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Biology for Young Children.

IT is sound educational practice for teachers to avail themselves of the innate interests and inclinations of their pupils, especially in the earliest stages of their training. The millennium is not yet, but a little child may lead us towards its advent in the teaching of biology. In a paper entitled "The Biological Interests of Young Children", recently published in *The Forum of Education* (vol. 7, No. 3, and vol. 8, No. 1), Mrs. Isaacs deplores the failure to link up the keenness evinced by little children in animal pets and in growing plants with later biological interests; and gives an illuminating record of her experiences at the Malting House School, Cambridge, with a group of children all of whom were less than seven years of age.

Mrs. Isaacs maintains that an active, continuous, and cumulative interest in animal and plant life, but particularly in animal life, develops easily and uninterruptedly out of the young child's innate curiosity and pleasure in these things; provided (1) that their adult associates emancipate themselves from prejudice and inadequate thinking as to the order in which plant and animal life should be dealt with, and the range of facts acceptable to children of tender age, and valuable educationally; and (2) that the child's actual direction of interest be followed, and heuristic help given. Her records suggest strongly that children at this age are more actively and spontaneously interested in animals than in plants; that the animal-interest is far more genuinely biological, plants being to the children little more than suitable gifts and decorations; that the facts of the life-cycle in animals are more easily and directly observed and understood by the child, and thus that the animal-interest is more easily sustained and naturally linked on to formal biological study.

To generalise from comparatively few examples is, perhaps, rash, but Mrs. Isaacs' experience will be confirmed by many who have to do with young children; and her conclusions merit careful consideration by those responsible for the education both of little and of older children.

Another consideration that emerges from Mrs. Isaacs' paper may be termed a moral one. There is in most children a curious mixture of tenderness and cruelty towards animals; nor do the behaviour of carnivorous animals, and the apparent inconsistencies of the adult population with regard to animal food, animal clothing, sport and the like, help to make clear to the child that cruelty is wrong, and that respect is due to all forms of life. It was found, however, at the Malting House School that 'looking inside' some dead animals, and hearing something of the functions of the organs exposed by dissection, so far from increasing the impulses to cruelty in children, had the reverse effect. The impulse to master and destroy was taken up into the aim of understanding a living mechanism not greatly differing from that of a human being.

By encouraging in the children any interest shown in the processes of life, a steadily humane outlook was achieved, and a sense of responsibility towards pets and towards animals in general awakened and enlivened. The standard of positive morality engendered by this method is of far more worth than the mere negative of not being unkind; and it expresses itself in eager interest in life-histories, and sympathy with all animal activities.

Egyptian Mathematics.

The Rhind Mathematical Papyrus: British Museum 10057 and 10058. Photographic Facsimile, Hieroglyphic Transcription, Transliteration, Literal Translation, Free Translation, Mathematical Commentary, and Bibliography. In 2 volumes. Vol. 1: *Free Translation and Commentary,* by Arnold Buffum Chace, with the assistance of Prof. Henry Parker Manning; *Bibliography of Egyptian Mathematics,* by Prof. Raymond Clare Archibald. Pp. vii + 210. Vol. 2: *Photographs, Transcription, Transliteration, Literal Translation,* by Arnold Buffum Chace, Ludlow Bull, and Prof. Henry Parker Manning; *Bibliography of Egyptian and Babylonian Mathematics (Supplement),* by Prof. Raymond Clare Archibald; *The Mathematical Leather Roll in the British Museum,* by Stephen Randolph Kingdon Glanville. Pp. xvi + 31 photographs + 109 plates + 12 + 8. (Oberlin, Ohio: American Mathematical Association, 1927–1929.)

WHEN Prof. T. Eric Peet's handsome and in every respect admirable edition of the Rhind Papyrus appeared in 1923, anyone who read it must have felt that we had at long last (nearly fifty years had passed since the publication of Eisenlohr's edition) a definitive translation and commentary, with all such detailed discussion of points arising on the text and its interpretation as would give Egyptologists and mathematicians, once for all, a sound basis for further researches on the subject. The immediate effect of Prof. Peet's publication was to usher in an epoch of fresh intensive study of the principles of Egyptian mathematics, which bids fair to put into the shade the work of those pioneers, like Moritz Cantor and Hultsch, who first took the matter up after Eisenlohr. First Mr. Battiscombe Gunn published in the *Journal of Egyptian Archæology* for 1926 an invaluable critical notice of Peet's work covering fifteen pages of small print, in which he put forward many suggestions for improvements in the translation of the text and the mathematical interpretation; so important were these that, wherever Peet's work is quoted by later writers, we almost invariably find Mr. Gunn also cited; the two are associated in a joint article in the *Journal of Egyptian Archæology* of November 1929 on four problems from the Moscow Papyrus, the publication of which in full is expected at an early date. But there has been equal activity abroad. Important papers have appeared in the last few years, notably those of O. Neugebauer (1926), O. Gillain (1927), and, last of all, Kurt Vogel in "Die Grundlagen der ägyptischen Arithmetik" (1929), a book of 208 pages, which deals mainly with the table at the beginning of the Rhind, showing the decomposition, into a sum of submultiples, that is, fractions with numerator unity, of the results of dividing 2 by each of the odd numbers 3, 5, 7 . . . up to 101, and which seems to be the most comprehensive work of all, since, in addition to the author's own elaboration of his subject, it contains notices of all earlier important contributions to the same.

As regards the text and translation of the Rhind Papyrus, one would, on general principles, have expected Peet's edition to remain without a rival for, say, another fifty years. Yet, within seven years of its publication, we have before us another which surpasses it in scale and magnificence. Peet's edition contained, besides the valuable and comprehensive introduction extending to 32 of the folio pages, and the translation and commentary combined (covering nearly 100 pages), a hieroglyphic transcription of the text on 23 plates, with another reproducing the hieratic text of the New York fragments. In the present edition, Vol. 1 contains (1) a full introduction on Egyptian arithmetic and geometry generally, on Egyptian measures, and on the methods and aims of the Egyptian mathematician, with notes on the Egyptian calendar and chronology, then (2) a free translation and commentary suitable for the mathematician and the general reader, and (3) the first part (covering the period from 1706 to 1927) of an extraordinarily valuable bibliography prepared by Prof. R. C. Archibald, of Brown University. The bibliography is not confined to works wholly devoted to the Papyrus, but includes numerous references to other mathematical, scientific, and Egyptological works, as well as popular papers and books, besides some of the literature of ancient Babylonian mathematics. The bibliography is enriched, in the case of the most important works mentioned, by very useful accounts of the contents of those works, their relation to one another, etc.; it covers altogether (with indices) 80 of the large pages; and it is continued in Vol. 2 by a supplement of 13 still larger pages dealing similarly with additional works issued down to 1930.

Volume 2 contains (1) a photographic reproduction of the whole of the Rhind Papyrus, including the New York fragments, on a scale of five-sixths of the original size (31 photographs); (2), on the right-hand pages following the photographs, a beautiful facsimile of the hieratic text (109 plates), in which are printed in red those portions of the text which are written in red ink in the original (Peet had in his edition distinguished the red-ink portions by underlining or otherwise); (3) a hieroglyphic transcription (based on that of Peet) which is annexed to the corresponding hieratic text on each plate; (3), on the left-hand pages opposite the facsimile plates, a transliteration of the text with a literal English translation interlined with it. In (2), (3), (4) the red-ink portions of the original text are printed in red as in (1). Accordingly, as the editors point out, from the free translation of the first volume to the original hieratic writing four steps are provided, and the portions of the original text which were written in red appear in red in each of these steps. In addition, the left-hand pages contain many notes (some of considerable length) on philological questions, the mistakes of the scribe, and so on. One wonders with what feelings the worthy scribe Ahmes, Aḥmōse or A'h-mosè, who presumably never dreamt of immortality, would regard this superb setting given to his work after 3500–3600 years!

The volumes, planned on this magnificent scale, owe their appearance to the initiative of Dr. Arnold Buffum Chace, who, while asking the Mathematical Association of America to undertake the publication, "generously provided the means necessary to ensure its appearance in a form commensurate with its importance". As compared with Prof. Peet, the editors had of course the advantage of being able to use the valuable work done by Mr. Gunn and others as regards the text, and by other writers upon the content and the mathematical interpretation.

The effect of the new editions and the extensive literature to which they have given rise is distinctly to put a higher value upon Egyptian mathematics than scholars were formerly inclined to assign to it. At one time the Rhind Papyrus was classed by one school of thought as the notebook of a pupil, and not a very intelligent one at that, in view of the numerous mistakes which disfigure it. But the more it was studied, the more clear it became that there was distinct method in it, as well as a high degree of skill in calculation. No doubt the problems dealt with may seem to be mostly practical rather than theoretical. Yet there is more science in the treatise than appears at first sight. Take first the table of decompositions of fractions which we should write as $2/n$, where n is odd, into a sum of fractions with numerator unity (together with 2/3): for example, $\frac{2}{13} = \frac{1}{8}\ \frac{1}{52}\ \frac{1}{104}$, and $\frac{2}{53} = \frac{1}{30}\ \frac{1}{318}\ \frac{1}{795}$. This table, together with the numerous cases of manipulation of fractions in the rest of the treatise, raises the whole question whether the Egyptian had any general conception of such a fraction as m/n where m is any integer less than n; and it is now clear that he had, although he had no means of writing down such a fraction, and had therefore regularly to transmute it into a sum of unit fractions (with 2/3 in addition) before he could put it on paper. The Egyptian regularly used, for adding together a number of his unit-fractions, a process equivalent to that of reducing to a common denominator, although he uses no such term; in fact, he was able to manipulate fractions to any desired extent.

The importance of prefixing to the treatise the table of decompositions of fractions of the form $2/(2n+1)$ will be readily appreciated. In Egyptian arithmetic direct multiplication was limited to multiplication by 2 (rarely 10) at a time. Hence the calculator would continually have to write down the result of multiplying a unit-fraction by 2. If the denominator was an even number this meant halving the denominator, simply; but if it was odd, reference had to be made to the table; the reckoner would have, say, to multiply $\frac{1}{23}$ by 2 and he would refer to the table and write down $\frac{1}{12}\ \frac{1}{276}$.

Again, if we consider the grouping of the problems into classes such as (1) divisions of loaves, (2) *hau*-calculations, (3) calculations of areas (of triangles, rectangles, squares, trapezia, circles) and volumes of containers (parallelepipedal and cylindrical), and the occurrence of questions about quantities or numbers in the abstract (for example, "two-thirds added and one-third [of the sum] taken away: 10 remains: [find the number]"), cases of arithmetical progression and one case of geometrical progression, we cannot resist the conclusion that Egyptian mathematics had a theoretical as well as a practical side. Though no theorems or rules are stated in general terms (only once does the Egyptian say, "Do the same thing in any example like this"), they can be inferred from the definiteness of the procedure followed in the particular cases.

No account of Egyptian mathematics is complete without mention of the Moscow Papyrus about to be published, which contains an application of the correct formula for the volume of a frustum of a pyramid on a square base, namely, $\frac{1}{3}h(a^2+ab+b^2)$, where h is the height and a, b are the sides of the square base and the face opposite to it respectively. The difficult question of how the Egyptian arrived at such a formula has already been the subject of discussion in published papers (for example, that of Peet and Gunn in November 1929), and will no doubt evoke many more suggestions as time goes on.

It is agreed that the Greeks were the first to conceive the idea of making arithmetic and geometry into sciences logically developed from a minimum number of admitted though indemonstrable principles. A suggestion has been somewhere made that, finding in ancient Egyptian and Babylonian documents many ready-made solutions of comparatively difficult problems without a hint of any underlying theory or rules, the Greeks *had* to seek for such in order to understand the solutions, and were therefore forced to try to lay down a scientific basis. The suggestion is interesting, though, even if it were true, it would not in any way detract from the Greek achievement.

T. L. H.

Chemical Engineering Economics.

Einführung in die theoretische Wirtschaftschemie. Von Dr. Rudolf Koetschau. Pp. xii + 155. (Dresden und Leipzig: Theodor Steinkopff, 1929.) 12 gold marks.

