is unredeemed fenland, most of its 600 acres uncultivated and untouched, it contains a typical marsh flora with several rare ingredients and a rich insect fauna nourished upon the plants, and it is near a flourishing school of biology which has detailed experts for the analysis of the various plant and animal groups, with the result that a preliminary survey has almost been completed. It has been found, however, that the cost of keeping the reserve in order has outrun the funds devoted to the purpose, last year by a sum of £268, and the National Trust has launched an appeal for a capital sum of £10,000, the interest of which will be available for the upkeep of the sanctuary. It is also the intention to add 340 acres to the present reserve and "so put the whole property on a sound financial basis."

A NOTICE of the appeal for Wicken Fen which appeared in the *Times* of July 14 contained the statement that, left to itself, the fen flora would decrease by two-thirds of the present number, and that the fauna would shrink from 6000 species to fewer than 2000. In Nature's care, Wicken Fen would quickly become an impenetrable swamp, uninhabitable by many fen plants and animals. To retain the present balance, which represents a typical fen flora and fauna, considerable expense has to be incurred. If the sanctuary is to preserve these fen conditions, a limited amount of human interference is necessary, the cost of which is not met by present

resources. A local committee of the National Trust, under Prof. J. Stanley Gardiner, is responsible for the area, and we are certain that money contributed towards the upkeep and extension of Wicken Fen sanctuary will be wisely spent for the furthering of knowledge of Nature.

THE British Medical Association has been celebrating the Lister centenary at its annual meeting during the past week—appropriately at Edinburgh this year—and, as part of the celebration, has issued a Lister memorial volume, which is one of the most complete that we have seen—"Joseph, Baron Lister" (Edinburgh and London: Oliver and Boyd, 1927. 10s. 6d. net). Apart from a biographical sketch of Lister's life, the work includes a number of reminiscences of 'The Chief' by surviving clerks, dressers, or house surgeons, amongst which is a contribution from the late Prof. Caird, the whole being edited by Dr. A. Logan Turner. An interesting section is that which gives a short account of the careers of Lister's fellow-residents at the Old Royal Infirmary, Edinburgh, in the summer of 1854, a group of men whose after history did not belie the promise of their early years. Two of Lister's addresses are reprinted, together with a number of *obiter dicta* from his published works. A chapter on the state of surgery before Lister's anti-septic work had banished the infections which too often followed surgical operations brings into full relief the great boon to mankind of his researches. His later surgical work perhaps rather overshadows his earlier physiological experiments, but the latter served as an excellent training and stood him in good stead when he came to devote himself entirely to the advancement of surgery. In virtue of the number of its contributors—upwards of a dozen—the volume gives an impression of completeness which may be lacking in one by a single hand. By perusal of these pages the reader may gain a very good idea of Lister's character and works, and of the development of the science and art of surgery at the period when he revolutionised its practice, the whole revealing a most fascinating story.

IN a short note in NATURE of July 9, p. 59, dealing with some recent work in hydrodynamics, the opinion was expressed that during recent years the centre of gravity of pure hydrodynamical research appeared to have shifted to the Continent. The writer had in mind the new orientation given to this subject by the Prandtl theory and its various developments on the theoretical side, and the extraordinarily high degree of experimental skill exhibited in the production of the kinematographic films of fluid motion shown at Prof. Prandtl's recent lecture before the Royal Aeronautical Society. More mature consideration, however, suggests that the opinion so expressed was too sweeping, in that it did less than justice to the large body of British scientific workers who have contributed to this and other branches of hydrodynamical investigation. A wrong impression cer-

tainly tends to be created by the tardiness with which completed papers reach publication. Reports and Memoranda of the Aeronautical Research Committee, for example, are not usually available until anything from six to sixteen months after completion of the research. The result is that independent research workers not in direct touch with the personnel at Government research stations may remain for a considerable period in complete ignorance of important developments occurring in their own field.

A VIOLENT earthquake occurred in Palestine and Transjordan on July 11. According to the official report, 268 persons were killed and more than eight hundred were injured. The places that have suffered most are Maan (more than 60 miles to the south of the Dead Sea), Ludd, Ramleh, Nablus (Shechem), Amman, and Es Salt. Some lives were lost and historic buildings were damaged at Jerusalem and the villages round about, the Mount of Olives, Jericho, etc. So far as can be judged from the accounts already received, the centre of the area of destruction lies in the Jordan valley depression, near the southern end of the Dead Sea, the longer axis of the area being parallel to that depression. The last great earthquake in Palestine was that of Jan. 1, 1837. On this occasion the shock was strong enough to cause considerable damage at Beyrout, Damascus, Safad (where 3500 out of a population of 4000 lost their lives), Acre, Tiberias, and Jaffa. The epicentre was probably in the Jordan valley, not far from the Sea of Galilee, and therefore about 100 miles to the north of that of the recent shock. Of the two earthquakes, that of 1837 seems to have been the more violent. A rather strong after-shock was also felt on July 17 at Amman, Es Salt, Haifa, Jaffa, Jericho, and Jerusalem, with its epicentre thus about midway between those of the previous earthquakes.

THE latest report of the Empire Cotton Growing Corporation (report of the administrative council submitted at the sixth annual general meeting on May 26) shows that the useful work which is being carried on by that body continues to expand and to produce good fruit, the production of cotton in the British Empire, excluding India, being 427,396 bales in 1925-26. The outstanding feature of the last twelve months was the fall in price in the latter half of 1926 from 10*d.* to a little more than 6*d.*, a fall which has been a great discouragement to many growers, causing the abandonment of some areas. Already, however, the price from various causes has risen once more to 9*d.*, and some of the defaulters are probably already regretting their hastiness. In general, though it may delay the hoped-for day when all or most of the cotton used in Lancashire shall be Empire-grown, this reaction will probably work for good by shaking out some of the weaker and more unprogressive cultivators, while at the same time allowing the specialist officers to press on with the breeding of the most valuable and useful types of cotton, and the Corporation and Governments con-

cerned to improve transport facilities before the pressure becomes too great.

THE work of the Empire Cotton Growing Corporation continues to expand, and the unexpended balance to diminish. The work in South Africa is first described, and though results have not yet been all that was hoped for, cotton appears to have come to stay as a crop that may ultimately cover large areas. In Rhodesia the beneficial results of rotation with mealies are becoming apparent—a step in the very desirable direction of regular rotation of crops with cotton, much useful work upon which subject has also been done by Mr. Sampson in Nyasaland, and is now being followed up by the School of Agriculture at Cambridge. Good work is being done in other parts of Africa in the breeding of improved varieties of cotton. The new Research Station in Trinidad is referred to, and the value of the work carried on there is expected to make itself apparent within a comparatively short period. An Imperial Agricultural Research Conference is to be held in October. Finally, the important work upon transport problems is referred to, and the subject of spinning tests is discussed. The whole report is well worth perusal.

UNDER the presidency of Prof. E. T. Whittaker an exceptionally interesting programme has been arranged in Section A (Mathematical and Physical Sciences) of the British Association for the Leeds meeting on Aug. 31-Sept. 7. The foreign guests include Profs. Millikan and Debye, and Drs. Heisenberg and Kolhörster. Prof. Millikan is speaking on the spectra of the elements of the first row of the Periodic Table, and is also giving an evening lecture to the Association on cosmic rays. Dr. Kolhörster will probably also speak on the latter subject in the sectional meeting. A paper by Dr. Heisenberg on recent progress in quantum mechanics will be followed by a discussion in which several English speakers will take part. Members will also have the opportunity of hearing Prof. Debye speak on the polar properties of molecules. Among other papers to be presented, those of Prof. Whiddington, Dr. Aston, and Prof. Barkla are of special interest at the present time. The joint discussion with Section B (Chemistry) on the structure and nature of colloidal particles will be opened by Sir William Bragg. There will also be several subsectional meetings. In mathematics a paper by Prof. Turnbull on non-commutative algebra will serve as a useful introduction to the discussion on quantum mechanics, and, in addition to papers by Profs. Milne and Brodetsky, a morning will be devoted to contributions on the theory of numbers.

IN an article published in NATURE of August 28, 1926, Mr. F. J. W. Whipple, the Superintendent of Kew Observatory, made the suggestion that the study of the passage of sound through the high atmosphere might be promoted by systematic observations of the sound of gunfire. He was able to record that he had heard at Grantham seven discharges of a gun on the Shoeburyness range and had been able to

time the passage of the sound. This success has led to the organisation of an experiment which was tried last Saturday. At the request of the Meteorological Office, and with the sanction of the War Office, the times of discharge of a gun on the Shoeburyness range were broadcast by the British Broadcasting Corporation from Daventry and London. There were three rounds fired in the morning and seventeen in the afternoon. Observers were asked to listen for the arrival of the sounds coming through the air. The reports received at Kew Observatory indicate that no observers at great distances were fortunate enough to be able to hear the gun regularly, though there were instances in which likely noises were heard after one or two of the rounds. Hot-wire microphones were in operation, however, at four places, and at one of these, the University of Birmingham, good records were obtained. The time of passage of the air waves over a horizontal distance of some 130 miles was about 11 $\frac{3}{4}$ minutes. Birmingham must have been in the zone of 'abnormal audibility.' There are not enough observations to define the limit of the zone of normal audibility. The gun was heard intermittently at Romford, but not in the south of London. It is hoped that the broadcasting experiment will be repeated.

AMONG the activities of the Science Museum, South Kensington, is that of placing on exhibition collections of apparatus and specimens illustrating current scientific research. To some of these temporary exhibitions we have already directed attention. Thanks to the co-operation of the National Physical Laboratory, further collections were opened to the public on July 18 and will remain on exhibition for about four months. One of the new groups of exhibits relates to the research being carried out in connexion with the transport of apples, a matter of importance to the producer, carrier, and consumer. A great deal depends on the ventilation of the fruit stores, and here is shown the control device which automatically admits cool air into the store during the night and excludes warm air from entering during the day. Three exhibits deal with the metallurgy of dental alloys and amalgams, spectroscopic analysis, and British Standardised Steel Preparations. Amalgams are extensively used for dental fillings, but there is need for further knowledge of their properties. Unsatisfactory fitting often arises from the fact that the changes which occur during the mixing, setting, and hardening of the amalgams are only imperfectly understood. In this research microscopic study plays an important part. The exhibit by the Wireless Section of the Natural Physical Laboratory include short-wave transmitters with apparatus enabling wave-lengths to be measured within 1 mm.; a model short-wave receiver for use on wave-lengths of less than a hundred metres; typical examples of elaborate screening arrangements used in connexion with modern radio apparatus; a typical form of modern single frame-coil direction finder and photographs and diagrams illustrating the equipment used for the study of distortion in radio receivers.