CHEMICAL industry is based upon a synthesis of chemistry, engineering, and economics. In the early days of chemical industry, each of these components was essentially empirical, both in outlook and method. The formulation of the law of mass action and the phase rule marked the development of chemistry into a quantitative science. With the help of these great principles, it became possible to define precisely the conditions which determine the successful issue of a given chemical reaction. The art of chemistry became an exact science. Engineering and economics also, each in its own field, gradually became more scientific.

The development of a set of physical and chemical reactions into a successful and profitable industrial undertaking is beset with numerous difficulties which are not at first apparent to the chemist, the engineer, or the economist. It is not until the undertaking is attempted that each realises how limited is the contribution that he can make to the common stock. The process must operate efficiently; this calls for a knowledge of chemical engineering. It must also operate profitably; this depends upon the successful application of the principles of economics.

When a successful laboratory investigation is being developed into a large-scale industrial process, new and often formidable problems arise at almost every stage. The minor difficulties connected with the storage and handling of large quantities of widely diverse materials can frequently be overcome successfully by the engineer with some assistance from the chemist. The major difficulties are generally associated with the reaction itself. Instead of controlling the reaction conditions for a kilogram of material in, say, a glass container in a well-equipped laboratory, it now becomes necessary to control with equal accuracy at every point the reaction conditions throughout a few tons of material. It may be necessary to guard against slight local changes in temperature and pressure or in the composition of the materials. Traces of impurities derived from some raw material or from the material of which the reaction vessel is made may vitiate the process or spoil the product. It is also necessary that as much of the product as possible must possess the right degree of chemical purity and must be in the most suitable physical condition.

These requirements provide problems in the design and operation of chemical plant which frequently are unfamiliar both to the chemist and the engineer. The scrap-heaps of our older chemical works bear witness to the empirical methods by which the chemist and engineer formerly strove together to design the most suitable form of plant. The chemist and the engineer now know that mere cooperation is not enough. The problems of chemical engineering must be investigated scientifically by men who, having been trained in the principles of chemical engineering, are able to understand the precise way in which the principles of both chemistry and engineering are modified and extended by their common fusion in the melting-pot of chemical industry.

The process, although efficient from the purely chemical engineering point of view, has yet to be made profitable. The operating conditions prescribed by the chemist and modified to meet the engineering requirements of the process must now be further modified in accordance with economic requirements. The site and size of the plant, the selection of raw materials, the working efficiency and the percentage yield, the degree of purity of the product and its physical condition, the relative importance of plant costs and labour charges, all these and many other factors depend upon economic considerations. When the final adjustment of the working conditions has been made and all three sets of conditions have been fused together, the final result, depending as it does upon all of them but differing essentially from each, may be stated in terms of chemical engineering economics.

The formulation of the underlying theory of this complex subject is the purpose of this little book, which we have read with great interest. The author, with great industry and considerable ingenuity, has attempted to co-ordinate the underlying theories of chemistry, engineering, and economics in so far as they are related in chemical industry, with the object of providing a foundation upon which a rational theory and method of chemical engineering economics may be developed. An attempt is made to provide a suitable notation by means of which the different sets of factors may be expressed individually. Their influence upon one another and the resulting effect of their combined operation in any particular process may then be represented mathematically. The book abounds in quotations from the writings of German industrialists and scientific workers, and is interesting in so far as it reflects the present trend of industrial thought in Germany. It is a notable book, of interest both to the chemical engineer and the economist. It provides the basis of a method by which the designs and estimates of the chemical engineer may be related to economic requirements. The economist will find in it much that will help him to relate his science to the underlying chemical and chemical engineering factors which play an essential part in all industrial chemical enterprise.

W. E. G.

Trade Rivalry and World Peace.

America Conquers Britain: a Record of Economic War. By Ludwell Denny. Pp. xi + 429 + xvi. (London and New York: Alfred A. Knopf, 1930.) 12*s.* 6*d.*

MR. LUDWELL DENNY'S book is the most complete, well documented, and interesting account of American and British rivalry in trade and finance that has yet appeared. It deserves close study, especially by all believers in growing international friendship, because, although the facts it describes are all capable of pacific settlement, they contain much dangerous explosive material and have in the past been treated far too carelessly. They are also in large part of quite recent growth.

The author's avowed theme is the economic victory of the United States. It gives a spice to the book and will commend it to American readers who may follow breathlessly the story of the rise and penetration of a flood of American capital all over the world. "Our weapons are money and machines. But the other nations of the world want money and machines. Our materialism, though not our power, is matched by theirs. That is why our conquest is so easy, so inevitable." As to England, "She is an over-populated, dependent, exposed island. As a major world Power, her days are numbered."

One might remark, in passing, that this melancholy conclusion is not quite in keeping with the general thesis and the manifold and startling findings of the book. From these we gather—and the author is constantly enforcing this conclusion—that the United States and Great Britain (meaning, of course, the whole British Commonwealth, so far as it acts as one) are waging a titanic combat for the mastery of the world. They and we are in the foreground of the picture and the rest are almost nowhere. If this be so, how can he at the same time represent Great Britain as fallen from the rank of 'major powers'? Which are the other 'major powers' which have taken her place?

This may, however, be considered rather as a debating point; it is the larger issues which call for most attention. Looking at the facts rather from the world point of view, what strikes one most is the pervasion of the whole world by giant financial interests which are insistently acquiring and attempting to control the materials and means of life necessary for our modern civilisation. It is on this side that Mr. Denny's review is so enlightening, and in one sense so disquieting. We see rubber, oil, chemicals, cables, radio communication, air routes, shipping, being fought for and, so far as possible, monopolised by huge trusts and mergers in which from time to time nationalist animosities blaze out and national governments take a part, but which on the whole are governed by financial considerations. This would be the conclusion of any fair-minded survey of the multitude of facts which Mr. Denny presents, and he admits it himself in the sentence quoted above. So far as America has 'conquered' Britain, or any other part of the world, it is by virtue of her wealth, size, population, and collective resources, not by the exercise of any deliberately hostile act or intention. This is why the constantly warlike language and analogies of the author are to be deprecated. Economic motives, no doubt, had some place in the War, but it would be a wild misreading of history to regard them as the most important, and in the future a real war, arising from the 'economic war' described in the book, is still less to be expected. If anyone is inclined to think this a piece of 'facile optimism', he should remember that practically all the trusts and mergers have money from many nations, that the two leading rivals, America and Great Britain, work side by side on many of them, and that the oil-kings and rubber-emperors, men like Sir Henri Deterding, are more and more international figures.

Still, the facts are extraordinarily interesting and serious, the more so because they are mostly of such recent date: most of the developments described are post-War. But though the facts are so complicated, two simple morals will be drawn by the plain, well-meaning man: The first, that it is not an unmixed evil that there should be some competition between the purveyors of oil and potash and rubber and tin, things that are increasingly needed in a modern State. That there should be an absolute monopoly would be quite intolerable. The second, that the spread of world-wide financial influences makes more and more urgent the strengthening of a world authority superior to them—the League of Nations and cognate bodies, representing and reconciling the interest of all. What the United States has done at home to curb the tyranny of trusts must be done internationally in so far as the trusts become strong enough to threaten the well-being not so much of rival governments but of the struggling consumers for whom they exist. Some of the great interests mentioned, aviation, for example, and radio, would seem to be eminently suitable for international control.

F. S. MARVIN.

Human Speech.

Human Speech: some Observations, Experiments and Conclusions as to the Nature, Origin, Purpose and possible Improvement of Human Speech. By Sir Richard Paget, Bart. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xiv + 360 + 6 plates. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1930.) 25*s*. net.

SIR RICHARD PAGET began his researches into the nature of human speech as follows: "Being alone in London, confined to bed with a slight chill, and disinclined to read, it occurred to me to try and listen to the whispered resonances of my own voice, as I had begun to do during the War". He required no other apparatus than a pencil and paper, for, although without the gift of 'absolute pitch', he can produce notes of 812 and 966 vibrations per second by tapping his skull in certain places. These he used as standards throughout his researches. He listened with such intensity to his whispered vowels as to produce a feeling of sickness. Gradually the power to recognise each resonance was acquired. The first product was a chart of vowel resonances more complete than any hitherto produced.

By adding plasticine, tubes of cardboard, glass and rubber, cork, clips, and other similar inexpensive means to his experimental equipment, Sir Richard Paget was able to accumulate the material for three Royal Society papers, which carried the whole matter much beyond the point attained by previous investigators, and are now recognised the world over as fundamental. All the sounds of speech have been dealt with in the course of his work.

'Sound, light, heat, magnetism and electricity' were the old pedagogic divisions of the science of physics: the least of these, though named first by some freak of fortune, was sound. Even the invention of telephone and phonograph failed to attract more than a negligible proportion of students into the domain of sound research. War and peace, sound-ranging and talkies, have changed all that. An army of investigators equipped with apparatus of the highest refinement is busy in America. Their results have confirmed those of Sir Richard Paget. We may be excused a certain pride and æsthetic pleasure in the elegant simplicity and genial intuition of our countryman, so truly in the tradition of our native scientific genius. We do not thereby admit vicarious ascetic virtue in our financiers, who leave our pioneer workers austerely devoid of the expensive equipment showered upon their colleagues abroad.

It would seem that, in many branches of industry, those who hold the purse-strings are willing to plead safety first, and relinquish our pride of place in industrial invention. They are willing to pay heavy tribute to other countries, particularly America and Germany, for inventions frequently based upon the pioneer work of Englishmen. The situation would be less deplorable if the money subscribed by the public to industrial undertakings were in fact always used with the maximum of economy and safety. On the contrary, it has recently been used, especially in this particular field, in so criminally careless a manner, that no more is forthcoming at the present time.

We may expect that so fertile a mind, capable of tackling a very old subject with prodigality of invention and economy of means, will range a good deal farther than the mere setting down of the facts ascertained. We are not disappointed. Sir Richard Paget's researches are for him a means to an end—not better and brighter 'talkies', but the improvement of language and speech based upon a full understanding of its mechanism and origin. Speech is effected by movements of parts of the oral cavity, which movements our ears recognise, even when the actual sounds transmitted to the ears as a result of them vary very much from time to time. The oscillograph record of a word as whispered, voiced, or sung by various people will be very different, but the oral movements are essentially the same.

How do these movements arise? The theory which Sir Richard Paget has made his own (though foreshadowed by others, whose work is here referred to very fully) is as follows: the movements were originally descriptive gestures, analogous to those made by the more visible parts of the body in sign-language, which probably preceded speech. These movements tend to arise along with sign-language, quite unconsciously: the schoolboy, painfully striving to write neatly, follows his pen with his lips and tongue. We see the gestures of sign-language with our eyes, which fail us in the dark, but we can see the gestures of our oral cavity with our ears: hence the superiority of such gestures.

This theory is worked out with skill, ingenuity, and a wealth of illustration, which make this part of the book absorbingly interesting. The work of the only noteworthy and specific forerunner, Dr. J. Rae, is printed in full. This is welcome, for the original appeared only in a paper called *The Polynesian*, published in Honolulu in 1862, and hence is not very accessible, though most entertaining.

The value and scope of Sir Richard Paget's researches confer upon the author every right to give us some advice as to how they may be turned to practical account. Those in search of a 'commercial proposition' may consider the construction of a talking automaton or robot, which would have the greatest value for teaching purposes. Teachers and students of elocution and singing will find abundant matter in the chapter on voice-production. Finally, there is a strong plea for conscious effort towards the improvement of our language in every respect—form, grammar, pronunciation, and orthography. We are competent for the task now that we know so much about it, physically and historically. The endeavours of devoted and enthusiastic people to popularise artificial languages for international communication seem destined to make little further progress, while English continues to spread rapidly. There can be little doubt that it will finally become the medium of international understanding, and we shall be doing a great work in making it as perfect an instrument as possible.

Sir Richard Paget appeals in his work for the development of a centre for the study of the relations of thought and speech: such a centre already exists, as he points out, in the Orthological Institute under the direction of Mr. C. K. Ogden, and is engaged in investigating these problems, and in applying the results to the simplification of English for practical international purposes. Sir Richard Paget would have us go further with such pioneers, and, casting aside custom and tradition, get down to fundamentals, transform our language by conscious effort into a more efficient means of expression, as well for the uses of art as for those of science and commerce.

The book is enriched with other valuable features —a discussion of notation, a mathematical exposition of the double resonator theory by Mr. W. E. Beaton, copious references, an adequate index. Altogether a worthy addition to the International Library of Psychology, Philosophy and Scientific Method, that bright star on the firmament of British publishing enterprise.

H. S. H.

Our Bookshelf.

Recent Advances in Preventive Medicine. By Dr. J. F. C. Haslam. With a chapter on the Vitamins by Prof. S. J. Cowell. (The Recent Advances Series.) Pp. viii + 328 + 6 plates. (London: J. and A. Churchill, 1930.) 12*s.* 6*d.*

This volume of the series describes 'recent advances' which are so modern that many of them might more aptly be said to constitute new departments of preventive medicine. The space allotted to each subject is so small that only a very condensed account can be given, but this is done without either obscuring the meaning or presenting an uninteresting catalogue of facts and theories. The nine chapters which deal with different branches of hygiene contain information only acquired in the last five or ten years on subjects the very names and substances of which did not exist twenty years ago.

Since matter of such recent date has been chiefly selected for treatment, the more gradual advances in other departments have of necessity been omitted. Dr. Haslam has included a notice of the difficult problems of practical eugenics and the various experiments which have recently been made. He expounds the most diverse themes from infantile mortality and nursery homes to the methods of investigating the excessive mortality of compositors from consumption, and the means of acquiring active immunity to diphtheria and scarlet fever. The causes and prevention of dental caries are well and judiciously discussed and the real knowledge gained clearly set out. The effect of atmospheric conditions on health and their study by the use of the kata-thermometer are interestingly discussed in 22 pages. The effect of psychological and other personal characteristics on the incidence of industrial accidents is among the subjects considered in the survey. Prof. S. J. Cowell in 30 pages on vitamins gives a very lucid account of the rapid advance and definite knowledge attained in this still actively growing field of research.

The book affords not only a pleasant means of obtaining a glimpse of so much that has been learnt of late in preventive medicine, but also provides a very useful list of books and papers from which more detailed information on the separate subjects can be obtained.

Modifications in Indian Culture through Inventions and Loans. By Erland Nordenskiöld. (Comparative Ethnographical Studies, Vol. 8.) Pp. v + 256. (London: Oxford University Press, 1930.) 18*s.* 6*d.* net.

Baron Erland Nordenskiöld's "Comparative Ethnographical Studies" have confirmed rather than won for him a standing as the foremost authority in the study of the Indians of Central and South America. His latest volume in the series has an added value in that it is a much desired contribution to the study of the 'diffusion' question, which relies upon an examination of detail and not upon generalised conclusions. Incidentally and as a matter of secondary interest, several sections might serve as demonstrations of the method of technological study.

Indian culture is here treated in various aspects. The first section deals with Indian invention and discovery in the pre-Columbian period, one of the most significant points being an apparent readiness to experiment in the utilisation of natural products. In a lengthy list of such discoveries, maize, the sweet potato, manioc, tobacco, coca, and cocoa are the most familiar. Perhaps the most remarkable and significant invention, however, is that of bronze, which, the author maintains, must be regarded as an element independent of the Old World. This, however, is one only of a number of inventions which the author concludes must have arisen independently in the New and the Old Worlds. In this connexion and in view of the discussion which has taken place on the origin of the Maya civilisation, it is remarkable that the Maya calendar and system of writing have no exact parallels elsewhere.

As a whole, this volume is a valuable contribution to the study of a difficult problem. It is only by such detailed studies as this that we are likely to arrive at the truth. It serves to demonstrate that only a most exact comparison of detail can afford a sound basis of argument. Generalised statements may appear to afford support for theory, but too often it vanishes when a more exacting search is made for correspondence in detail.

(1) *Science and Mathematical Tables: for Use in Schools.* Arranged by W. F. F. Shearcroft and Denham Larrett. Pp. vi + 33. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 1*s.*

(2) *Cambridge Five-Figure Tables.* By F. G. Hall and E. K. Rideal. Pp. viii + 76. (Cambridge: At the University Press, 1929.) 3*s.* 6*d.*

(3) *Seven Place Natural Trigonometrical Functions: together with many Miscellaneous Tables and Appendices on the Adjustment of the Engineer's Transit and Level, Area Computation, Vertical Curves, Simple Curves, and Determination of Latitude, Longitude, and Azimuth.* By Howard Chapin Ives. Pp. v + 222. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 12*s.* 6*d.* net.

(1) This is a clearly printed set of four-figure tables of logarithms, antilogarithms, natural and logarithmic sines, cosines and tangents, together with some formulæ and physical constants.

(2) The main contents are logarithms of numbers from 1,000 to 9,999, natural and logarithmic sines and tangents for each minute of arc. The tables are arranged on a novel and interesting principle. The arguments are in descending order of magnitude, so that each tabular entry is greater than the following one. This arrangement facilitates the formation of differences, since the numbers are in the most suitable position for subtraction. The type is very clear and well spaced.

(3) These seven place tables give six natural trigonometric functions for each minute of arc,

versed sines, external secants, chords, circular arcs, and miscellaneous tables, formulæ and appendices of interest mainly to surveyors and railway engineers. It is rather difficult to see any reason for tabulating external secants ($\sec x - 1$) in a book which already contains a table of secants. No differences are given, and this, together with the closeness of the printing, makes the tables somewhat difficult to use. L. M. M.-T.

Field Book of Marine Fishes of the Atlantic Coast from Labrador to Texas ; being a Short Description of their Characteristics and Habits, with Keys for their Identification. By Charles M. Breder, jr. (Putnam's Nature Field Books.) Pp. xxxviii + 332 + 16 plates. (New York and London: G. P. Putnam's Sons, 1929.) 15*s.* net.

THIS little volume, more or less of pocket size, is designed primarily to meet the needs of the amateur outdoor naturalist, its main purpose being to enable a worker with the minimum of technical knowledge quickly and easily to identify any species of fish likely to be found in the area treated. The author therefore begins by defining what is meant by the term fish, and describes briefly their general manner of life. A short chapter is devoted to descriptions of the various types of environment included in the region under survey, which extends from the cold boreal waters of Labrador through the temperate seas of the Atlantic seaboard of America down to the warm tropical waters of the Gulf of Mexico. An offshore limit has been set at the twenty-five fathom line, and the brackish water zone marks the shoreward limit up streams and estuaries. The greater part of the book is devoted to analytical keys and descriptive matter. Keys are given to enable the worker to place his fish successively in its correct order, family, genus, and species. Further to facilitate identification, an outline drawing of nearly every species is given, with an appended short note on its range, habits, relative abundance, and average adult size.

There is a fairly comprehensive glossary of technical terms and a short bibliography.

Leçons sur la théorie des tourbillons. Par Prof. Henri Villat. (Institut de mécanique des fluides de l'Université de France.) Pp. v + 300. (Paris: Gauthier-Villars et Cie, 1930.) 65 francs.

PROF. VILLAT'S treatment of vortex motion has both the virtues and defects which are usually found in French treatises on mathematical physics. The mathematical treatment is clear and logical, and presented in an attractive style. On the other hand, although the lectures on which the book is based were delivered at an institute founded by the Ministry of Air, we have scarcely any reference to experimental data. There is one oasis in the desert of mathematical symbols (p. 80), where we read that a cylinder moving in liquid is really found, in certain circumstances, to set up two series of vortices closely conforming to those calculated by Bénard. With this exception, the book suggests that the author cares much for mathematical analysis and little, if at all, for real fluids. However, if we accept his point of view, there can be no question as to the quality of the work. After an exposition of the classical results, we have a good account of more recent work, in particular that of Bénard, Synge, Rosenhead, Caldonazzo, Riabouchinsky, and Lichtenstein. The last chapter uses Oseen's integral equation to discuss vortices in a viscous fluid.

H. T. H. P.

Opera. By Richard Capell. Pp. 80. *Libraries and Museums.* By Sir Frederic Kenyon. Pp. 79. *Banking.* By W. W. Paine. Pp. 80. (Benn's Sixpenny Library, Nos. 99, 100, and 108.) (London: Ernest Benn, Ltd., 1930.) 6*d.* each.

THE provision of inexpensive 'libraries' is not a new feature in England. Prof. Henry Morley long years ago edited a 9*d.* library of classical literature and a 3*d.* library of general literature ; in each case the volumes issued were standard works, mostly of earlier date than the nineteenth century. The present library proceeds upon a different basis, seeking individual authors to deal with some special subject. Mr. Capell in "Opera" has an interesting theme, which in the earlier portion of the book is overloaded by a flamboyant style of writing which detracts from the pleasure that a reader may experience. Sir Frederic Kenyon's remarks upon libraries and museums are well worthy of attention, and his rapid survey of the centuries is alluring. But he is mistaken in stating that Merton College Library, Oxford, is a fifteenth century building, as it is fourteenth century. Perhaps Mr. Paine's "Banking" is the most engaging of the books under notice ; his treatment is masterly in its presentation—in a manner truly captivating—of what might easily prove dry-as-dust to the lay public. P. L. M.

Horological Hints and Helps. By F. W. Britten. (Lockwood's Manuals.) Pp. xi + 327. (London: Crosby Lockwood and Son, 1930.) 7*s.* 6*d.* net.

THIS volume is addressed more to the young practitioner than to the novice, as it assumes a certain minimum of actual acquaintanceship with horology, in the absence of which the book would prove difficult to follow. That the author is proud of being his father's son is made pleasantly clear from the reference on the title page. After dealing at sufficient length with general horological work, the remaining pages are distributed between watches and clocks. That Mr. Britten understands his subject from the dial plate and hands down to the very least screw is abundantly evident, but the book is entirely lacking in any graces of literary style. It may be granted that knowledge is the quality to be preferred, but a work of art exhibits something more than mere technique ; in truth, the latter is better shown by concealment. There are numerous diagrams, and these would have been better had some idea of limiting dimensions been given, or had the amount of magnification been stated. It would be difficult to select any one part of the book as being more valuable than any other, where all is so practical and masterly. P. L. M.

Letters to the Editor.

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

Stark Effect in the Ultra-violet Spectrum of Neon.

THE ultra-violet spectrum of neon consists of the lines belonging to the principal series of the arc spectrum and the lines of singly and doubly ionised neon. To obtain the Stark effect for these lines it is essential to increase the field strength for the lower members and the intensity for the higher members. The spectrograph used was the Steinheil Q.D. type. The field stength was determined from helium lines.