A NOTE by Prof. R. Verneau in the recent issue of *L'Anthropologie* (vol. 37, Nos. 1-2) directs attention to still another case of fraud in alleged archæological discoveries. In this case it is the neolithic mines with human figurines sculptured in chalk, engravings, decorated vases, stone axes, etc., which M. Lequeux claimed to have discovered at Spiennes, near Mons. An investigation carried out by La Service des Fouilles des Musées in 1926 failed to find any of the galleries alleged to have been discovered, and the objects therefore remained without evidence of origin. M. Verneau recalls a similar unauthenticated discovery of skeletons with bronze masks by M. Lequeux in Morocco. A commentary which needs no elaboration is afforded by the announcement that M. Lequeux has just been arrested for violating graves in the cemetery of Montparnasse.

AN article by Mr. J. D. Unwin on "Monogamy as a Condition of Social Energy" in the *Hibbert Journal* for July is interesting as an example of how anthropological data can be brought to bear upon the interpretation of history. It might even, perhaps, in an ideal State in which social organisation was an intellectual rather than an emotional process, serve to illustrate the practical value of studies at first sight rather remote from the conditions of modern life. Mr. Unwin has attacked the great problem of the historian—the rise and fall of great civilisations and empires. He shows that in the case of Sumeria and the early empires of Mesopotamia, Egypt and Crete so far as we have any knowledge, Greece, Rome, and the peoples of medieval and modern times, such as the Arabs and, up to a point, the British, this rise and fall in power presents a curve which agrees with the curve of progress towards the strictest form of monogamy and the departure therefrom in the relations of the sexes. Recent correspondence in the *Times* has suggested the responsibility of malaria for the decadence of Greece and Rome—a theory which was put forward by Mr. W. H. S. Jones some twenty years ago or more. This suggestion is open to the objection that it offers one cause only for a very complex set of conditions, and Mr. Unwin's view would be obviously open to the same criticism did he suggest an immediate connexion. His conclusion is, however, far more subtle and by that so much the more plausible. He suggests that the 'force of life,' which primarily seeks satisfaction in sexual activity, is directed under a strictly enforced monogamy into other manifestations which lead to the advancement of the race or nation—conquest, empire, art, and science.

IN connexion with the celebration this month of the diamond jubilee of the Confederation of Canada, the Dominion Bureau of Statistics has compiled a handbook entitled "Sixty Years of Canadian Progress, 1867-1927," which is being distributed to libraries, schools, and other institutions. In about a hundred and fifty pages a survey is taken of most aspects of Canadian life, with particular reference to the natural resources and industries. Abundant statistics are given and there are many illustrations and maps, including maps of the growth of Canada, its climate

and forests. An appendix gives the text of the British North America Act of 1867.

AN expedition to the coast of Labrador for the study of its mollusca has lately left Washington under the auspices of the Smithsonian Institution. The members of the expedition comprise Dr. Paul Bartsch, the Curator of Mollusks in the National Museum, and Mr. and Mrs. Paul Bowman of the George Washington University. Its headquarters will be on the Matamek River on the south coast, where Mr. C. Amory has offered the use of his camp. The collection of anatomical material is to be the primary object, but special attention is to be paid to the environmental conditions in the places from which specimens are procured, while Mr. Bowman will study the flora and examine the peat bogs of the interior.

IN accordance with the recommendation of the recent Colonial Office Conference, a Colonial Medical Research Committee has been appointed as follows: The Right Hon. W. Ormsby-Gore (chairman), Sir George Maxwell (deputy chairman), The Secretary of the Medical Research Council (Sir Walter Fletcher), and the Chief Medical Adviser to the Secretary of State for the Colonies (Dr. A. T. Stanton), *ex officio*; Prof. J. W. W. Stephens, Sir Leonard Rogers, Dr. Andrew Balfour, Dr. Charles Todd, Dr. P. H. Manson-Bahr, and Dr. C. M. Wenyon. The terms of reference are: "To advise the Secretary of State and the Medical Research Council upon the initiation and promotion of medical research in the interests of the Colonial Empire; upon the recruitment and conditions of service of the necessary *personnel*; and upon the management and allocation of any funds available for these purposes." The Committee will also investigate proposals for the creation of a Colonial Medical Research Service, and for the payment from a pool of grants to medical institutions which are considered to deserve the support of Colonial Governments.

SPEAKING on July 18 in the House of Lords on the problem of river pollution in Great Britain, Lord Balfour stated that the Government has decided to set up a committee representing the Ministry of Health and the Fishery Board, under the chairmanship of Sir Horace Monro, to advise on the question of new legislation and administration. At the same time, scientific research on river pollution is being undertaken by the following committee: Sir Robert Robertson, Prof. V. H. Blackman, Prof. F. G. Donnan, Sir Alexander Houston, Mr. H. C. Whitehead, and Dr. G. C. Bourne; with Mr. Maurice, Mr. Calderwood, Mr. Ronald, and Mr. Simpson—all connected with the Ministry of Health, the Scottish Board of Health, the Fishery Board for Scotland, or the Ministry of Agriculture and Fisheries—as assessors, and Dr. H. T. Calvert as director.

A NEW type of electric cord which acts as a push button at any point of its length is coming into use in Berlin in connexion with electric bells and buzzers and for starting and stopping machinery. It is the invention of Oscar Nagy, a Hungarian engineer. If the

cable is squeezed at any point throughout its length, the circuit is completed and the signalling or operating device is actuated. This is effected by having the wires woven into a loose braid separated by an elastic non-conductor, which, however, makes contact when pressure is applied. It is expected that this device can be usefully employed with complicated machinery where threatened accidents to either operator or material make sudden stopping a necessity. It can be operated also by the knee or the elbow, and so has advantages over ordinary types of switches and push buttons. Hidden beneath carpets it would make a useful burglar alarm. In mines and quarries it could be arranged so that a fall or slide of rock would automatically sound an emergency signal.

THE Hanbury Memorial Medal, which is given for excellence in the prosecution or promotion of original research in the chemistry or natural history of drugs, has been awarded to Dr. T. A. Henry, Director of the Wellcome Chemical Research Laboratories.

DR. R. KING BROWN, for many years Medical Officer of Health to the Borough of Bermondsey, where the practice of artificial light therapy has been extensively carried on under the Public Health Department, and chairman of the executive committee of the Institute of Hygiene, has been appointed medical editor of *The British Journal of Actinotherapy*.

THE following have been elected to fill the vacancies which will occur in the council of the Institution of Electrical Engineers on Sept. 30 next: *President*: Mr. A. Page; *Vice-President*: Captain J. M. Donaldson; *Hon. Treasurer*: Lieut.-Colonel F. A. Cortez Leigh; *Ordinary Members of Council*: Mr. J. R. Beard, Major B. Binyon, Mr. P. V. Hunter, Mr. H. Marryat, Mr. H. T. Young, and Mr. D. N. Dunlop.

SOME extra copies of the portrait of the late Arthur Bolles Lee, author of "The Microtometist's Vade-Mecum," which was issued with the last number of the *Journal of Pathology and Bacteriology* are available and may be had by any one interested on application to the editor at 17 Loom Lane, Radlett, Herts. It will be remembered that Mr. Lee died on Mar. 3 last.

THE eightieth annual meeting of the Palæontological Society was held in the rooms of the Geological Society, Burlington House, on July 14, Mr. E. T. Newton, president, in the chair. The annual report referred to the completion of the monograph of the Upper Eocene flora of Hordle, and progress with the monographs of Gault Ammonites and Macrurous Crustacea. It also announced another instalment of the monograph of Palæozoic Asterozoa. Prof. Morley Davies, Dr. F. L. Kitchin, Mr. S. L. Wood, and Mr. Henry Woods were elected new members of council. Mr. E. T. Newton was re-elected president, and Mr. Robert S. Herries and Sir A. Smith Woodward were re-elected treasurer and secretary respectively.

MESSRS. COOKE, TROUGHTON AND SIMMS, LTD., have issued a small catalogue (No. 553B) of portable survey

equipment which gives a wide choice of plane table outfits. The instruments cover equipment for purely graphic plane tabling as well as tacheometric instruments, as the pattern used by the Survey of India.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An analytical chemist at the Main Drainage Outfall Works of the Dublin Corporation—The Secretary, Local Appointments Commission, 33 St. Stephen's Green, Dublin (July 30). A junior engineer at the Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Aug. 4). A temporary botanist at the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Aug. 4). An assistant lecturer in the mathematics department of the Coventry Technical College—The Director of Education, Council House, Coventry (Aug. 5). A lecturer in physics, and assistant lecturers in mathematics, book-keeping, geography, and French at the Belfast Municipal College of Technology—The Principal, Municipal College of Technology, Belfast (Aug. 5). An assistant lecturer and demonstrator in botany at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Aug. 6). A male assistant in the geological department

of the Liverpool Free Public Museums, Liverpool (Aug. 30). Appointments as follow, at the International Institute of Agriculture, Rome:—A chief of section specially qualified in tropical agriculture, and editors for, respectively, tropical agriculture, dairy science, plant diseases, rural economics, and trade in agricultural products—The Bureau du Personnel, Institut International d'Agriculture, Villa Borghese, Rome (Aug. 31). A woman B.Sc. (physiology or biochemistry) at the Wellcome Physiological Research Laboratories—The Director, Wellcome Physiological Research Laboratories, Beckenham. Two junior assistants under the Directorate of Ballistics Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. An assistant entomologist at the Wellcome Tropical Research Laboratories, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1. A principal of the Leicester College of Technology—The Director of Education, Leicester. A lecturer in fuel technology at the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, South Kensington, S.W.1.

ERRATUM.—In NATURE of July 2, p. 4, col. 2, the second term of the left-hand side of the equation should read " 2OH_2 ."

Our Astronomical Column.

COSMIC DUST CLOUDS.—The question of the absorption of light in space by clouds of cosmic dust is a very difficult one, and different observational results seem to lead to inconsistent conclusions. Prof. Shapley's study of the variables in the globular clusters indicates that the phases occur appreciably simultaneously in light of all wave-lengths; further, he finds that the clusters contain stars just as blue as any in our neighbourhood. These and similar facts tend strongly against any general absorption of appreciable amount. On the other hand, the occurrence of numerous regions with sharply defined boundaries, where there is a sudden drop in the star-density (the Coal Sacks are a notable example), gives cogent reason to believe in the existence of local dust clouds which absorb nearly all the light from stars behind them.

Prof. Edward S. King, of Harvard College Observatory, makes the suggestion in a recently issued Bulletin from Science Service, that the group of stars to which the sun belongs, extending outwards to a distance of a hundred light-years, contains a sensible amount of scattered dust. He bases this on observational evidence of increasing redness with distance up to the distance mentioned: after that he finds no further increase in redness. He notes the evidence of a large amount of scattered dust in the Pleiades as being a parallel case. It is well known that the Pleiades nebulae give spectra similar to those of the stars that they surround, indicating that they shine by reflected light. So Prof. King's result implies that the sun is a member of a local cluster somewhat similar to the Pleiades. His evidence for increasing redness with distance up to a hundred light-years will be awaited with interest.

Shapley's result, mentioned above, shows that the time of passage of light through this cloud does not differ by more than a minute for light of different

colours. This gives evidence of the extreme tenuity of the supposed cloud.

SOLAR RADIATION.—In *Smithsonian Miscellaneous Collections*, vol. 80, No. 2, under the title "A Group of Solar Changes," Dr. Abbot continues his tests of the sun's intrinsic variability, as reflected in the measures of solar radiation made with the pyrheliometer at Montezuma. One test applied is to compare, for any given month throughout the interval considered, the averages of selected pyrheliometer measures of total solar radiation with those of the solar constant determinations. This selection aims at comparing measures which have been made under as nearly as possible identical conditions, namely, when the sun is equally high above the horizon, the atmosphere equally clear, the quantity of atmospheric water vapour identical. For the observations discussed, 1921–1926, there is a very good agreement shown for each of the twelve months separately between the pyrheliometer and solar constant curves. On comparing either of these set of curves with that showing the sunspot variation for the corresponding periods, it is seen that a general similarity exists, but it is not so close for all months as was previously found for July, 1910–1920 (see *Monthly Weather Review*, May 1926).

A useful table is given of monthly averages of solar constant values determined at Chilean stations from 1918 to 1926. Dr. Abbot directs attention to indications in these figures of a 26-monthly period in solar radiation. As additional evidence of related solar and terrestrial changes, monthly solar constant values are compared with (1) ultra-violet radiation values, taken at Mt. Wilson; (2) long-range radio-signal intensities. During the interval, 1924–1926, for which comparisons are available, there is a marked accord. Dr. Abbot is sanguine that his continued investigations of solar radiation will yield useful positive results.

Research Items.

MAN'S ORIGIN.—Still another view on the place and manner of the origin of man is put forward by Dr. E. A. Hooton in *Antiquity* for June. Like other recent writers on this subject, he reviews our present knowledge of the geological, palæontological, and archæological evidence in each of the continents. In both Australia and America the probabilities are in favour of the late appearance of man, and the same is the case in South Africa, while the number of finds of the remains of early types of man in Europe lends great weight to the view that man may have originated on this continent. Dr. Hooton is not inclined to accept the view recently put forward in favour of Asia, that in that area the modification of environmental conditions was responsible for a progressive modification of the stock, each receding from a common centre with the conditions to which it was adapted. On his view, the variations in man and his immediate precursors originated from generalised forms living in the Lower and Middle Miocene, and were due to the relinquishing of the arboreal habit at various times and at various points in a forest area stretching from the oriental region along the Mediterranean zone to western Europe and in Africa south to the farthest forest zone.

NORTH AMERICAN DIATOMS.—Mr. Charles S. Boyer, in his "Synopsis of the North American Diatomaceæ" (Part I. Coscinodiscatæ, Rhizosolenatæ, Biddulphiatæ. *Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. 78, 1926, Supplement), states that "it is intended to comprise all recent species occurring in North America, including the West Indies," and begins with a short introduction and survey of the group, the volume in hand including the Centricæ and part of the Pennatæ. Whilst this is a valuable addition to diatom literature, it is by no means complete with regard to the planktonic forms. On p. 3, under *Habitat*, we find the following instructions as to the occurrence of marine diatoms; these are "obtained from dredgings, the scrapings of vessels or pilings, the stomachs of fish, the cleanings of shells, and particularly from the surfaces of salt marshes and tidal pools." No mention is made of tow-nets and water bottles, and apparently the work of the many recent plankton workers, notably Bigelow of the Bureau of Fisheries since 1912 (published 1914 and up to the present time), has not been consulted at all. A beginner studying Mr. Boyer's work would conclude that planktonic diatoms only occur plentifully in the open sea, whereas in reality they abound in coastal waters also. One has only to examine the records, for example, from Chesapeake Bay and the Gulf of Maine to verify this. To mention only a few important species which are omitted, we have *Asterionella japonica*, which occurred in profusion in the Gulf of Maine in 1914 (Bigelow), *Guinardia flaccida*, *Chaetoceros densum*, *Lauderia glacialis*, and several others. *Skeletonema costatum*, that common neritic species, is merely said to be pelagic, and no mention is made of its pronounced preference for inshore waters. There is no index and no bibliography, very decided drawbacks in a work which is essentially one of reference, and it is to be hoped that they will be given in a future volume.

BURMESE HELMINTHES.—Prof. F. J. Meggitt (*Journal Burma Research Soc.* vol. 15, part 3, 1926) records the results of examination of forty fowls from Rangoon, none of which was free from infection with tapeworms. The number of tapeworms present

varied from ten to several thousands. A species of Raillietina is much the commonest tapeworm in Burmese fowls, but a *Hymenolepis* is nearly as common while *Amabotania sphenoides* is comparatively rare. In England the common tapeworms of fowls are *A. sphenoides* and *Davainea proglottina*, while Raillietina was recorded only twice out of some 200 birds dissected. A key to the adult cestodes of fowls is appended. In the same part, G. D. Bhalariao describes the intestinal parasites of bats in Rangoon and gives a list of the Trematoda recorded from Burma.

CANADIAN COPEPODS.—Prof. A. Willey in a description of a new species of freshwater copepod of the genus *Moraria* from Canada (*Proc. U.S. Nat. Mus.* vol. 71, art. 1, 1927) makes some observations on the distribution of copepods. Giesbrecht (in 1892) directed attention to the fact that the calanoid fauna of the warmer parts of the ocean exhibits a greater degree of specific divergence than in the North Atlantic. Prof. Willey remarks that the reverse is true of freshwater copepods, especially the harpacticoids, in which the number of species increases from south to north, a fact which not only suggests a northern origin for these forms but also points to their Pleistocene derivation. In other words, the northern freshwater harpacticoids as an ecologic group are relict forms of the post-glacial fauna. There is a further point that requires repeated confirmation—it was tentatively assumed by Prof. Willey that North American freshwater harpacticoids differ to the extent of certain unit characters from their nearest representatives in the Old World, and he remarks that the present species seems to bear out that interpretation.

NUCLEAR DEGENERATION.—The March issue of *Journal of the Royal Microscopical Society*, which appears in a new form with larger pages, contains the presidential address by Dr. J. A. Murray on nuclear degenerations following multipolar mitotic cell-division. The material on which the studies described in the address were based was provided by the eggs of the sea-urchin fertilised by two sperms instead of by one. Boveri showed that in such cases a tri- or quadri-polar mitotic figure results and the egg divides simultaneously into three or four primary blastomeres, after which cleavage proceeds normally by bipolar mitosis until the blastula stage is reached. But whereas in normal fertilisation each cell of the resulting larva receives a complete set of chromosomes from each parent, in disperm fertilisation the bi-partition of each chromosome of the three sets of chromosomes (one from the egg and one from each sperm nucleus) between three or four asters, and consequently between the three or four primary blastomeres, inevitably entails a fortuitous distribution of the daughter chromosomes, so that each cell does not necessarily receive even one complete set of chromosomes. The varying abnormality of the descendants of the primary blastomeres is a consequence of this faulty chromatin distribution. Dr. Murray describes the nuclei of some of the descendant cells in which the chromatin is condensed into a homogeneous, hollow hemisphere in the concavity of which lies a highly refractile achromatic sphere. These cells form a striking feature of larvæ resulting from disperm eggs. In other pathological material, especially in higher animals, there is also the possibility that multipolar cell division, with consequent

derangement of the chromosome groupings, may have taken place, and, as Dr. Murray points out, it is perhaps not without significance that the most frequent sources of nuclear degenerations of this type have been met with in hypertrophic and hyperplastic conditions of the lymphatic glands. Dr. Murray gives a group of figures illustrating nuclear degenerations, all taken from lymphomatous tumours of mice, in which the similarity of the appearances to those seen in the pathological echinoderm material is evident, and emphasises the need for attention to forms of cell degeneration in the analysis of pathological processes.

OXYGEN IN THE SOIL.—Before the meeting in Washington of the First International Congress of Soil Sciences, Dr. Lee M. Hutchins, of the United States Department of Agriculture, demonstrated the operation of an apparatus which he has devised to measure the oxygen-supplying power of the soil. The essential part of the apparatus is a hollow vessel of porous porcelain buried in the soil to be studied. Pure nitrogen is passed through it and the outgoing stream of gas is bubbled through a solution that changes colour if any oxygen is present. The shade of colour after a given time indicates the amount of oxygen that has passed from the soil through the walls of the vessel and into the nitrogen. Dr. Hutchins has been using his invention to study the oxygen needs of such crops as corn and wheat, and also such plants as rice and willow, which can grow in soils that are water-logged and hence very poor in oxygen.

REST PERIOD AND GERMINATION.—Many devices have been used with varying success by plant physiologists to shorten the rest period which seems a necessary precursor to the germination of many seeds. In the *Malayan Agricultural Journal* (vol. 15, No. 3, March 1927) J. N. Milsum describes some experiments to hasten the germination of oil palm seeds by means of the heat induced by growing seeds under glass. The temperature under the glass frames was 6° F.-18° F. higher than the temperature of the open beds. One thousand seeds were planted under glass, and another 1000 planted under normal conditions as a control. After eight weeks, 523 of the heated seeds had germinated to 132 of the control set. After this period the percentage germination in the control beds rapidly approximated to that of the heated frames, so that after twenty weeks the ratio became 928 in frames to 857 in controls. The result of the experiments seems to be that under the given conditions, germination under glass accelerates germination by approximately five weeks.

THE TIDE AT TAHATI.—Under this title, H. A. Marmer publishes in the *Journal of the Washington Academy of Sciences*, vol. 17, pp. 157-184, the results of harmonic analysis of observations extending over a year. Particular interest attaches to tide at Tahati, since this island was considered to furnish a striking exception to the general rule that the tide follows the moon, for it was considered that high tide occurred every day at noon and midnight instead of coming later each day by about 50 minutes. Owing to the small range, amounting to barely one foot at springs, local conditions of barometric pressure and wind made the neap tides difficult to determine. The observations of the U.S. Coast and Geodetic Survey show that there is some progression of the times of high and low water from day to day. This progression is considerably less than 50 minutes about the time of spring tides, and considerably more about the time of neap tides.

INFLAMMABILITY OF COAL DUSTS.—The degree of fineness of a coal dust mainly determines the ease with which it can be ignited and can propagate flame when raised as a cloud in air. The fineness of a dust is not, however, the only factor on which the inflammability depends, but its chemical properties, which render it of greater or less reactivity towards oxygen, must also be taken into consideration. Paper No. 33 of the Safety in Mines Research Board (London: H.M. Stationery Office, 1927. 6d. net) describes experiments directed towards determining the effect, apart from any other factor, that the chemical composition of a coal dust has on its inflammability. The results disclose a relationship between the inflammability of a dust and its content of 'volatile matter' as determined by standard methods, the more inflammable dusts containing the higher proportions of volatile matter.