It was found that sixty lines of the principal series are affected, and these practically include the most important lines. As an illustration, the accompanying photographs are reproduced (Fig. 1). Most of these lines are deflected toward the negative side, but six of them are deflected toward the positive. Some of the higher members accompany the *sd* combination lines, which in turn are slightly deflected in the same direction as the associated principal series lines. It is remarkable how these *sd* combination lines appear. As the figure illustrates, the *sp* lines lose their intensities almost abruptly at about the same field strength as the *sd* lines appear, so that they can be recognised only with caution. The discontinuity of the intensity (that is, *sp-sd*) shifts toward the upper part of the

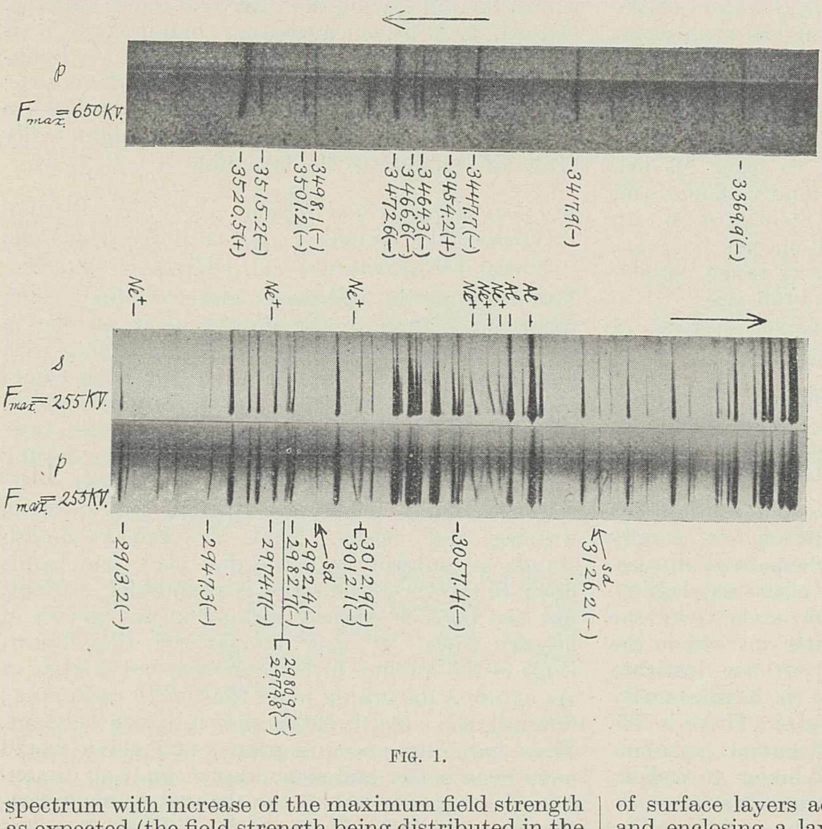


FIG. 1.

spectrum with increase of the maximum field strength as expected (the field strength being distributed in the same spectral length, the point corresponding to the same field strength would shift toward the upper part as the maximum field is increased). Another remarkable feature is that Pashen's $1s_2 - mp_1$ series suffers a change of sign (in the electrical deflection) at $1s_2 - 4p_1$ and then regains the original positive sign as m increases (for $1s_2 - 2p_1$, +).

As regards the spectrum of ionised neon, it is a peculiar fact that the affected lines are very weak in intensity at low electric fields, and disappear altogether in high fields, the optimum field being in the interval of 120-250 k.v. per cm. The presence of helium tends to reduce the intensity of the ionised neon in general, but with these affected lines it is very decidedly so, for with helium they totally disappear. These lines are deflected to the positive side, and most of them accompany combination lines at the more refrangible side, the deflections of which are negative, the magnitude being nearly as large as that of the associated lines. All the affected lines are grouped in the range λλ2915-3123. The non-combination lines were recorded by Bloch [1] but were not investigated by the Bruin [2] system. The lines considered by Bruin are scarcely affected and they, too, disappear in high fields. The effect on the doubly ionised neon is uncertain at present.

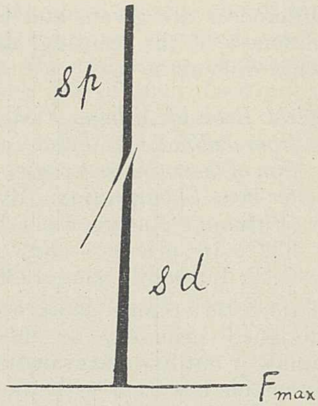


FIG. 2.

Both groups of the affected lines are only slightly polarised. Details will be published in the Scientific Papers of this Institute.

YOSHIO ISHIDA.

Institute of Physical and Chemical Research,
Tokyo, Japan.

[1] L. Bloch, E. Bloch, and G. Déjardin: *Comptes rendus*, vol. 180, No. 10, p. 131; 1925.

[2] T. L. de Bruin: *Zeit. f. Phys.*, vol. 46, p. 856; 1928.

Stability in Soap Films.

SOAP films exhibit a stability (permanence and mechanical strength) which is without parallel in films of water or other pure liquids which contract almost instantaneously to spherical droplets under the influence of surface tension. In a letter to NATURE of May 31, p. 815, Mr. Green attributes this stability to "stratifications . . . almost certainly pervading the whole film". This conclusion is directly opposed to the view, now widely held, that soap films have a 'sandwich' structure, as I have called it (*J. Phys. Chem.*, **34**, 263; 1930); that is, that they consist of a pair of surface layers adsorbed at the liquid/air interface and enclosing a layer of liquid, identical in composition with the channel of liquid around the boundary of the film and its rigid support (often called the Gibbs' ring) and with the solution from which the film was made. In reply to Mr. Green's contentions, there is no evidence that soap films have greater stability than is to be expected from the sandwich structure. There is no reason to suppose that any degree of strength would result from the structure suggested by him, nor that such a structure exists except in abnormal and rare cases. The evidence for these opinions is as follows :

1. The number of bimolecular stratifications—of molecules of molecular weight 300 and occupying an area of 20 A.U. sq.—which could be formed in a film 1000 $\mu\mu$ thick of 5 per cent soap solution is only 10. That is, the stratifications would be some 100 $\mu\mu$ apart. It is useless to postulate " powerful but labile forces " to act over these distances ; and the figures show that *no close-packed arrangement of molecules in the interior of a soap film can account for enhanced mechanical strength.* In any event, the thinning of a film which had such a structure would seem to require the destruction of the structure which is being suggested as essential for its continued existence ! The conclusion that " the disruptive action of surface tension is overpowered by structural cohesiveness " takes no account of the origin of surface tension and its mechanism. Disruption occurs under its influence when soap molecules are being pulled (by molecular attraction) from the surface layer into the interior at a faster rate than they can be replaced.

I explain the checking of this disruptive tendency of surface tension by :

(*a*) The lateral cohesion of the oriented molecules of the surface layers of the ' sandwich '.

(*b*) The presence of a reserve of adsorbed solute just beneath the surface layer and ready to fill any vacant places in it.

It is obvious that the " powerful but labile " forces postulated by Mr. Green as acting between his stratifications must be an inward pull on the surface layer additional to surface tension, and therefore a serious source of weakness and not of stability at all.

2. *There is no evidence that stratification of the interior of a soap film is of general occurrence.* The term ' stratification ' when applied to soap films has a definite significance (see Perrin, *Annales de Phys.* (9), **10,** 165 ; 1918. P. V. Wells, loc. cit. (9), **16,** 79 ; 1921. Also Lawrence, " Soap Films ", p. 58 ; 1929). The sharp boundaries of coloured bubbles cannot be interpreted in this way, since the steps-up in thickness are from 12 to 20 times that of the bimolecular layer. The suggestion that these discontinuities result from aggregation of the molecules under the perfectly quiet experimental conditions ignores the fact that such conditions do not mean a cessation of the kinetic motions of the molecules in question. It is more likely that these boundaries are due to colloidal soap threads which may well be responsible also for the persistence of inequalities of thickness, since their long flexible form will enable them to act as boundaries retarding free mixing.

3. *Stratification of soap films containing a fluorescent substance is the formation of a new phase.* We have no right to regard the interior of the soap film as in any way different from the solution of which it was once a part, *unless some definite change can be shown to have occurred.* No attempt has been made to explain the mechanism of stratification. As we have already seen, a film 1000 $\mu\mu$ thick of 5 per cent soap solution can only yield 10 bimolecular layers ; hence the maximum thickness of the resultant stratified film from one of this thickness should be 42 $\mu\mu$ (or less). Actually, however, brightly coloured stratifications will be observed 10 or more times as thick. The extra solute comes from the Gibbs' ring and its extrusion is clear (see frontispiece of " Soap Films "). It appears that, under the influence of light upon a soap film containing a fluorescent substance, molecules of soap separate at the face nearer to the source of illumination ; these then link up with the surface layer of molecules, already oriented there, to form a bimolecular layer, the molecules being associated by their carboxyl extremities and therefore no longer soluble nor surface-active. Fresh solute will therefore be adsorbed, but only to be transformed in turn until the supply from the Gibbs' ring is exhausted. The process is quite similar to the formation of Grandjean's terraces of liquid crystalline substances on an initially oriented layer of molecules. I have not the space to go further into the matter—how, for example, the fluorescein can bring about this change—but there is no doubt that we are dealing with the formation of a new phase. It is, in fact, a crystallisation. I may add that a completely stratified film of the sort discovered by Perrin, in which the stratifications are close together and not separated by large distances as Mr. Green's hypothetical ones are, has a mechanical strength apparently vastly inferior to that of a liquid film.

This explanation of the rôle of the Gibbs' ring, coupled with the fact that all the stratified films hitherto studied have been very small ones, shows that Mr. Green's suggestion that the ' stratifications ' in large bubbles are due to the absence of disturbance from the Gibbs' ring is another argument against their being true stratifications at all.

4. There is the final possibility of the occurrence of flakes in colloidal solution so that their presence in a soap film would not involve the formation of a new phase. This, however, seems quite remote, since the characteristic form of the colloid particle in all soap solutions is the long thread ; possibly the zigzag form and absence of radial symmetry of the molecule chain is the reason why colloidal lamellæ do not exist. On the other hand, where soap separates from molecular dispersion by association of the carboxyl groups, the resultant form is always lamellar (Darke, McBain, and Salmon, *Proc. Roy. Soc.*, A, **98,** 395 ; 1921. Also Lawrence, *Koll. Zeit.*, **50,** 12 ; 1930). It is clear then that the *ordinary soap solution contains no stratifications and that they only appear as a new phase.*

I have no space to discuss blackening as the formation of a new phase, but I hope to deal with this and the whole question of the thinning of coloured films and to give an explanation of the hitherto inexplicable sharpness of the black boundary in a future publication.

A. S. C. LAWRENCE.

Laboratory of Physical Chemistry,
Cambridge, June 8.

The Striated Discharge.

IT is well known that the striation separation in the electrical discharge in gases varies with the radius of the discharge tube and the pressure of the gas. The exact relation between these factors was first investigated by Wehner (*Ann. der Phys.*, **32,** p. 49 ; 1910), who gave as a result of experiments with hydrogen and nitrogen the relation

$$S = C . \frac{r^{1-m}}{P^m}$$

where S is the striation separation in mm., r the radius of the tube in mm., and P the pressure of the gas in mm. of mercury. C was a constant for both gases with a value of approximately 2, and m a constant which varied with the nature of the gas. For hydrogen, $m = 0{\cdot}53$, and for nitrogen, $m = 0{\cdot}32$. Further experiments were carried out by Neubert (*Ann. der Phys.*, **42,** p. 1454 ; 1913), in which he used hydrogen free from any impurities and found the same law to hold.