THE REFRACTIVE INDEX OF WATER.—An ingenious method for finding the refractive index of a liquid for short continuous electric waves has been described by L. E. McCarty and L. T. Jones in the June issue of the *Physical Review*. A valve oscillator is suspended so as to affect two tuned receiving circuits simultaneously: one is separated from the transmitter by air, and a water trough is interposed in the alternative path. The two induced electromotive forces are employed to deflect the electron beam in an oscillograph, and the changes which take place in the Lissajou pattern as the thickness of liquid is varied give a measure of the retardation due to the latter, and so permit of calculation of its refractive index. The many experimental difficulties have still to be completely overcome, but it has been found that the refractive index of water is approximately constant and has a value of about 9 for waves of 3 m.-7 m. in length. The authors hope to make an elaborate series of measurements of dielectric constant and of refractive index under conditions as nearly identical as possible.

SUBSOIL INFLUENCES ON THE INCLINATION OF RADIO WAVE.—J. E. Cairns, of the Watheroo Magnetic Observatory of the Carnegie Institution of Washington, has recently investigated experimentally the influence of a low resistivity layer subsoil on the forward inclination of radio waves. His conclusions are published in the *Journal of the Washington Academy of Sciences*, vol. 17, p. 264. It had been suggested that ground water, which is equivalent to a low resistivity layer, would almost entirely annul the forward inclination experienced by radio waves when travelling over ground of considerable resistivity, provided that the depth of the water was only a fraction of a wave-length below the ground surface. The survey of the country round Watheroo Observatory showed that the surface layer, down to depths varying from 5 to 10 metres of the sand plain which comprises the greater part of the surrounding country, is of very high mean resistivity. At depths of 60 metres, however, its resistivity is only about one thousandth of what it is near the surface. The country, therefore, was admirably adapted for testing the theory. The Observatory was 132 miles north of the transmitter. The results prove that over soil consisting of a surface layer of sand of exceptionally high resistivity, which at a depth of from 60 to 100 metres had very low resistivity, radio waves of wave-length 1250 metres experienced no forward inclination. As the resistivity measurements of the soil had been made with great precision, this gives a definite experimental proof of the effect of ground water, or a layer of low resistivity under the surface, on the polarity of radio waves.

The Lister Institute.

THE thirty-third annual report was presented by the governing body at the annual general meeting of the Lister Institute of Preventive Medicine on May 18. In certain of the researches carried out by the Institute, the Medical Research Council, the Department for Scientific and Industrial Research, and the British Empire Cancer Campaign have co-operated by providing salaries or grants for the workers engaged: thus the Medical Research Council has provided the salaries of the staff of the National Collection of Type Cultures. On the occasion of the Lister centenary celebrations in April last, an address was presented from the governing body and staff by Sir James K. Fowler, in the absence of the chairman, Sir David Bruce.

Short abstracts of the scientific researches of the members of the Institute occupy the major part of the report, and are accompanied by a list of papers published during the year. A few only of these are selected for notice in the following account.

In the department of bacteriology, Prof. Ledingham has shown that the dermal reaction to vaccinia virus can be prevented by injection of Indian ink into the cutis, either before or with the virus. Presumably the ink stimulates the reticulo-endothelial system and increases the local defensive powers so that the virus fails in its attack on the tissues. A similar effect is obtained (in the rabbit) if the site of injection of the virus has been previously exposed to the X-ray or to infection by the streptococci of erysipelas. H. Schütze and S. S. Zilva have completed an investigation on the effect of diet upon the course of tuberculosis in animals: guinea-pigs on a diet restricted in quantity were found to be less resistant to the progress of an infection than the controls. In rats, sodium chaulmoograte was without influence on the lesions, but it appeared that a large excess of cod-liver oil or irradiation with ultra-violet light did inhibit their formation: the leucocytosis simultaneously produced is not the only agent in this inhibition, if concerned with it at all.

In the department of biochemistry, W. T. J. Morgan has prepared the α - and β -methyl hexoside-diphosphoric acids from hexosediphosphoric acid, and is attempting to obtain the methyl hexoside from the former by means of Robison's bone enzyme. In collaboration with H. P. Marks he has shown that neither the mono- nor the di-phosphate will relieve the symptoms of hypoglycaemia in rabbits and mice following injections of insulin. R. Robison has continued his work on the phosphoric esters occurring in blood, and has found that these compounds account for nearly all the acid soluble phosphorus present in this fluid: at the same time a compound which does not contain phosphorus but reduces alkaline copper solutions has been isolated and is being examined. He has also found that the bone enzyme will produce phosphoric esters synthetically, under suitable conditions, from inorganic phosphate and glycerol, glycol, mannitol, glucose, etc. In further experiments on calcification *in vitro*, the same author has shown that deposition of calcium phosphate in rachitic bones occurs when so little as 5 mgm. calcium and 5 mgm. inorganic phosphorus per 100 c.c. are present in the surrounding solution, provided that phosphoric ester is also present: so little as 0.5 mgm. organic phosphorus per 100 c.c. has a significant effect, and the deposit increases proportionately to the increase in the ester present.

In the department of experimental pathology, the director of the Institute, Sir C. J. Martin, and

Elizabeth Lepper have continued their investigations on the protein error of indicators: in the case of horse-serum it was found that the serum-albumin diminished the colour of phenol red and neutral red, whilst the pseudoglobulin increased it. Prof. Korenchevsky has found that after thyroidectomy, rabbits show a more pronounced fall of body temperature on cooling, and much less increase on warming, than normal animals. Castration has similar but less-marked effects, but para-thyroidectomy is without influence. Thyroid feeding will restore the power of adjustment to normal, but in excess will cause a marked rise of temperature under conditions previously well borne.

Work on vitamins includes assays of cod-liver oils carried out by the Institute on behalf of the Health Committee of the League of Nations: Miss Hume and Miss Henderson Smith have developed a new technique for vitamin A, in which the test material is fed to the experimental animals from the commencement of the experiment, the amount given to different animals increasing in geometrical proportion. For vitamin D assay, Miss Soames and Miss Leigh-Clare have worked out a basal diet containing both vitamin A and phosphorus in adequate amounts. They have also found that the vitamin D content of cod-liver oils is more uniform than the vitamin A content, and have obtained agreement between the biological method of assay of vitamin A and the colorimetric titration by the method of Drummond and Rosenheim. Miss Leigh-Clare has also been unable to detect any vitamin D in the marine diatom *Nitzschia*, so that this organism cannot be regarded as the ultimate source from which the cod obtains the antirachitic vitamin stored in its liver oil. Miss Hume, Dr. Lucas, and Miss Henderson Smith have found that young rats and rabbits are protected from rickets when 0.2 gm. irradiated cholesterol in hardened cotton seed oil is daily applied to an area of depilated skin equal to about one square inch, lending support to the idea that vitamin D may be synthesised in the skin when ultra-violet rays fall upon it. T. Lumsden in experimental researches on cancer has found that the immunity of an animal to an homologous tumour is the result of two factors: antibodies in the blood serum and some excretion from the white blood corpuscles when they have extravasated and are subject to a low oxygen tension.

In the department of protozoology, Dr. Muriel Robertson has performed experiments on the parabasal body of the free-living flagellate *Bodo caudatus*: after treatment with acriflavine, a proportion of the organisms, otherwise appearing normal in their behaviour, were found to have lost the parabasal body, and in their progeny it is also absent. In studies on *Heteromita* it was found that, after nuclear division, the daughter cells sometimes failed to separate; the double individual which results from this non-separation gives a most realistic simulation of conjugation, so that it is not yet certain that the latter process occurs in this form.

In the department for the study and preparation of antitoxic sera, it has been found that with continued subcultivation in ordinary laboratory media the streptococcus tends to change its characteristics. Recent cultures are hæmolytic, virulent to mice, and appear 'rough' in broth medium, whereas the older cultures, into which the former tend to pass, are non-hæmolytic, less virulent, and 'smooth' in character. Their antigenic relationships are being investigated.

The Spacing of Young Trees.

FOR some time past there has been a certain amount of dissatisfaction amongst a section of members of the Royal Scottish Arbicultural Society with the *Transactions*, it being held that the publication was behind the times, both in appearance, arrangement of material, and so forth. In the recently issued number for March 1927 the Council has taken the step of rechristening this conservative magazine as *The Scottish Forestry Journal*, though otherwise it remains unchanged. Amongst the chief matters of interest in the present number is the attention given to spacing in planting in Great Britain, a point of vital importance. The matter was given a prominent place in the presidential address of Sir Hugh Shaw Stewart to the Society last February (which is reproduced in this number), and was commented upon by partisans of both wide and close spacing during the ensuing discussion. It was touched upon by Lord Lovat in an address, also printed, and forms the theme of other writers.

It might appear, from some of the opinions expressed, that this question as to whether better results can be obtained by planting the young trees in the first instance at a closer or wider interval was a new problem. If it is new in Britain, it is merely due to the fact that when we commenced to plant conifers last century, we did so in ignorance of the methods in force on the Continent of Europe and knew nothing of that necessary concomitant—scientific thinning. The advocates of wide spacing, which, chiefly on account of the far heavier costs of planting since the War, is being practised both by the Forestry Commission and others, have, it must be confessed, few proofs to support their contention that they will obtain as good a quality of timber. That, in other words, they are not risking the reproduction of the inferior article which brought British timber into such disrepute that foreign conifer timbers were always preferred, if not demanded, even by the

British Government Departments. This question cannot be divorced from a consideration of the manner of growth of the larger area of the forests of the globe, which are of natural origin. In a naturally regenerated forest the young plants come up densely, and with proper attention are gradually thinned out. It would appear that those who advocate closer planting based on this analogy have a strong case.

The problem has to some extent become involved owing to the so-far-observed development of young plantations of Douglas fir. In many parts of Britain there has been an extraordinary variation in development of individuals in young Douglas woods in which the young trees were all of the same age and size when planted. It may be agreed that the ordinary British planting distance of 4 ft. by 4 ft. or thereabouts, at first adopted for Douglas, was too close. This is true, and, moreover, remains true for most exotic trees in any part of the world when introduced into a climate and under conditions which result in their growing very much faster in their early years than in their own habitats. A forester going to the tropics has to revise all the ideas as to planting distances with which he became acquainted in temperate Europe. But because 7 ft. or 8 ft. spacing may be correct for Douglas in Britain or parts of Britain, to apply the same spacing or anything near it to Scots pine, the spruces, and some other species is, in the opinion of many, to court disaster; or, at any rate, to reproduce an inferior British timber.