The results of a series of experiments by us on the same topic, using different gases, have led to a modified form of the Wehner-Goldstein law. In these experiments a set of five discharge tubes was arranged so that the tubes were all connected in series. Each tube had plane aluminium electrodes nearly filling the cross-section of the tube. The internal radii were approximately 1·4, 2·6, 4·0, 5·3, and 6·5 cm. respectively, and the tubes were all about 78 cm. long. The current density was kept the same in each tube

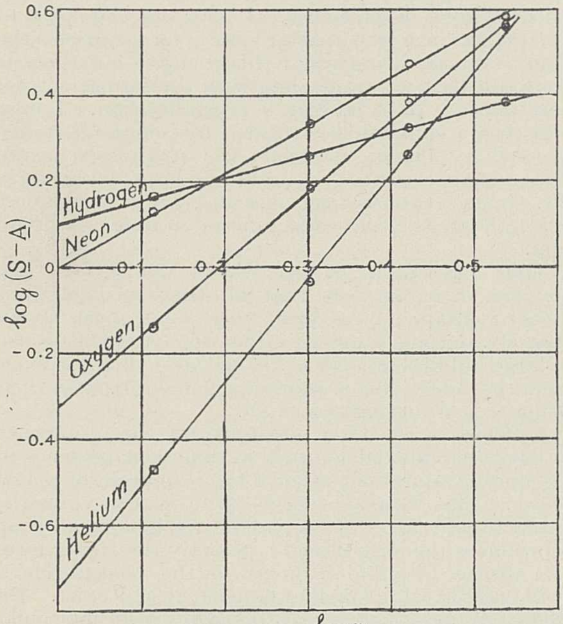


FIG. 1.

and the pressure adjusted until steady striations could be obtained in at least four of the tubes. An Evershed and Vignolles direct current generator was used as a source of current. The gases were pure except for contamination with mercury vapour from the McLeod gauge and from the mercury diffusion pump which was used to exhaust the system. The five tubes were then all filled with the same gas at the same pressure. The results of experiments with hydrogen, oxygen, helium, and neon indicate that the law for the variation of striation separation with the radius of the tube is given by

$$S = A + C \cdot r^n$$

where A and C are arbitrary constants depending upon the nature of the gas. A typical set of results for these gases is shown in the accompanying diagram (Fig. 1), where log $(S - A)$ is plotted as ordinates and log r as abscissæ. The value of the pressure P was constant but different for each gas. For hydrogen A is zero, thus agreeing with Neubert's result. The values of n and C appear also to depend upon the amount of mercury vapour present. The current density in each case was 0·28 milliamp./cm.^{2}, and the equations giving striation separation for each gas for the pressures used are given in the following table:

Gas.	Pressure in mm. Mercury.	Striation Separation S in Terms of Radius of Tube r in mm.
Hydrogen . .	0·21	$s = 1{\cdot}26\, r^{0{\cdot}52}$
Neon . .	0·16	$s = 0{\cdot}95 + 1{\cdot}1\, r^{1{\cdot}1}$
Oxygen . .	0·07	$s = 1{\cdot}2 + 0{\cdot}48\, r^{1{\cdot}8}$
Helium . .	0·51	$s = 1{\cdot}6 + 0{\cdot}18\, r^{2{\cdot}3}$

An interesting investigation by Prof. John Zeleny on the variation of striation separation with pressure has just appeared in the *Journal of the Franklin Institute* for May. In our experiments the pressure was kept constant, but the same law appears to hold for different pressures. For example, in the case of helium the equations for the different pressures were found to be as follows:

Pressure in mm. of Mercury.	Striation Separation in mm.
0·38	$s = 1{\cdot}5 + 0{\cdot}55\, r^{1{\cdot}5}$
0·53	$s = 1{\cdot}6 + 0{\cdot}64\, r^{1{\cdot}5}$
0·67	$s = 1{\cdot}4 + 0{\cdot}23\, r^{2{\cdot}3}$

A full account of this investigation will appear later, and further experiments will be done with tubes free from mercury vapour.

D. A. KEYS.
J. F. HEARD.

Macdonald Physics Laboratory,
McGill University, May 10.

Mortality amongst Plants and its Bearing on Natural Selection.

THE interest for the theory of natural selection of the researches on the mortality of seedlings reported by Dr. E. J. Salisbury (NATURE, May 31) is so great, as is, in all its aspects, the development of a quantitative ecological technique, that it seems important not to allow the interpretation of the new observational material to be prejudiced by the use of an argument which contains a concealed fallacy. This argument could not be more briefly stated than in Dr. Salisbury's words, "The mortality and therefore the operation of natural selection is almost entirely confined to the juvenile stages of development".

It may be recalled that this same argument was used by Wallace as a reason for rejecting the application of the theory of sexual selection to butterflies ("Darwinism", p. 296): "In butterflies the weeding out by natural selection takes place to an enormous extent in the egg, larva, and pupa states; and perhaps not more than one in a hundred of the eggs laid produces a perfect insect which lives to breed. Here, then, the impotence of female selection, if it exists, must be complete." Wallace, however, did not apply this argument to a second case to which evidently it is equally applicable, for he has no hesitation in advocating the development of *protective* coloration by the natural selection of adult butterflies (*ibid.*, p. 207).

I believe the most useful step in examining the nature of this fallacy is to realise that, when mortality is heavy, immature forms of different ages are not of equal value, in the purely objective sense that they will not be equally represented in the ancestry of future generations. Knowing the rates of death and reproduction at all ages, it is possible to calculate the reproductive value, in this sense, at each age, and the course of this function for ages prior to the commencement of reproduction, is, in a stationary population, easily seen to be inversely proportional to the number living at each age. If, therefore, starting from the seed, we have three stages of development, A, B, and C, to which 1 in 10, 1 in 100, and 1 in 1000 seeds actually attain, single individuals at these stages will be worth, in respect of their probable contribution to future generations, just 10, 100, and 1000 times respectively as much as the newly shed seed is worth. The selective elimination of certain individuals at stage C is for this reason as effective in modifying the genetic constitution of the species as the selective elimination of 10 times as many individuals at stage B, or of 100 times as many at stage A, or of 1000 seeds in their initial condition.

The concept of reproductive value seems to provide a powerful method of resolving many of the paradoxes which have arisen in Darwinian discussions. It is easy by its means to show in what circumstances, and for what reasons, such widespread assumptions as that the death-rate is a more important selective agency than the birth-rate ; or that selection is most intense at times when the death-rate is highest may be in fact very far from true. The prospect of determining the vital statistics of wild populations, with sufficient accuracy to establish the relative values of different stages of development, is one of the most attractive features of the quantitative method in these fields. R. A. FISHER.

Rothamsted Experimental Station,
Harpenden, Herts,
June 2.

THE interesting and valuable letter of Prof. Salisbury on the subject of "Mortality amongst Plants and its Bearing on Natural Selection", which appeared in NATURE of May 31, cannot be allowed to pass without comment, as the issues which it raises are fundamental. Prof. Salisbury finds that amongst plants it is in the seedling stage that the unfit are eliminated and that there is no evidence that little peculiarities of form which are manifested only in the adult condition have any bearing on survival at all. What determines the survival of a seedling is its *vigour of growth*, not peculiarities of its morphology. Prof. Salisbury does not touch on the causes of these differences in vigour, and doubtless in every particular case a special investigation would be required to determine them.

My purpose in writing this letter is to direct attention to the fact that similar differences in vigour are to be seen in the eggs of animals and that some light has been thrown on the causes of these differences.

In a recent paper ("General Physiology of Development of Simple Ascidians", *Phil. Trans. Roy. Soc.*, Series B, vol. 218, 1930), Mr. N. J. Berrill, lecturer in comparative physiology in McGill University, describes *inter alia* his investigations into the causes of the differences of vigour among ascidian tadpoles. He finds that these are referable to the length of time that the eggs remain in the oviduct and the toxicity of the oveducal fluid.

Thus natural selection only weeds out the feeble and diseased and by no stretch of the imagination can be regarded as capable of giving rise to anything new.

In conclusion, I may mention a typical experience which we ourselves have experienced in the zoological laboratory of the Imperial College of Science this year. On two occasions we have had sent to us from Plymouth living *Echinus miliaris*. On both occasions the animals arrived alive, and males with active sperm and females with ripe eggs were found among them. On the second occasion we received the specimens within fifteen hours of their leaving Plymouth, and from them we have raised three vigorous cultures of exceptionally healthy larvæ. On the first occasion, however, through an error on the part of the G.W.R. officials, thirty-six hours elapsed before the specimens reached us. The eggs, though apparently normal, reacted feebly to fertilisation and admitted numerous spermatozoa, with the result that the vast majority had cytolysed by next morning. A few apparently normal larvæ were produced, but these all died off in about a week for no obvious reason but feebleness of constitution. E. W. MACBRIDE.

43 Elm Park Gardens,
Chelsea, London, S.W., June 6.

The Thermo-Electric Properties of Ferromagnetics.

IT has long been known that there are peculiarities in the thermo-electric power curves of the ferromagnetic metals. Fairly recently Dorfman, Jaanus, and Kikoin (*Zeits. für Phys.*, 54, 277 ; 1929) have measured carefully the thermo-electric power of nickel against platinum over a range of temperatures in the neighbourhood of the Curie point of nickel. The variation is such as to indicate a fairly sudden change in the 'specific heat of electricity' for nickel at the Curie point. The magnitude of the change in the specific heat per electron, ΔC_e, is of the same order as the change in the specific heat per atom, ΔC_a, determined in the usual way. From this point it was concluded that the magnetic 'carriers' could be identified with the conduction electrons, although this does not fit in with other evidence.

For some time I have suspected that the sign of ΔC_e was given incorrectly, but the trickiness of signs is such that I have felt doubtful about my own conclusions. I have, however, recently had a letter from Dr. Dorfman (dated May 16) in which he tells me that a mistake was made in his paper. The magnitude of ΔC_e was given correctly, but the signs of ΔC_a and ΔC_e are opposite. This renders the previous conclusions untenable. So far as I know no explanation has been given of the modified result, of which I would like to suggest a tentative interpretation.

For approximate purposes, the specific heat of electricity per electron, C_e, may be defined as the change in specific heat of the metal due to the addition of one electron. The suggestion I wish to put forward is that the relation of the change in C_e in passing through the Curie point to the change in the atomic heat, C_a, depends on the number of electrons required per atom to convert the substance from a ferromagnetic to a non-ferromagnetic state, in which there is no additional 'magnetic' specific heat. If one electron per atom is required, ΔC_e should be equal and opposite to ΔC_a. More generally, if n electrons are necessary, the relation would be

$$n\,\Delta C_e = -\Delta C_a.$$

Dorfman's results give for n the value 0·78 for nickel. If the nickel atoms were converted into copper-like ions, the assembly would be non-ferromagnetic. The result suggests, in agreement with other evidence, that less than one electron per atom is required to produce a non-ferromagnetic state. Moreover, if this interpretation is on the right lines, it indicates that the ferromagnetic properties of nickel are to be traced to a deficiency of electrons from complete groups rather than to an excess of electrons.

This brief outline will probably be sufficient to indicate the general nature of the suggested interpretation of Dorfman's experimental results.

EDMUND C. STONER.

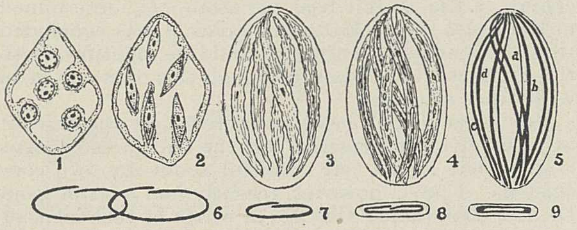
Physics Department,
University of Leeds,
May 26.

Multiple Spermatozoa and the Chromosome Hypothesis of Heredity.

IN 1928 I published (*Annals of the Natal Museum*, vol. 6, pt. 1) a short account of some observations indicating the production of more than one spermatozoon from a spermatid in the case of two Natal spiders, *Evarcha natalensis* and *Saitis leighi*. The conclusions then arrived at have now been confirmed by a more detailed examination of the spermiogenesis of an unnamed species of *Evarcha*.

The facts would seem to have considerable interest in their bearing on the hypothesis that hereditary characters are transmitted by specific particles of chromatin incorporated in the chromosomes at definite sites.

Very briefly to summarise the observations, we have, in the accompanying figure, 1, lobule of spermatids; 2, nuclei enlarge into spindle-shaped bodies; 3, spindles elongate into weakly basophil cords with sinuous outlines and showing the vanishing karyosome; 4, spermatic cords or straps become vacuolated in a longitudinal line and ultimately divide into two; 5, the members of each pair of cords condense into threads of intensely basophil chromatin; 6, a



pair of threads separating from each other and becoming spirally curved; 7, shrinkage of spermatozoon; 8, 9, formation of capsule. Thus, a lobule produces about twice as many spermatozoa as spermatids.

The longitudinal splitting of the cords is far from being a regular process; sometimes it is not in the mid-axis, and one member of the pair (5) is thin (*a*) and the other thick (*b*), while at other times the two members may be more or less similar to each other (*c*, *d*). In this connexion it must be added that in the genus *Saitis* there is a strong evidence that three, or even more, spermatic threads may arise from a single spermatic strap. All the chromatin threads, whether relatively thick or thin, appear to form perfectly normal spermatozoa.

From the very exacting nature of the chromosome hypothesis, with the enigmatical genes arranged in serial order along the chromosomes, it would seem to be essential that the spermatic cords should split with mathematical accuracy into identical halves, but the processes outlined above are altogether inconsistent with any great precision in the subdivision of the chromatin substance in the formation of the spermatozoa.

A detailed account of the observations will be published shortly, and in the meantime, granting their validity, it would be very interesting to hear how it is proposed to reconcile them with the current chromosome hypothesis of heredity.

ERNEST WARREN.
Natal Museum, Pietermaritzburg.

Silicon Transformer Steel Residue.

IN his book "Applied X-Rays" Dr. G. L. Clark publishes some very interesting photographs showing the connexion between the magnetic hysteresis loss and the grain size of 4 per cent silicon steels. He takes the grain size to be inversely proportional to the number of spots produced under given conditions on a Laue photograph, and quotes a formula connecting this number with the magnetic hysteresis loss of the steel. The fewer the Laue spots, the less is the hysteresis loss.

Dr. G. Shearer, Mr. C. Wainwright, and myself some time ago obtained Laue photographs of samples of 4 per cent silicon transformer steels of different hysteresis loss which showed little difference in the number of diffraction spots, and what difference was to be observed tended to be contradictory to the above generalisation. Further, no appreciable trace of orientation, which might have accounted for the anomaly, was found.

Whilst the grain size must always be large for a steel of small hysteresis loss, it would appear that for closer comparison of magnetic value the straightforward interpretation of the Laue photographs can be misleading, and that other factors must be involved.

Such a factor is suggested by the following preliminary account of an observation made in the course of a recent X-ray study of steel residues, obtained by the method of Arnold and Read, in which the iron is removed by electrolytic dissolution. The residues of six samples of silicon transformer steels, which, examined by the Clark method, gave anomalous indications of hysteresis loss, were investigated. Three of these steels were good in that their hysteresis losses, measured at a maximum flux density of 10,000 lines per sq. cm. were only 1·19, 1·16, and 1·19 watts per kilogram respectively. The other three were relatively bad with hysteresis losses of 1·78, 1·90, and 2·28 watts per kilogram respectively. It was found that the residues of the bad steels gave a spectrum which was purely that of cementite, Fe_3C. On the other hand, two of the good steel residues were amorphous, showing no diffraction pattern whatsoever, and the third gave only a few weak lines of some substance which was not cementite.

It is suggested, then, that a difference like this will correspond to a difference in the value of the steel. I have already shown that the state of subdivision of the carbide residues of steels is generally the same as the state of subdivision of the carbides when in the steel itself, so that the differences in aggregation of the particles observed by means of the X-ray photographs of the silicon steel residues will correspond to similar differences among the carbides whilst in the steel. It is hoped soon to pursue the matter further.

W. A. WOOD.
Physics Department,
National Physical Laboratory,
Teddington, May 29.

Transmission of Potato Leaf-Roll.

IN the course of experiments on potato leaf-roll in progress at this College, proof has been found that *Myzus circumflexus* (Buckton) is an efficient transmitter of this disease. There is also some evidence that another aphis, *Macrosiphum gei* (Koch), can transmit leaf-roll feebly, but a definite opinion must await the completion of notes on the appearance of the progeny of infested plants.

Myzus circumflexus, with us, has proved to be almost as reliable a transmitter as *Myzus persicæ* (Sulz), but there is a curious lag in the development of symptoms when the former aphis is used, so that plants infected with leaf-roll by means of *M. circumflexus* will still be in the 'primary' stage when those infected by *M. persicæ* show rolling in lower as well as upper leaves. Apart from the difference in the rate at which symptoms develop in infected plants, there is little to choose between the two species in their efficiency as transmitters.

The discovery is of interest in several directions. It corrects the growing tendency amongst plant-virus workers to regard the relation of *M. persicæ* to leaf-roll transmission as specific and unique. At the same time, the difference in the response of a plant according to the species of aphis by which the inoculum is carried will tend to concentrate attention on the precise rôle played by the insect in virus transmission. I have been unable to find any record of the occurrence of *M. circumflexus* on field potatoes in this country, so that, even if it does occasionally visit the potato crop it is unlikely to be of much importance as a field transmitter of virus diseases in most seasons and most localities. On the other hand, it has been recorded on *Hordeum*, *Avena*, and *Trifolium pratense* under field conditions, and this fact should be taken into account by workers who are attempting to maintain healthy stocks of potatoes in the field by isolating them in cereal crops or by intervening meadow land. Theobald found it in great abundance out of doors in May, and quotes Laing as saying that the species breeds quite readily outdoor in mid-summer. Under glass-house conditions it feeds voraciously on potato—whether sprouts, stem or leaves, and, with us, it has proved more prolific than either *M. persicæ* or *Macrosiphum gei* on potato.

Those facts and the ease with which the apterous viviparous female can be distinguished from other potato-feeding aphides make it a valuable species with which to work on virus transmission. Most of my work with aphis vectors has been carried out during the winter and spring months, and it is conceivable that summer generations of some species of aphides might vary in the efficiency with which they will transmit virus diseases. May not this be a partial explanation of the negative results recorded by some workers when using species other than *M. persicæ* ?

T. WHITEHEAD.

University College of North Wales,
Bangor, June 16.

A Relation between the Continuous and the Many-Lined Spectra of Hydrogen.

RECENT investigations on the continuous and the many-lined spectra of hydrogen seem to show that there is some relation between the origin of the continuous spectrum and the electronic states of the term systems of the spectra of the hydrogen molecule. We have often observed in our experiments that although the intensity of the continuous spectrum seems quite independent of the intensity of the atomic lines, certain band groups of the many-lined spectrum in the whole region of the visible are often strong when the continuous spectrum is intense. In an ordinary discharge tube, for example, this continuous spectrum is produced with strong intensity at high pressure (5-8 cm. of mercury), and is accompanied by the band groups of the triplet system of the hydrogen molecule in greater intensity than the other many-lined spectrum. According to our observations, most of them are classified as the transitions $2\,^3\Sigma - 3\,^3\Pi$, (Fulcher bands) and $2\,^3\Sigma - 4\,^3\Pi$.

According to the interpretation of J. G. Winans and R. C. G. Stueckelberg (*Proc. Nat. Acad. Sci.*, **14**, 867 ; 1928), this continuous spectrum originates in the transition from any one of the excited triplet levels to the unquantised ground state ($1\,^3\Sigma$) of this system. Thus the above experimental fact suggests one relation between the continuous spectrum and the many-lined spectrum of hydrogen and seems to favour the view of Winans and Stueckelberg. After further experiments the results will be published elsewhere in detail.

Y. HUKUMOTO.

The Physical Institute,
Imperial University, Sendai,
Japan, May 3.

Siliceous Shells of Protozoa.

IT is of course well known that some Protozoa (as Radiolaria and Heliozoa) have the hard parts siliceous, while others (as Foraminifera) have them calcareous. Sponges show analogous groups. In 1911,[1] when discussing the freshwater genus *Quadrulella* (Rhizopoda), I remarked : " In his recently published (1911) paper on the Rhizopods of the British Antarctic Expedition, Penard calls attention to the curious fact that while the square plates of *Q. symmetrica* are siliceous, those of *Q. irregularis* (Archer) are calcareous, and will dissolve in hot concentrated sulphuric acid. He therefore inclines to agree with Awerinzew that the two animals are really generically distinct, and represent a case of convergent evolution." There has just been published a very interesting paper by Heron-Allen and Earland [2] in which they describe a new genus (*Miliammina*) of Foraminifera with a siliceous test, represented by five species in the Antarctic. But, in 1914, Chapman dealt with one of these species, calling it a new variety *arenacea* of the northern *Miliolina oblonga* (Montagu). The new form is said to be a siliceous 'isomorph' of the porcellanous *M. oblonga*. The question naturally arises, whether in such cases we do have 'convergent evolution', as I postulated in 1911, or divergent evolution, the form of the shell being ancestral, the material of it changed. Heron-Allen and Earland are a little ambiguous about the type species of their new genus. I now formally designate as such *Miliammina arenacea* (Chapman), which they, for no apparent reason, call *M. oblonga* (Chapman).

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado, May 17.

[1] *University of Colorado*, **8**, No. 4, p. 240.
[2] *Jour. Royal Microscopical Society*, March 1930, p. 38 *et seq.*

Slug or Horned Viper ?

THE earliest example of the animal which is shown in Prof. T. D. A. Cockerell's letter in NATURE of May 17 proves that it is a snake and not a slug.

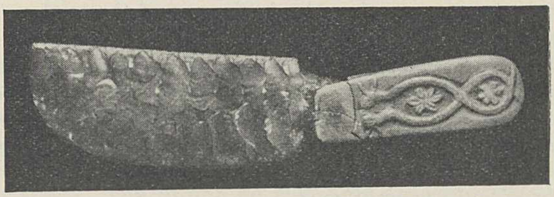


FIG. 1.

The chronological evidence is of importance, for Prof. Cockerell's example dates only to about 1400 B.C., while the ivory carving is predynastic, that is, before 3000 B.C.

M. A. MURRAY.

University College,
Gower Street, London, W.C.1.

The Diffraction of X-rays by Vitreous Solids and its Bearing on their Constitution.

I WAS interested to see the statement, by Messrs. J. T. Randall, H. P. Rooksby, and B. S. Cooper on the above subject in NATURE of Mar. 22, p. 458, that silica glass corresponds to either cristobalite or tridymite crystallites of average size $1\cdot5 - 2\cdot0 \times 10^{-7}$ cm. This confirms the theory of the formation of glass I published in the *Transactions of the Society of Glass Technology* in 1919 (vol. 3, p. 282). I pointed out then that glass is not a super cooled liquid, such as phenol, which becomes solid on the addition of a small crystal of that substance, but is a solid colloid consisting of amicroscopic crystals, the formation of which is due to the high viscosity and degree of aggregation of the components in the fused state.

S. C. BRADFORD.

The Science Museum,
South Kensington,
London, S.W.7, May 15.

The 1851 Exhibition Commissioners and their Work.*

The 'Sixties, 'Seventies, and 'Eighties.

In the 'sixties, 'seventies, and 'eighties the Commissioners were occupied in promoting the usefulness of the 'Main Square' of the ground they had reserved for purposes concerned with science and art. Some of these may be noted as representing the breadth of view with which they regarded the trust committed to them.

The Exhibition of 1862, proposed and carried through by the Royal Society of Arts, occupied part of that southern section of the ground which was bought in 1867 by the Government and on which the Natural History Museum was built for the Trustees of the British Museum. To the north of that area the central portion of the ground was let to the Horticultural Society for a period of years. After that Society's occupation the galleries which the Commissioners had erected along the east and west sides were leased to the Government: that in the east, in 1879, for the India Museum—and that on the west, in 1882, for the Science Collections. From 1862 to 1871 the Commissioners co-operated with the public in providing a representative memorial to the Prince Consort in "a Hall forming a central point of union where men of Science and Art could meet . . ."—the Albert Hall. The Hall did not, in fact, establish itself to this effect. What we see to-day in part—and soon shall see in still larger part—is rather the fulfilment of the wish expressed at the time by Her Majesty Queen Victoria: "*That the establishments then already placed upon the Estate, as well as those that might be expected to come there, should be considered as a whole . . . forming the most lasting and worthy memorial of the Prince's untiring and unselfish exertions for the general good*".

In the period during which the Commissioners had unoccupied ground within their 'Main Square' they afforded facilities for many temporary measures for extending knowledge and for cultivating a desire for it. To cite a series of international exhibitions, there were: 1883, The Fisheries Exhibition; 1884, the Health Exhibition; 1885, the Inventions Exhibition, which included the permanent Science Collections mentioned above; 1886, The Colonial and Indian Exhibition, which included the permanent India Collections.

Of loan collections the most pregnant was the 1876 "Loan Collection of Scientific Instruments and Apparatus", which was opened by Queen Victoria. In 1882 they leased the Western Galleries to the Government for the Science Collections, consisting at first mainly of objects placed in that Loan Collection and either given for the permanent collection or left as long-term loans. This collection was reinforced in 1883 by the addition of the Patent Museum collections. The combination thus effected formed the nucleus of the Science Museum of to-day.