Experiments are in existence in the form of sample plots and so forth, the object of which is to endeavour to provide rule-of-thumb information on this matter. But as we shall have to wait some thirty years or more ere results of any value are obtainable from them, it would conceivably be a wiser policy to imitate Nature as closely as possible, and not to hurry the planting campaign forward at the expense of the future quality of the marketable timber.

Properties of Nickel- and Nickel-Chrome Steels.

EXTENSIVE researches on the nickel- and the nickel-chromium steels are described in a recent publication from the Bureau des Poids et Mesures.¹ The memoir deals with work commenced in 1896 and continued consistently during the intervening years. Certain of the results have already been published in part from time to time, but the present collection serves a very useful purpose in bringing together in one volume work which has been spread over many years and published in very different places. Further, the results are now available in greater detail than has hitherto been the case.

Detailed descriptions are given of the apparatus and the methods used in the measurements, the majority of which, however, are by now fairly widely known. The properties chiefly investigated are magnetic—the Curie point, the dilatation and the torsional modulus of elasticity. The account of the work on the nickel steels by M. Guillaume deals in the main with changes in these properties over a relatively small temperature range, but M. Chevenard considers the changes in the nickel-chromium steels up to quite high temperatures.

One of the most interesting aspects of the work is the interpretation offered of the well-known but curious properties of 'invar' and the less generally

known, but equally interesting, constancy of the modulus of elasticity with temperature of the nickel-chrome steel to which the name 'elinvar' has been given. In each case the presence of an intermetallic compound is invoked in order to explain the results, compounds which are not believed by all metallographers to have any real existence. Regarding the one which is believed by the authors to occur in 'invar,' it is stated that "this compound Fe_3Ni is formed with expansion, and its magnetic transformation is accompanied by an anomalous negative dilatation and by an exceptionally large positive thermo-elastic anomaly. Its presence explains the appearance of the minimum in the curves of density and modulus of elasticity with composition at the ordinary temperature." The ferro-nickels which contain chromium show a reversible magnetic transformation just as do the pure iron-nickel alloys. The higher the content of chromium for the same amount of nickel, the lower is the Curie point and the less pronounced are the anomalies of dilatation and elasticity. This intense diluent effect of chromium appears to point to the presence of a compound Ni_2Cr_3 , and one may obtain alloys either of a determined dilatability or of constant elastic properties as in 'elinvar.' The latter alloy, in addition to nickel and chromium, actually contains carbon, manganese, and tungsten.

So far as more directly important practical applica-

¹ "Travaux et Mémoires du Bureau des Poids et Mesures." Publiés sous les auspices du Comité International, par le Directeur du Bureau. Paris, 1927.

tions of these steels are concerned, M. Chevenard says that "chromium exerts a very favourable influence upon the mechanical properties of the austenitic nickel steels, especially at high temperatures. At the same time it renders these alloys very resistant to oxidation and to the attack of a large number of corrosive agents." These facts are already being applied industrially in the newer varieties of stainless iron and steel.

The volume ends with a paper on butt-ended standards of length which forms the continuation of previous work.

The Supply of Information.

IN October 1924 the President of the Board of Education appointed a Departmental Committee to inquire into the adequacy of the library provision already made under the Public Libraries Acts, and the means of extending and completing such provision. Those who recognise that an efficient library system is the essential foundation for progress in education and culture, without which no people can hold its own in the struggle for existence, will welcome the Report¹ of the Public Libraries Committee, a volume of some 350 pages now published, as offering the basis for a reorganisation long overdue.

The Committee recommends a national system of co-operation between libraries, whether borough, urban district, county, or special, with the Central Library for students, reconstituted as a department of the British Museum, acting as a central bureau of exchange for the whole system, and as a national lending library to supplement the resources of other libraries. It is contemplated that, in the first place, an application for a rare or expensive book needed for the purposes of research will be made to the local public library. If the public library does not possess the book and does not consider it reasonable to buy it, the librarian will refer to the 'regional library,' provided such an organisation has come into being. If the regional library cannot supply the book, the application will be sent to the Central Library. The Central Library will supply the book from its stock, endeavour to borrow the book from the institution likely to possess it, accepting responsibility, or purchase the book.

A considerable proportion of the books for which application will be made under this scheme will be scientific literature, and in particular scientific periodicals. The necessity for a central library to provide for the needs of scientific workers has been widely recognised and was emphasised by Dr. Chalmers Mitchell at a conference of the Association of Special Libraries and Information Bureaux in 1925, when he said: "Some of the periodicals are contained in no library in Great Britain. I am glad to be able to state that the Library of the Science Museum is making a great effort to fill the gap. In my view there is no more urgent need than the establishment in this country of a central library, the duty of which shall be to contain a copy of every periodical publishing scientific research."

The nucleus of such a library already exists in the Science Library at South Kensington, with its great collection of periodicals. The Committee suggests that the most easy and least expensive way of solving the problem will be to make the Science Library complete, and it recommends that an additional sum of £3500 a year, with a small contingent increase of staff, should be granted to enable the Science Library

to obtain most of the volumes of which it stands in need. The Science Library has already assumed many of the functions of a central library, by the extension of borrowing facilities to approved institutions where scientific or technical work is carried on, and should be the principal source on which the Central Library will depend for the supply or loan of books needed by research students in science.

If scientific research is the foundation of commercial prosperity, it is no less true that such research cannot be carried out efficiently without the means of consulting the records of previous work. The organisation necessary to secure this end would not be very great. It is estimated that the cost of all the proposals, including those relating to the Central Library and the Science Library, would not exceed £12,000 a year during the next few years, while the benefit to learning, research, manufactures, and trade can scarcely be estimated.

University and Educational Intelligence.

EDINBURGH.—At the recent graduation ceremonial, the honorary degrees conferred included the following: *Doctor of Divinity*: The Right Rev. Ernest William Barnes, Lord Bishop of Birmingham. *Doctor of Laws*: Sir John Carruthers Beattie, Vice-Chancellor and Principal of the University of Capetown; the Abbé Henri Breuil; Prof. C. F. Jenkin, professor of engineering, University of Oxford; Prof. J. C. Meakins, professor of medicine, McGill University, Montreal; Prof. A. C. Seward, Master of Downing College and professor of botany, University of Cambridge. The degree of Doctor of Science was conferred on Douglas A. Allan, *thesis*—"The Geology of the Highland Border from Tayside to Noranside"; T. W. M. Cameron, *thesis*—"Studies in Economic Helminthology"; John Macqueen Cowan, *thesis*—"The Forests of Kalimpong—An Ecological Account"; J. F. V. Phillips, *thesis*—"Forest Succession and Ecology in the Knysna Region"; C. M. Yonge, *thesis*—"Structure and Function of the Organs of Feeding and Digestion in the Septibranchs, Cuspidaria, and Poromya."

LONDON.—A course of four lectures on "Heat Transfer in Reciprocating Engines, including Internal Combustion Engines," will be given (in English) by Prof. Dr. Adolf Nägel, professor of engineering in the Technische Hochschule, Dresden, at the Institution of Civil Engineers (by kind permission) on Oct. 11, 14, 18, and 21, at 5.30 P.M. The lectures will be illustrated by lantern slides. Admission is free, without ticket.

THE International Federation of University Women in its Occasional Paper, No 6, describes Crosby Hall, the Federation's new office which was recently opened by the Queen as a club-house. University women carrying on research or other post-graduate work in London will be eligible for residence at the Hall, if members of the Federation, and the dining-hall and common rooms are available for all members visiting or living in London. The same pamphlet contains addresses by Prof. Zimmern and Prof. Kristine Bonnevie on the work of the League of Nations Committee on Intellectual Co-operation and the Federation's collaboration with it, and a note on the functions of the American National Committee on Intellectual Co-operation, described by Prof. Zimmern as the model national committee. This American committee, organised at the beginning of last year, undertakes to procure or compile whatever information from the United States may be needed in connexion with any investigation being made by the International Institute of Intellectual Co-operation,

¹ Public Libraries Committee. Report on Public Libraries in England and Wales, pp. 356. Cmd. 2868. (London: H.M. Stationery Office, 1927.) 6s. net.

the working instrument of the League of Nations Committee. It has been interesting itself in the question of obtaining financial support for the Geneva School of International Studies and for a working library for the Institute. The Federation has a committee on standards which is engaged in investigating the thorny problem of assessing the relative values of the degrees and diplomas granted by the various universities and other institutions of university standing.

THE Trustees of the Beit Fellowships for Scientific Research at their recent twelfth annual meeting elected the following to fellowships, the proposed course of research being indicated after the Fellow's name: Mr. I. Vogel, ring formation (Organic Chemistry Laboratories of the Imperial College, under Profs. H. B. Baker and J. F. Thorpe); Mr. K. V. Thimann, the effect of electrical currents on proteins (Bio-chemistry Department of the Imperial College, under Sir John Farmer and Prof. S. B. Schryver); Mr. A. G. Forsdyke, the nature of the motion in the wake of a body moving in a viscous fluid as a contribution towards the problems of fluid resistance (Mathematics Department of the Imperial College, under Profs. S. Chapman and H. Levy). All these fellowships are of the value of £250 a year and tenable at the Imperial College of Science and Technology. In addition, the Trustees approved the extension for a second year of the fellowships held by Mr. J. Topping for research on the mechanical equilibrium of crystal lattices, Mr. J. W. Maccoll for studies in the motion of viscous fluids, and Mr. G. H. Mitchell for further work on the geology of the Borrowdale volcanic series of Kentmere, Westmorland. The experiment during the past year, under which the tenure of these fellowships was tentatively made for two years instead of one year as before, having proved successful in every way, the Trustees have now adopted it as the tenure basis of the new fellowships now announced and of future awards.

THE report on the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1926-1927 has recently been issued, and in it the Principal, Mr. George Patchin, is able to show some satisfactory results of development. Since the last annual report (1925-26) the Department has been enlarged by the addition of a Petroleum Technology Laboratory with a fully equipped lecture room adjoining the same; it is hoped that this extension will provide the necessary facilities for advanced study and research. The schedule of lectures given during the past session comprises lectures on petroleum technology (in three parts), introduction to the chemical and physical properties of petroleum, properties, applications, and examination of petroleum, and the applications of engineering and mechanical drawing. For those who have little or no previous knowledge of the fundamental sciences, there is a preliminary course, including elementary chemistry, physics, and practical mathematics. It is not clear from the report what subjects are comprised in the petroleum technology course, other than part 3 dealing with internal combustion engines and colloids in relation to petroleum. It is to be hoped that provision is here made for those who wish to acquire some knowledge of the geological aspects of the industry, also that the important subject of economics of petroleum is included. Close contact has been kept between the school and various oil companies in London; in this connexion lectures have been given by members of the staffs of the latter, and thus essential practical knowledge is placed at the disposal of the students, a vital factor in the training of all concerned with the petroleum industry, whatever particular branch is favoured.

Calendar of Discovery and Invention.

July 24, 1747.—About the same time that Franklin was experimenting on lightning conductors, William Watson (1715-1787) made experiments which appeared to show that the passage of electricity was instantaneous. Some of these experiments were made in the summer of 1747. On July 24 of that year Watson, assisted by Charles Cavendish and Martin Folkes, sent a charge of electricity through 800 feet of water at the New River, Stoke Newington. The following year Watson, at Shooter's Hill, also sent discharges through 12,276 feet of wire.

July 24, 1842.—“That a glacier moves like a sluggish river, and under the same laws,” wrote J. D. Forbes, “was an idea which first clearly entered my mind as a definite probability on the evening of the 24th July 1842, when from the heights of the Charmoz I saw the dirt bands stretching across the breadth of the M^{er} de Glace at my feet like floating scum on a partially stagnant stream . . . and from that hour the viscous or plastic theory was to me a conviction and a reality.”

July 25, 1675.—Halley was the son of a wealthy soap boiler whose town house was in Winchester Street, in the city of London, and it was here that Halley, on July 25, 1675, observed an eclipse of the moon. He was then nineteen years of age and this eclipse formed the subject of his earliest published observations.

July 25, 1909.—The first flight in an aeroplane across the English Channel was made by Louis Blériot, who on July 25, 1909, crossed from Calais to Dover in a monoplane of 28 feet span, weighing with the pilot 462 pounds. The machine was fitted with a three-cylinder Anzani engine developing 24 horsepower.

July 26, 1790.—What was probably the earliest advertisement of a steamboat appeared in the *Federal Gazette and Philadelphia Daily Advertiser* on July 26, 1790. This gave notice: “*The Steamboat* sets out to-morrow at 10 o'clock from Arch Street Ferry, in order to take passengers from Burlington, Bristol, Bordentown, and Trenton, and return next day. Philadelphia, July 26, 1790.” The steamboat referred to was one of those built by the unfortunate pioneer, John Fitch.

July 28, 1851.—In the development of the study of the various phenomena associated with total eclipses of the sun, especial interest is attached to the total eclipse of July 28, 1851, observed with success in Norway and Sweden. It was on this occasion that the prominences were closely followed and described. Hind wrote of “a long range of rose-coloured flames”; Dawes of “a low ridge of red prominences, resembling in outline the tops of a very irregular range of hills,” while Airy termed the portion of this “rudded line of projections” visible to him the “Sierra.”

July 29, 1857.—An outstanding improvement in the manufacture of iron rails was the introduction of the ‘three high mill’ in place of the ‘two high mill.’ The story of its introduction was told by the great American ironmaster, John Fritz, in 1899. Declared by others “a visionary scheme and one that had never been done before, and had it been practical it would have been done long ago,” the first ‘three high mill’ was put into action by Fritz himself at the Cambria Iron Company, U.S.A., making the company a great financial success and giving it a rail plant far in advance of any other plant in the world.

July 30, 1828.—An account of the Brownian movements witnessed by Robert Brown was privately circulated under this date, with an additional account the following year dated July 29, 1829. E. C. S.

Societies and Academies.

LONDON.

Royal Society, ¹ June 30.—A. Fage and F. C. Johansen: On the flow of air behind an inclined flat plate of infinite span. The airflow behind a flat plate has been explored with a heated wire, used in conjunction with an Einthoven galvanometer. As the inclination of the plate is decreased from 90°, both the frequency and velocity with which individual vortices behind the plate pass downstream become greater; and the longitudinal spacing between successive vortices becomes smaller. Vorticity is shed at the same rate from the two edges of the plate; this rate slowly decreases with the inclination of the plate. Only a part of the vorticity generated at the edges passes downstream in the form of well-defined vortices.

L. G. Brazier: On the flexure of thin cylindrical shells and other 'thin' sections. St. Venant's solution of the flexure problem shows that hollow beams are more efficient than solid beams in economy of material. His theory suggests that this advantage increases without limit as the cylinder is made of thinner material. Actually a limit is reached when the section fails under flexure by distortion of the cross-section. The distortion of the cross-section of 'thin' section beams subjected to pure flexure is examined and a modification to St. Venant's result is obtained. The analysis suggests the existence of a form of elastic instability, characterised by the absence of a 'point of bifurcation,' for beams of such sections subjected to pure flexure.

W. H. George and H. E. Beckett: The energy of the struck string (Part ii.). The initial velocity of the hammer does not determine the character of the impact, and the fraction of its initial energy lost by the hammer is independent of the initial velocity of the hammer. The results obtained with an actual felt-covered pianoforte hammer are remarkably like those for a pointed or a broad unyielding metal hammer. A specially designed yielding metal hammer gave less energy to the string than did any of the other types of hammer. The partition of the energy among the various partial tones of the vibrating string shows that it would be possible to obtain almost any kind of tone quality from a pianoforte merely by altering the mass of the hammer.

G. A. Tomlinson: Rusting of steel surfaces in contact. Hardened steel surfaces in contact and subject to relative motion are liable to become stained with a deposit of oxide, which may cause trouble in high-precision apparatus. This effect occurs with quite small contact stresses and with various different materials in contact with steel. It is necessary that relative tangential motion shall occur. An oscillatory tangential motion of 8×10^{-8} inches, repeated sufficiently often, will produce oxidation debris, but smaller motions do not. This suggests that actual molecules are detached by cohesion forces and combine with oxygen molecules from the air. The effect of a film of castor oil between the surfaces has been examined. A sphere and a plane can be completely separated by a film of great mechanical strength, when the mean intensity of pressure over the area of contact is less than a critical value of about 65,000 lb. per square inch. For pressures above this, the film may rupture and solid cohesion occur, accompanied by the same oxidation effect.

F. I. G. Rawlins and E. K. Rideal: The absorption spectra of aragonite and strontianite in the near infra-red. Definite displacements of the three

fundamental frequencies of the CO_3^{--} ion occur in the two crystal forms. From the overtones of the fundamental at 7μ , it is shown that the frequencies do not follow the order $3\nu_1$, $2\nu_1$, $3\nu_1$; a correction must be introduced analogous to the Kratzer correction for an harmonic coupling in gases. In CaCO_3 this correction is greatest for the less symmetrical form. In bi-axial crystals of the carbonates of calcium, strontium, and barium, the absorption wave-length at ν_1 (7μ) and its overtones increase with the molecular volume, but the reverse is the case for the bands at ν_2 (14μ) and ν_3 (11μ). This dependence upon the molecular volumes is likewise observed in calcite and aragonite.

C. N. Hinshelwood and P. I. Askey: The influence of hydrogen on two homogeneous reactions. The decomposition of propionic aldehyde is unimolecular at low pressures if sufficient hydrogen is present. Increasing pressure of hydrogen soon brings the propionic aldehyde reaction to a limiting rate, which is the same as the limiting rate reached when the partial pressure of the aldehyde itself is increased. Similar pressures of hydrogen have no tendency to make the acetaldehyde decomposition appear unimolecular, and no saturation value is reached for the comparatively small effect which the hydrogen exerts. These phenomena indicate that activation of acetaldehyde involves a few degrees of freedom only, while that of propionic aldehyde is a more complex process, and that in the propionic aldehyde reaction there is a time-lag between activation and transformation.

H. Stanley Allen and Ian Sandeman: Bands in the secondary spectrum of hydrogen (ii.). A system of bands of a distinctive type occurs in groups throughout a wide range of the visible and infra-red spectrum of hydrogen. The bands in a group have been spaced out at intervals of very nearly 92 wave-numbers, and various reasons have been given for attributing the system to triatomic hydrogen, H_3 . A considerable number of new bands has now been added. The structure of some of the better defined bands suggests that the spacing depends on a new quantum number.

G. D. Bengough, J. M. Stuart, and A. R. Lee: The theory of metallic corrosion in the light of quantitative measurements. A new version of the electrochemical theory of metallic corrosion has recently been widely accepted as fitting satisfactorily experimental facts, from a qualitative point of view; but the theory has not been subjected to exact quantitative examination. A method of measuring corrosion has been worked out, based on the determination of the amount of oxygen absorbed during corrosion, and has been applied to the metal zinc. The nature of the surface of the metal is an important factor in determining corrosion. Reasonable agreement between duplicate experiments has only been obtained with specimens annealed in argon at temperatures in the neighbourhood of 250° C. 'Spectroscopically' pure zinc is readily attacked by $N/10,000$ KCl solution; in solutions between $N/20,000$ and $N/5000$ KCl the time-corrosion curves are of exponential form during their earlier course, and the controlling factor appears to be the number of chlorine ions initially present in, and their rate of withdrawal from, solution. The later course of the curves appears to be controlled largely by the behaviour of films of corrosion products. With stronger solutions the amount of available oxygen becomes an important factor.

H. A. Wilson: Chemical equilibrium in a mixture of paraffins. The compositions of the gaseous and liquid phases of a mixture of paraffins, $\text{C}_n\text{H}_{2n+2}$, when in a state of chemical equilibrium, are worked out approximately as functions of the temperature and pressure. A chart is drawn on which the equilibrium

¹ Continued from p. 103.

composition of the phases can be read off. The results obtained enable the temperatures and pressures at which the maximum amount of any particular paraffin is present in the vapour to be determined. The amount of the gaseous phase which condenses when the temperature and pressure are changed can also be obtained.

Physical Society, June 10.—J. H. Awbery: The latent heat of evaporation of sulphur. The latent heat of evaporation of sulphur was determined by finding the loss of weight of a vessel full of sulphur when energy was dissipated in it at a known rate. Heat losses were prevented by immersing the vessel in the vapour of sulphur. The value found for the latent heat was 79, the accuracy being estimated at 2 per cent.—H. Lowery: The refraction and dispersion of gaseous carbon tetrachloride. The refractive index has been found for the green mercury line ($\lambda 5461$), the result being expressed in connexion with the density of the gas, that is, so as to show the refractivity of the gas by the same number of molecules as 1 c.c. of hydrogen contains at N.T.P. Adopting the value 1.001799 for the refractive index under these conditions, the dispersion of the gas over the range $\lambda 4800$ to $\lambda 6700$ is represented by the expression $\mu - 1 = 13.543 \times 10^{27} / (7831.7 \times 10^{27} - \nu^2)$, ν being the frequency of the light.—P. K. Kichlu: Regularities in the spectrum of ionised neon. A number of lines lying between $\lambda 7282$ and $\lambda 3142$ occurs in the condensed discharge spectrum of the more volatile gases of the air. These have been attributed to singly ionised neon, and the present work confirms this view.