In 1879 the Commissioners had leased the Eastern Galleries to the Government for the India Collections.

In this period the Commissioners had granted long leases at nominal rents for institutions that they considered pertinent to their aims. To mention some of these: 1872, The Albert Hall; 1879, The City and Guilds Institute; 1882, The Royal College of Music; The Imperial Institute, opened by H.M. Queen Victoria in 1893. In 1876 they had offered to the Government to provide a site and £100,000 towards the cost of buildings connected with science and arts, and in particular for a Museum of Science. This offer was declined in 1879. In 1888 they submitted a further offer in this sense and they pointed out that progressive appropriations of sites on their estate increased the urgency of the Science Museum question. In 1890 the Government accepted this offer.

'Taking Stock' as at the end of the 'Eighties.

Let us take stock—moral and material—as at 1889. To the credit side we must place not merely the great achievements which are indicated in the foregoing paragraphs, but also—what the Commissioners themselves had kept constantly in view—the influence these had had, at long or short intervals, upon the development of public opinion and of official activity. The record of early results of this influence need not be detailed; it springs to the mind as one thinks of the several points of departure. From the remarkable intellectual and industrial success of the great adventure for which the original members of the Commission were recruited, Britain at home and abroad reaped a wonderful widening of vision as to its own powers and possibilities, together with a keen realisation of the activities and methods of its foreign neighbours. From the material success of the Exhibition, the Commissioners garnered *money* which they devoted to the promotion of aims in direct furtherance of the aims of the Exhibition itself. They found themselves, as it were, in a position with a wide outlook over a half-developed area. They determined to stabilise their position so that it could be held and used as a centre of influence for generations to come. They watched for good openings in the wide stretch of the interests of science, the arts, and the industries. Their material resources were but trifling in proportion to the possibilities of their indirect action. They could do effective work only by pointing to fertile areas for public activity, by illustrating methods of improvement, and by tempting the strong to put their backs into the work. They themselves could, to some extent, explore, but only in a very small way could they act as pioneers. They could point to illustrations of fertility which their exploration had disclosed or their pioneer work had proved. They must leave to others its development.

In their Sixth Report (1878) the Commissioners recall that their "surplus" (1852) was £186,000, and they show that between 1852 and 1878 they had contributed to public purposes sites, buildings, etc., to the value of nearly half a million. They state

* Continued from p. 932.

that the land in their possession or soon to fall in, would, if cleared, possess a market value as building land exceeding a million sterling. At the same time, however, they had considerable liabilities. To buy out the interest of the Government in the land purchased jointly, the Commissioners had to supplement their available funds by borrowing, in 1859, £120,000 at 4 per cent; then in 1860 they borrowed £50,000 in connexion with the development of the "Main Square". This debt was reduced or increased at intervals as the development of the estate proceeded and as the financial results of their temporary activities varied. In 1878 it was £155,000; in 1889, £134,000. (By 1891 it was reduced to £24,000.)

AIMS CARRIED FORWARD FROM THE 'EIGHTIES TO THE 'NINETIES.

Some items in the earlier records of the Commissioners bear directly on their activities in their second forty years. Thus, in June 1876, they received a memorial from the president and fellows of the Royal Society urging the establishment of a Museum of Science. The Commissioners themselves had submitted to the Treasury in the same month an offer of substantial co-operation in this project; but no effective progress ensued. As mentioned above, this offer had been declined in 1879.

Next the Commissioners were assailed by the cry 'Divide'—divide the possessions committed to their trust. In July 1877 they received a deputation of municipal representatives from provincial boroughs in England and Wales urging the realisation of the funds of the Commission to as great an extent as possible and the distribution of the proceeds of this realisation in grants to provincial museums. Mr. Joseph Chamberlain introduced the deputation and the Prince of Wales (afterwards King Edward), chairman of the Commission, asked Lord Granville to reply. It was a reasoned reply—*in the negative*. Towards the end of that reply it was stated that the Commissioners aimed rather at establishing scholarships. (This interesting, and critical, interview is reported in detail in Appendix 'S' of the Commissioners' Sixth Report, 1878, and the subject is fully discussed in that Report.)

The establishment of scholarships then forecast was held over until the Commissioners could make a sufficient reduction in their mortgage debt to set free an adequate surplus of income. In 1889 they reported that they were in a position to allot for scholarships an annual sum "not less than £5000".

1891–1930.

Science Research Scholarships.—The Commissioners established their scheme of science scholarships in 1891. It had been prepared with great care, and it soon proved itself well and wisely conceived. This scheme has been outlined in the opening section of these notes.

In certain other fields the Commissioners have endeavoured, by such schemes as they could afford, to meet particular difficulties of the time. They thus initiated:

Industrial Bursaries in 1911, to enable well-qualified university students of limited means to enter employment in industries which, at the outset, would entail costs greater than their means could meet. The Commissioners award these bursaries by selection based on the reports of the university or college authorities as to the qualifications of the men they recommend.

Post-Graduate Naval Architecture Scholarship in 1911, similarly awarded on the recommendation of the Institution of Naval Architects.

Art Scholarships, 1912—the Rome Scholarships —administered by the British School at Rome, These are awarded by competition in London, and are tenable for three years in the School at Rome. Three are offered at each annual competition; each scholarship is of value £250 per annum, and is tenable for three years at the School at Rome. To provide suitable conditions in Rome for the studies and practice of their scholars, the Commissioners have co-operated with others in the provision and maintenance of the British School at Rome.

Throughout this period, successive developments in science, art, and industries led to expansion of the field, intermediate between education and practice, in which the Commissioners found it to be their opportunity, and indeed their duty, for the time being, to supplement other restricted resources or facilities available. To-day, four-fifths of their ordinary income, which is limited, is devoted to such purposes.

A 'LOCALITY' AND ITS BUILDINGS.

Yes, Locality again. Their own baby born nearly eighty years ago—"Vision" his father: his mother 'Surplus'. His foster parents—as usual in these days—an incorporated body, would fain see him functioning to the full of his inherited ability. The public he was born to serve, proved tardy in recognising his inherent powers to serve them. Generations of trustees have tended, watched, and worked for his development. For this they required understanding and help alike from the State and from the public. In the opening years of the present century these came in with good effect. To-day the omens are good, and it is not too much to look for great progress in the course of the 'thirties.

DEVELOPMENT AFTER 1890.

In 1891 the Commissioners had sold to the Government—at much less than its value, but "for purposes of Science and Art"—a key section of their "Main Square". The opening century found this eligible site in much the same condition as did 1891; but soon the Government had put in hand a building to accommodate the Physics and Chemistry Departments of the Royal College of Science, the Science Library, and two galleries for the Science Museum. In 1905 the Government appointed a Committee—with an experienced and energetic member of the Royal Commission as its first Chairman—to consider the Royal College of Science and Royal School of Mines, present and future, as to staff, buildings, and equipment.

The outcome of this—made possible by liberal support from generous donors and from private funds for buildings and from the Commissioners as to sites—was the Imperial College of Science and Technology. The new College was constituted by incorporating in this single institution the Royal College of Science, the Royal School of Mines, both Government institutions, and the Central Technical College. The last named had been established by the City and Guilds of London : H.M. King Edward VII. laid its foundation stone in 1909.

The terms of the charter of the Imperial College showed that it was conceived as an institution with such freedom of action as would enable it to react quickly to developments of outlook, alike in science, in industry, and in methods of training. The Commissioners welcomed the new college as one that would be in a strong position to promote the organisation of advanced education and research in science as applied to industry, and they devoted to its use the unoccupied sites on the south side of Prince Consort Road. This allocation of sites did not interfere with any institution already on the area.

BUILDINGS.

The erection of the first block of the new building for the Science Museum was in progress in 1914, but was then interrupted. It was resumed after the War, and the new building was opened by H.M. King George V. in 1928.

Operations have now begun for the erection of the new Museum of Practical Geology and headquarters of the Geological Survey. This building will be contiguous to that of the Museum of Natural History and to that of the Science Museum. Its completion will bring the Geological Survey and Museum close to the Royal School of Mines, which was first opened under its wing in Jermyn Street in 1851.

On the Prince Consort Road section of the "Main Square" there now stands—at the east end, the Goldsmiths' Company's extension of the City and Guilds' Engineering College, and, continuous with that, the block devoted to geology and specialised sections of the Royal School of Mines. This combined block of buildings was opened by H.R.H. the Duke of York in 1926. Then to the west—beyond the Royal College of Music—there now stands the first part of the Chemical Technology Department of the Imperial College. On the north side of the road, and facing this last, is the Students' Union and the Botany Department of the College. On the southern transverse road of the "Main Square"—Imperial Institute Road—the central feature of the north side is the Imperial Institute itself. The eastern part of that building is occupied by the headquarters services of the University of London. Facing this, on the south side of the road, is that block of the Imperial College which houses the Physical and Chemical Departments and, in the centre, the Science Library, in connection with the Science Museum.

The central part of the northern portion of the "Main Square" is largely occupied by buildings of a temporary nature, but the main lines of utilisation, as a whole, are now determined by the permanent buildings in being or in course of erection.

The Victoria and Albert Museum, the Natural History Museum, the central block of the Imperial College, the first section of the new Science Museum, were all built by the Government on land bought, on favourable terms, from the Commissioners. The new Geological Museum is in course of erection on the same section of the ground.

It ought to be noted that the methods of construction used in the buildings of recent years make it relatively easy to transform interiors so as to meet changes of requirements as times change.

SUMMARY.

Let there be no misunderstanding. While every forward step referred to in these notes has had a definite relation to the aims the Commissioners maintained through the decades, their expenditure in promoting the realisation of these aims has been but trifling in proportion to the costs of converting aims into practice. Their influence has been essentially in the direction of initiation, of nursing, of demonstration on a small scale, and of affording to others an opportunity of trying out this or that idea. For causes in which they firmly believed, they have not failed to continue their assistance through many years when other support failed to materialise. Again, when a scheme seemed to have done all it could at the time, they discontinued demonstration and waited and watched.

Their primary and their large aim was the development of 'system'—'system' in the sense in which they used the word *after* their first Report—the sense in which it is used in these notes. The development and natural application of 'system' in this sense has been carried on and is being carried on by the *State*—not by the Commissioners. In all major causes none but the State *could* carry it out.

The speech from the Throne at the opening of Parliament, 1852–53, contained the following passage :

"The advancement of the Fine Arts and of Practical Science will be readily recognised by you as worthy of the attention of a great and enlightened nation. I have directed that a comprehensive scheme shall be laid before you, having in view the promotion of these objects, towards which I invite your aid and co-operation."

Following on this, the question of extending "a system of encouragement to local institutions for Practical Science" was taken up by the Government. The Department of Science and Art was established in 1853 and the administration of Schools of Design, which had been established previously, was transferred from the Board of Trade to that Department. Under the Department of Science and Art and, from 1903, under the Board of Education, which absorbed it and could administer its services on a broader basis and with a greater measure of central and local assistance, art, science, and technology became essential elements in national administration. Government departments and local authorities, the University

Grants Committee, and the Universities have co-operated in promoting a full development of 'system'. From time to time the Commissioners have provided aids for able students at critical points, and they have already found it possible to move upward one of their scaling ladders.

The Royal Commission has been, in its years, prospector, promoter, patron—patron in the centuries-old sense of extending wise guidance and limited assistance to persons or projects that appeared capable of furthering science or the arts, or of stimulating inventions or industries. In the nature of things the ideas of the Commissioners have occasionally been too much in advance of the time to secure effective response. Yet, when prospects improved and the idea still seemed good, it was tabled again with any modification that seemed desirable.

It has been so with the realisation of all that was implied in their aim—a Locality—the establishment of varied central institutions in the area pegged out nearly eighty years ago. The realisation of this part of their aim has been slow, and time has altered the conditions—alike as to purposes and as to methods. The substantial elements are taking shape, but it is fully realised that they must retain elasticity.

F. G. Ogilvie.

Progressive Agriculture.