Royal Anthropological Institute, June 28.—V. G. Childe: The Ægean and the Danube valley in the second millenium B.C. The Central European bronze age was the child of the Ægean but eventually turned upon its parents and devoured them. Recent excavations in Hungary and Macedonia have thrown light on this double process. In the lowest strata at Toszeg near Szolnok on the Tisza, the connexion with Troy is clearly revealed in the pottery, and at the same time a link is found with the early bronze age civilisation that arose round the tin deposits of Bohemia. In the fourth layer at Toszeg, an intrusive pottery appears that is identical with a foreign ware found by Mr. Heurtley in a sub-Mycenæan context in Macedonia. This fabric was native neither to Macedonia nor to Hungary, but originated round the headwaters of the Adir and March. Its authors could be traced as far as Thessaly and central Greece. Were they the Dorians of Greek tradition?

PARIS.

Academy of Sciences, June 13.—Marcel Brillouin: The earth's magnetic field and the internal electromagnetic properties of the globe.—J. Costantin: The economic and agricultural importance of cultivation in tropical mountain regions. An account of the fight against the sugar-cane disease (Sereh) in Java. The simplest treatment, and the one in general use, is to raise the cuttings of the plants in the mountains, first at an altitude of 1500 m. to 1800 m., then removal to nurseries at a height of 600 m. to 700 m., and finally removal to the plain. The regenerated plant remains free from disease for about five years. A modified treatment is to cross the Java cane with a mountain variety from the lower slopes of the Himalayas and to give this the mountain cure as above, about every six years.—Gabriel Bertrand and L. Silberstein: The amount of total sulphur in arable soil. Analyses of soil from various parts of

France showed the total sulphur to vary between wide limits—0.202 gm. to 5.175 gm. of sulphur per kilogram of dried soil. It was noticed that the regions richest in sulphur were also the most fertile.—A. Desgrez and H. Bierry: The variations with the diet in the elimination of the urinary carbon in diabetics. Two ratios have been experimentally studied, $A = (C_t - C_g) / N_t$, where C_t is the total carbon in the urine, C_g the glucose carbon, and N_t the total nitrogen and the ratio $B = \{C_t - (C_g + C_u)\} / (N_t - N_u)$, where C_u is carbon as urea and N_u the nitrogen as urea. Both these ratios are at a minimum during the period of an equilibrium diet, and the measurements of these ratios establish with precision the value of a particular diet for diabetics.—Beniamino Segre: The transformation of R networks.—A. Buhl: The symmetries of the theory of continued groups.—Léon Pomey: The normal integro-differential equations of infinite order.—V. A. Kostitzin: The singular solutions of the integral equations of Volterra.—René Lagrange: an algorithm of series.—M. Lavrentieff: Conformal representation.—Spyridion Sarantopoulos: The meromorph functions represented by a Taylor's series with rational coefficients.—Martin Ålander: A property of meromorph functions at the interior of a line of constant modulus.—G. H. van den Dungen: The calculation *a priori* of the vibrations of bending and other vibrations.—André Défour: The utilisation of the tides.—André Charrueau: The figures of equilibrium relative to a liquid mass in rotation, to the Newtonian attraction between its particles and to the surface tension.—J. Ubach: Observations of the eclipse of the sun of Jan. 3, 1927, at Buenos Ayres (Argentine Republic). 94 photographs, 81 of which could be utilised for measurements, were taken under very favourable conditions.—Robert Esnault-Pelterie and Osée Marcus: The theoretical electrical resistance at the contact of two elastic conducting spheres, disregarding the passage layer.—Emmanuel Dubois: The Volta effect. If a metal is heated in a vacuum, it is found after cooling that the heating has rendered it electro-negative, provided that the heating has been sufficiently prolonged and carried out at a sufficiently high temperature. From the experiments given it would appear that the variations in the electromotive force obtained after heating an electrode in a vacuum arise from the disappearance of impurities common to all metals.—Rouelle: Certain peculiarities of ferro-resonance when the resistance is not negligible.—E. Pierret: The Barkhausen oscillations obtained with French valves.—Nicolas Perrakis: The magnetic properties of vanadyl chloride and sulphate and the atomic moment of tetravalent vanadium. The experiments cited prove that V^{IV} possesses at least two atomic moments, one of 8 and the other of 9 magnetons.—Jacob: An experimental method permitting the comparison, at a given moment, of the velocity of light in one sense and in the opposite sense.—Duffieux: The production of the continuous spectrum of mercury by rotation in a vacuum. A detailed account of the phenomena observed when a drop of mercury is placed in a spherical evacuated glass globe, maintained in rotation (120 to 180 turns per minute), and the temperature slowly raised to a maximum of about 200° C.—G. Reboul: The production of X-rays without a focus tube.—E. Darmais: The rotatory power of tartaric acid in solution in calcium chloride.—René Audubert: The application of the radiochemical theory to solutions of sodium iodide.—W. Kopaczewski and W. Szukiewicz: The rôle of some physical factors in the electrocapillary penetration of coloured colloids.—A. Boutaric and G. Corbet: The critical temperatures of solution of

mixtures of alcohol and some hydrocarbons. The method given, specially designed to deal with mixtures possessing a low critical temperature of solution, was used to show that although benzene and pure alcohol are miscible in all proportions, contrary to the view generally held, petrol and absolute alcohol are not miscible in all proportions.—Eugène Cornec and Paul Klug: The boiling of saturated solutions, a method of physico-chemical analysis.—F. Bourion and E. Rouyer: The boiling-point study of the affinity relating to the complex compounds formed from mercuric chloride and alkaline chlorides.—Svend Aage Schou: The transformation of acetaldehyde into its enolic form. The change has been followed by the quantitative study of the ultra-violet absorption of neutral, basic, and acid solutions of acetaldehyde.—A. Job and G. Dusollier: Organo-magnesium compounds containing phosphorus. Study of the reaction between ethyl-magnesium bromide and mono- and diphenylphosphine. The magnesium compounds obtained react with ethylchloroformate.—M. Wilmet: The sensibility of some test papers towards gaseous phosphoretted hydrogen. Papers containing silver nitrate or mercuric chloride are capable of showing the presence of 1 part in 1,000,000 of gaseous phosphine.—C. Dosios and G. Leucaditis: The mechanism of the formation of ketones during the dry distillation of the salts of organic acids. It is well known that asymmetrical ketones are produced by the dry distillation of mixtures of salts of two different acids, but the mechanism of the reaction has not been made out. The hypothesis of an intermediate phase, the anhydride of the organic acid, is put forward. The exchange of alkyl and aryl groups between a mixture of ketones at a high temperature does not appear to take place, but the acid anhydrides can, under the conditions of these reactions, exchange their characteristic groups.—Charles Prévost: The tautomerism of two dibromides of an erythrene hydrocarbon. The preparation of the hydrocarbon diisocrotyl in a state of purity is described. Bromine gives two dibrom derivatives, only one of which can be isolated. Attempts to prepare the fully saturated tetra-brom derivative failed.—Albert Kirmann: The α -bromaldehydes. The α -halogen aldehydes react as though they contained acid halides, even after a bisulphite purification.—M. Tiffeneau and Mlle Jean Lévy: The affinity capacity of the p -tolyl radical.—P. Fallot and R. Bataller: The north-east edge of the Cretaceous massif of Bas-Aragon.—E. Tabesse: Magnetic measurements in the centre and west of France. A table of the measurements is given, reduced to Jan. 1, 1922. The distribution of the magnetic elements is generally normal, except in the Civray region, where there appears to exist a strong anomaly, principally for the declination.—P. Idrac: A self-recording apparatus for the oceanographic study of deep currents. The apparatus described has been used experimentally on the coasts of Cotentin. It is specially intended for use on the *Pourquoi-Pas?* for studying the fluctuations of the currents in the English Channel and on the banks of Rockall and Porcupine.—Pierre Gavaudan: The origin and characters of the oil-bearing elements of *Madotheca platyphylla*.—A. Ch. Hollande: The renovation of the epithelium of the middle intestine of the Egyptian cricket, *Orthacanthacris (Acridium) aegyptia*.—Alphonse Labbé: The existence of specialised branchia in some copepods.—M. and Mme Lapique: The electrical reaction of plant cells and its relations with the excitability. A repetition of Waller's experiments that the blaze current is a sign of lesion; it is only a sign of life in so far as it marks the passage to death.—Mlle M. L. Verrier: The

determination of the anatomical visual field in fishes and batrachians.—H. Labbé and A. Kotzareff: The action of mesothorium bromide on glycaemia in normal and cancerous mice.—Philippe Fabre: Neuro-muscular excitation by cuneiform waves.—Raymond-Hamet: The cardiac action of adrenaline during the stimulation of the vagus.—E. Roubaud: The eclosion of the egg and the stimulants of eclosion in the *Stegomyia* of yellow fever.—L. Lutz: The soluble ferments secreted by the hymenomycete fungi. Tannin as an antioxygen.—X. Chahovitch, V. Arnovljévitch, and Mlle M. Vichnjitch: The proteid sugar in various pathological states. Proteid hyperglycaemia is not a disorder specific to a disease, but is met with whenever there is some lack of nutrition and is the expression of the general metabolism changed by the influence of a non-specific agent.—A. T. Salimbeni and R. Sazerac: The action of bismuth on the spirochæte of Sodoku in the experimental infection of the guinea-pig.

ROME.

Royal National Academy of the Lincei, Mar. 20.—G. Fubini: The geometry of a surface in the projective group and in the conform group.—O. M. Corbino: Electrolysis without electrodes. In cases when electrolysis of a liquid is induced by an arc or an ionic discharge between an external electrode and the liquid, the lack of a metallic electrode not only changes the form of the cathodic deposit, which may assume the colloidal state, but also the chemical character of the electrolytic process may undergo modification. This is shown by the liberation of hydrogen rather than the deposition of metallic gold from a gilding bath.—A. L. Herrera: Growth and multiplication of artificial amoebæ. These structures, formed by drops of sodium hydroxide solution in a mixture of light petroleum and olive oil, are able to exhibit, although only to a limited degree, the phenomena of growth and multiplication, owing to increase of the osmotic pressure by absorption of fresh quantities of oil dissolved in petroleum through the soap membrane surrounding the alkaline drops.—E. Bompiani: Some general ideas for the differential study of [geometrical] varieties.—E. Bortolotti: Axial systems and connexions in V_m .—W. Blaschke: The linear element of Liouville.—G. Andreoli: Curvature and parallelism in a surface.—S. Cherubino: The integration of linear differential forms.—J. Dubourdieu: The holonomy groups of Riemann spaces of four dimensions. Case of an Einsteinian ds^2 .—V. Hlavaty: Contact of two curves in a V_m .—L. Labocchetta: The analytical representation in finite form of the magnitudes expressed by different functions in arbitrarily assigned regions of the plane and of space.—N. Spampinato: Further contributions to the general theory of Riemann's matrices.—M. Pascal: Curves for the maximum (or minimum) thrust [aerial].—G. Todesco: Investigations on the accidental thermo-electricity of bismuth. Majorana's experiment with an amplifier and a thermionic valve demonstrated the possibility of obtaining a sound in a telephone connected with the amplifier if the latter is joined to a flat coil of high resistance having as nucleus a bismuth disc or ring, one of the faces of which is exposed to luminous radiation, periodically interrupted. The dissymmetries which cause this accidental thermo-electricity of bismuth are due merely to the fact that, in the crystallisation following fusion of the metal, the elementary crystals are disposed in the mass of the metal with varying orientation, contact of differently inclined crystals resulting in the formation of thermo-electric couples.—G. Piccardi:

Isotopy, excess weight, and atomic structure. According to a hypothesis previously advanced, an atomic species of number N and atomic weight P should possess $(P-2N)$ positive electrons and $(P-2N)$ negative electrons external to the atomic nucleus and arranged to form an electrically neutral whole. This hypothesis is now supported by the relations, manifested but as yet incompletely studied, between the atomic weight and (1) the difference between the weights of the lowest and highest isotopes, or the field of variability of the isotopes, for each element, and (2) the maximum excess weight exhibited by any group of isotopes.—D. Bigiavi: Relations between aromatic nitro-derivatives and azoxy-compounds. Evidence is adduced which confirms the reluctance to undergo substitution exhibited by the aromatic nucleus contiguous to the pentavalent nitrogen of the azoxy-compounds, and moreover shows that, in general, the presence in the aromatic nucleus of an azo-derivative of nitro-groups in the para- or ortho-position to the azo-grouping renders difficult the addition of oxygen to a nitrogen atom of the azo-group by means of peracetic acid.—G. Malquori: The system $Al(NO_3)_3 : KNO_3 : H_2O$ at 25° . The isotherm of this system for the temperature 25° fails to indicate the formation of an additive compound between the two nitrates.—P. Pasquini: Homeoplastic grafting of the ocular rudiments in embryos of *Pleurodeles Waltli*.—R. Savelli: Lack of confirmation of the Giglio-Tos 'rational laws' on hybridism.

Official Publications Received.

BRITISH.

The British Institute of Philosophical Studies. Annual Report and Statement of Accounts for the Year ended 31st March 1927. Pp. 19. (London.)

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1926. Pp. 19. (Hong Kong.)

Journal of the Chemical Society: containing Papers communicated to the Society. June. Pp. x+iv+1221-1400. (London: Gurney and Jackson.)

The Plan of the Educational Colonies Association (of Great Britain and India): the Substance of a Series of Lectures on the Plan delivered in the Universities of Calcutta, Madras and Dacca. By J. A. Petavel. Pp. xi+288. (Calcutta: Educational Colonies Association.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 2, No. 3, June. Pp. 199-283. (Cambridge: At the University Press.) 12s. 6d. net.

Board of Education. Report of H.M. Inspectors on the Provision of Instruction in Pure Chemistry in Technical Colleges and Schools in England. Pp. 11. (London: H.M. Stationery Office.) 3d. net.

The Tea Research Institute of Ceylon. Bulletin No. 1: Annual Report for the Year 1926. Pp. 29. (Kandy, Ceylon.)

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty, for the Year 1926. Pp. 10. (Cape of Good Hope.)

Forestry Commission. Seventh Annual Report of the Forestry Commissioners, Year ending September 30th, 1926. Pp. 45. (London: H.M. Stationery Office.) 1s. net.

The Physical Society. Proceedings, Vol. 89, Part 4, June 15. Pp. 251-374. (London: Fleetway Press, Ltd.) 6s. net.

South Australia: Department of Mines. Mining Review for the Half-Year ended December 31st, 1926. (No. 45.) Pp. 105+7 plates. (Adelaide: R. E. E. Rogers.)

FOREIGN.

Proceedings of the Academy of Natural Sciences of Philadelphia. A Revision of the Nematodes of the Leidy Collections. By Arthur C. Walton. Pp. 49-163+plates 4-10. The Structure and Affinities of Humboldtiana and related Helicid Genera of Mexico and Texas. By Henry A. Pilsbry. Pp. 165-192+plates 11-14. (Philadelphia, Pa.)

The Carnegie Foundation for the Advancement of Teaching. Bulletin No. 19: Dental Education in the United States and Canada. A Report to the Carnegie Foundation for the Advancement of Teaching. By William J. Fies. Pp. xxi+692. Bulletin No. 20: The Quality of the Educational Process in the United States and Europe. By William S. Learned. Pp. x+183. (New York.)

The Rockefeller Institute for Medical Research: Organization and Equipment. Pp. 24. (New York.)

Proceedings of the United States National Museum. Vol. 71, Art. 12: Megachilid Bees from Bolivia collected by the Mulford Biological Expedition, 1921-1922. By T. D. A. Cockerell. (No. 2684.) Pp. 22. (Washington, D.C.: Government Printing Office.)

Index to Bulletin of the Geological Institution of the University of Upsala. Edited by H. Sjögren. Vols. 11-20 (1912-1927), with an Appendix containing List of Exchanges, etc. Pp. 43. (Uppsala: Almqvist and Wiksells Boktryckeri A.-B.)

CATALOGUES.

The Cambridge Bulletin. No. 57, June. Pp. 32+8 plates. (Cambridge: At the University Press.)

Mr. Murray's Quarterly List. July. Pp. 32. (London: John Murray.)

Microscopical Preparations: Zoological and Botanical Material. Catalogue 'A.' Seventh edition. Pp. 96. (Manchester: Plattars and Garnett, Ltd.)

Catalogue of B.D.H. Fine Chemical Products. July. Pp. 108. (London: The British Drug Houses, Ltd.)

Laboratory Apparatus and Equipment. Fourteenth edition. Pp. 151. (London: Brown and Son (Alembic Works), Ltd.)

A Catalogue of Important and Rare Books on Botany, Agriculture, Forestry, Fruit-Culture, Gardens and Gardening, Herbals, Early and Modern Medicine and Surgery, Tobacco. (No. 409.) Pp. 144. (London: B. and Quaritch, Ltd.) 1s.

Diary of Societies.

SATURDAY, JULY 23.

PHYSIOLOGICAL SOCIETY (in Physiological Laboratory, Edinburgh), at 10 A.M.—Communications from 10 to 1:—Dr. B. A. McSwiney: Structure and Movements of the Cardia.—C. W. Greene: Unique Characteristics of the Electrogram of the Isolated and Automatically Contracting Uterus of the Rat.—C. H. Greene, Martha Aldrich, and L. G. Rowntree: Studies in the Metabolism of the Bile Acids.—R. W. Gerard: The Metabolism of Peripheral Nerve.—A. J. Clark and A. C. White: The Action of Acetyl Choline on the Cardiac Frequency and the Blood Pressure of the Cat.—H. Dryerre: (a) The Effect of the Intermittent Injection of Adrenaline on Perfusion Rate; (b) The Effect of Ingestion of Calcium Chloride on the pH of Urine.—W. P. Kennedy: The Deflection of the Armet Count by Radiation.—J. D. S. Cameron: The Effect of Ingestion of Creatinine on Blood and Urine-Creatinine.—Sir E. Sharpey-Schafer: Further Observations on the Effect of Section of Cutaneous Nerves.—E. Ponder: Hæmatocrite Method of Determining the Volume of the Red Cell.—O. Meyerhof: A Communication.—H. E. Magee and A. E. Glennie: Effect of Ether Anæsthesia on some Blood Constituents. (Preliminary Communication.)—R. Brinkman: Registration of pH of Circulating Blood by Means of the Antimony Electrode.—Demonstrations from 2 to 4:—(a) A Method for Showing Continuous Tracings on the Screen; (b) A Simple Adjustment to deliver Make Induction Shocks, by N. E. Condon.—The Measurement of the Red Cells of Man before and after Exercise, by H. Dryerre, W. G. Miller, and E. Ponder.—The Estimation of pH of Faeces, by H. Dryerre.—Precipitation and Protection of Silver Sols, by W. W. Taylor.—The Estimation of Percentage Hæmolysis by the Selenium Cell, by E. Ponder.—Hæmolysis by Ultra-violet Light, by W. P. Kennedy.—Autolytic Changes in Lymph and Blood, by J. Lorrain Smith and T. Retlie.—Apparent Cilia on the Epithelium of the Intestine and Ovary, by May L. Walker.—A New Cytological Method, by May L. Walker and W. A. Bain.—A Simple Slide Rule for the Rapid Determination of Respiratory Quotients using the Formula:

$$R.Q. = \frac{x-0.03}{20.93 \left(\frac{100-x-y}{79.04} \right) - y}$$

where x is the % CO_2 and y that of O_2 in the expired Air, by W. A. M. Smart.

MONDAY, JULY 25.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—E. G. Dymond: Excitation by High Velocity Electrons.—Dr. L. H. Thomas: The Production of Characteristic X-rays by Electronic Impact.—Dr. W. L. Webster: The Hall Effect in Single Crystals of Iron.—G. E. Wynn-Williams: A Valve Amplifier for Ionisation Currents.—To be communicated by title only:—J. B. S. Haldane: (a) A Mathematical Theory of Natural and Artificial Selection. Part V: Selection and Mutation; (b) The Comparative Genetics of Colour in Rodents and Carnivora.—S. Pollard: On the Generalisations of the Theorems of Parseval and Riesz-Fischer.—F. W. Carter: Eddy Currents in Thin Circular Cylinders of Uniform Conductivity due to Periodically Changing Magnetic Fields, in Two Dimensions.—J. H. Grace: (a) A Theorem of Dr. P. Zeeman; (b) The Pedal Planes of a Tetrahedron; (c) An Illustration of the Space Representation of Circles.—Miss M. E. Grimshaw: Summation of the Integral Conjugate to the Fourier Integral of Finite Type.—F. S. Russell: The Vertical Distribution of Plankton in the Sea.—A. Lipschütz: On Some Fundamental Laws of Ovarian Dynamics.

CONGRESS.

JULY 26 TO 28.

BRITISH-AMERICAN NEUROLOGICAL MEETING.—Combined Meeting of the Neurological Section of the Royal Society of Medicine and of the American Neurological Association (at Royal Society of Medicine, 1 Wimpole Street, W.1).

Tuesday, July 26, at 9.30 A.M.—Short Papers.

At 2 P.M.—Short Papers.

Wednesday, July 27, at 9.30 A.M.—Drs. F. Tilney, H. A. Riley, L. J. Pollock, L. E. Davis, A. J. Mussen, T. H. Weisenburg, and Harvey Cushing: Discussion on the Cerebellum.

At 2.30 P.M.—Special Clinical Meeting.

Thursday, July 28, at 9.30 A.M.—Drs. J. S. B. Stopford, W. Harris, S. A. K. Wilson, and Gordon Holmes: Discussion on Sensory Disorders in Organic Disease of the Nervous System.

At 2 P.M.—Papers and Demonstrations on Pathological Subjects.

At 5 P.M.—Dr. C. L. Dana: The Hughlings Jackson Lecture.