An unusual and interesting example of successful co-operation between industry and agriculture is portrayed in the jubilee volume issued to commemorate fifty years' work of the Blanchisserie et Teinturerie de Thaon,* in the Vosges. After the annexation of Alsace and Lorraine, France found herself bereft of several of her most important bleaching establishments, and in 1872 a society was formed to establish the industry at Thaon in the Vosges, M. Armand Lederlin being installed as the first director. The difficulties to be overcome were great, as the selection of the site had to be largely determined by the presence of abundant water free from chalk and iron, so essential for bleaching purposes. This was the first industry to be established in a purely agricultural area, and, from the beginning, it has also been the centre of agricultural demonstrations seeking to aid the peasants and workmen to get the best results from their land. The success of the venture was primarily due to M. Armand Lederlin, an impassioned agriculturist and a great industrial worker, whose work was carried on by his son, M. Paul Lederlin, who succeeded him as director in 1909. Their endeavours have raised the status of a little country village, numbering only 555 inhabitants in 1870, to an important township of 8000 people, prosperous in industry and also in agriculture.

After 1903 many other allied establishments were acquired, until at the present time about ten thousand workpeople are employed, dealing with some two million metres of material per day of eight hours. The Thaon Blanchisserie is probably the most powerful firm in Europe for the treatment of textiles. Throughout its history a very close association has been maintained between the heads of the firm and local social and municipal life. Housing problems, questions of public hygiene, the moral and intellectual development of the personnel, libraries, insurance, and organisations to reduce the cost of living, represent but a few of the activities which are supported and encouraged by the Blanchisserie.

Before the foundation of the firm, the chief industries of the district were cattle-raising and potato-growing, a little oats and rye also being cultivated. M. A. Lederlin was inspired by the work of the Rothamsted and Woburn Experimental Stations in England, and of M. George Ville in France, to strive to introduce the new ideas of the utilisation of chemical fertilisers for the improvement of crops, with the view of increasing the prosperity of the district. His aims and interests were primarily local, being intended to determine what varieties of agricultural plants were most suited to the district, but the results ultimately attained wider significance as the scope of the experiments extended. The jubilee report recently issued is intended to prevent the results of the earlier experimental work from falling into oblivion, and generous support from the Blanchisserie has facilitated the reproduction of many tables and photographs.

From 1879 until 1919 continuous agricultural experiments, carefully laid out, were carried on by M. Armand Lederlin, and when he gave up the work by reason of age his son proceeded to carry on another series of somewhat different scope. The aim is still to be useful to the Department of the Vosges, and the produce of the plots is sold to the personnel at prices often below the cost of production. The chief immediate aim is now to improve cattle and crops by numerous experiments on selection and acclimatisation. In connexion with the experimental farm, potatoes are the most important crop, for they are well suited to the soil and are also the source of the starch of which so much is used in the industry, the whole production of 2000 tons of potato starch per annum being absorbed by Thaon and its daughter establishments.

Unsuccessful attempts have been made to establish another potato, *Solanum commersoni*, which provides edible aerial parts suitable for cattle food, and comes up year after year without replanting, from portions of the root left in the soil. There is also a model dairy farm, with land specially cultivated for cattle food, a horticultural society with a very high standard of production, nurseries for raising conifers and deciduous trees for street

* Hoffmann, P., et Deboffe, J. (1930?). Cinquante ans de travaux sur l'agriculture et sur l'horticulture, 1877–1927. (Paris: J.-B. Baillière et Fils.)

planting, and apiaries to encourage local beekeeping, while laboratories have been equipped to deal with the various chemical and biological problems associated with plant growth.

The latter part of the report gives a detailed account of the results of the experiments. An interesting feature is the agronomic soil map of Thaon, showing the areas lacking in certain essential plant nutrients, with some land containing too much nitrogen. In this connexion is given a detailed table of the necessary manuring for various crops in different parts of the Thaon area. Thirty-seven per cent of the whole area is in woods and forests, the rest being chiefly potatoes, with some wheat, oats, beetroot, and carrots. The experiments on these crops embrace tests on variety, adaptation and acclimatisation, transmission of disease by seed, problems of selection and the degeneration of species, as well as the effect of manurial treatments. In the latter connexion the action of disinfectants and accessory elements, such as sulphur and manganese, is receiving attention.

The problem of weed eradication has been dealt with experimentally in this district, as charlock is a very serious menace to the crops. Many sprays have been tried out, the results varying as usual with the weather, but excellent results and increased crops are claimed from the use of sulphuric acid, as much as thirty-five per cent increase over the control being obtained. Special systems of crop rotation are also suggested to mitigate the pest.

The value of the agricultural section of the report would have been much enhanced if the conclusions from the many years' experiments had been collected and summarised, as it is generally necessary to go laboriously through the work of several years to gain information on any special point of interest. Apart from this, the authors are to be congratulated on the production of a volume setting forth so clearly the working out of a sociological problem which offered special and unusual difficulties that have been successfully overcome by MM. Armand and Paul Lederlin, with the co-operation of their staff.

W. E. B.

Obituary.

PROF. G. N. STEWART.

NEWS has been cabled from Cleveland, Ohio, of the death of George Neil Stewart, the well-known physiologist. Born in 1860 in London, Ontario, whither his parents had temporarily migrated from Lybster, Caithness, Stewart, while yet a child, was brought back to Great Britain. He entered the University of Edinburgh in 1879 and graduated M.A. four years later with honours in mathematics, having meanwhile acted as assistant to Tait, the professor of physics. During the session 1883–84 he was Mackay Smith Scholar and in 1887 received the degree of D.Sc. But physics did not hold Stewart for long. He turned his attention to medicine and graduated M.D. in 1891, receiving a gold medal for his thesis. Then followed a year's post-graduate study in Berlin, after which Stewart was appointed senior demonstrator of physiology at Victoria College, Manchester. In 1889 he became George Henry Lewes student in physiology at Cambridge, a position which he held until 1893, meanwhile acting as examiner in physiology in the University of Aberdeen and taking the then recently established Diploma in Public Health of Cambridge. Several months during 1892 were also spent in the physiological laboratory in Strasbourg.

Migrating in 1893 to the United States, Stewart spent some months as a voluntary research worker with Prof. Bowditch at Harvard University, who then nominated him for the chair of physiology at the Medical School of the Western Reserve University, Cleveland, Ohio, which was one of the first of the medical schools west of the Alleghany mountains to abandon the proprietory system, establishing in its place a full-time staff in the laboratory subjects. During the next nine years, Stewart found in Cleveland every opportunity to develop his subject both in teaching and research, the first evidence of his success being the publication in 1895 of "A Manual of Physiology with Practical Exercises". It can truthfully be said that his admirable book marked an epoch in the teaching of physiology, for it succeeded in showing how formal exposition could be interwoven with practical work. The student of medicine under Stewart learned his physiology by doing experiments which were carefully chosen and planned so as to form the basis for the more or less informal lectures which were grouped around them. Many of the practical courses in experimental physiology in the American schools are patterned on those outlined in Stewart's book, which passed through eight editions, of which the last appeared in 1918. It was largely through Stewart's influence that Western Reserve Medical School was among the first to follow the example of Johns Hopkins in raising its entrance requirements to three years in an academic college, thus making a combined arts and medicine course of seven years' duration. This scheme in a somewhat modified form has since been adopted by the majority of medical schools in America.

In 1903, Stewart was called to the University of Chicago to succeed Jacques Loeb in the chair of physiology, but here he stayed for only four years, being enticed back to Cleveland to organise and direct the department of experimental medicine which was established in memory of H. K. Cushing, whose son, Harvey Cushing, is the well-known professor of surgery in Harvard. In this position Stewart found full scope for his untiring and painstaking research work in various fields of experimental medicine, the results of which have appeared from time to time in numerous papers, published mainly in the *American Journal of Physiology*, the *Journal of Pharmacology and Experimental Therapeutics*, and the *Journal of Experimental Medicine*. These papers along with those of his associates have been issued in eight volumes (1911–1926) of

"Collected Papers from the H. K. Cushing Laboratory for Experimental Medicine, Western Reserve University". In 1920, Stewart was honoured by receiving the LL.D. of his Alma Mater.

It would occupy too much space to give here an account of the many problems to the solution of which Stewart and his pupils have made valuable contributions. His earliest work, influenced by his training in physics, concerned the electro-physiology of nerve and the application of Talbot's law. Then followed researches on the nerves of the heart and the circulation time, the latter being really pioneer work. Attracted by the development of knowledge concerning the physical chemistry of solutions, Stewart then conducted numerous investigations bearing on the mechanism of the action of hæmolytic and agglutinative agents and the problem of permeability of animal cells. The results of these researches were published in a monograph in 1909 ("The Mechanism of Hæmolysis with Special Reference to the Relations of Electrolytes to Cells").

Desiring to contribute to clinical medicine something which might be of assistance in the precise diagnosis of circulatory disturbances, Stewart elaborated (between 1910 and 1915) an ingenious calorimetric method for measurement of the rate of blood flow through the hands and feet, and with this he made numerous observations on hospital patients. About 1918 were started researches on the functions of the adrenal glands, which occupied his attention until his death.

Stewart was induced to enter this field because of the extravagant claims which were then being made concerning the relationship of the internal secretion of the adrenals to arteriosclerosis, diabetes, and various other diseases and conditions of the body. With great experimental ingenuity and meticulous care, Stewart, with the assistance of Rogoff, proceeded to investigate the conditions in animals under which increased secretion of epinephrine occurs. This work led him to conclude that epinephrine does not represent an internal secretion in the ordinary sense, but is rather of the nature of a metabolic by-product, and that variations in its secretion into the blood are not of the physiological significance which others have assigned to them. He denied, for example, that conditions of emotion, fright and fear in animals, are associated with significant variations in the internal secretion of this substance. As the work proceeded, it became more and more evident that it is the cortex rather than the medulla of the adrenal gland that is of real physiological significance. Whereas all of the medullary tissue could be destroyed without significantly affecting the well-being or the behaviour of the animal, destruction of the cortex as well led ultimately to death, although not until after a much longer period than had hitherto been supposed. Convinced that the cortex must produce an internal secretion which is essential to life, its deficiency being the cause of the symptom-complex known as Addison's disease, Stewart during the past few years sought for methods by which extracts could be prepared that would prolong the lives of adrenalectomised animals and prove of value in the treatment of adrenal disease in man.

By those who knew him intimately, Stewart was greatly admired both as a scientific worker and as a man of broad sympathies and deep culture. His quick wit, his remarkable memory, and his eloquence made him a most interesting lecturer and a notable figure in society meetings. Although domiciled for more than thirty-five years in the United States, he remained a British citizen, and during the earlier years of the War spent several months in England and in France seeking for an opportunity to do service for the allies.

Stewart leaves behind him a widow and four children, who may rest assured that their grief is shared by the many who were fortunate enough to have him for a friend. J. J. R. MACLEOD.

MR. A. F. R. WOLLASTON.

ALEXANDER FREDERICK RICHMOND WOLLASTON, who died in his rooms at King's College, Cambridge, on June 4, shot by one of his pupils in a moment of insanity, was the son of George Hyde Wollaston, for many years a master at Clifton College. He came of distinguished parentage. Through his mother he had kinship as grandson and nephew with the artists George and W. B. Richmond: from her he inherited a love of good music and painting and literature, and unerring taste. On his father's side, the name and family has been famous for two centuries and more, as the "Dictionary of National Biography" shows. Chief in the list there given are the brothers Francis and William Hyde Wollaston; the former was his direct ancestor.

Wollaston was born in 1875, and went from Clifton to Cambridge and the London Hospital, where he qualified in 1903. Many friendships were formed in his university days, among them one which decided the course of his life. Alfred Newton, professor of zoology, Wollaston's senior by some forty-five years, recognised his exceptional gifts and encouraged him to become a naturalist-explorer. All the activities of his student years combined to fit him for this. Besides his medical qualifications he had acquired experience as a traveller and mountaineer, and a wide range of knowledge of living creatures and plants. As a field naturalist he was in the first rank; and he possessed a tall spare frame capable of great endurance.

Wollaston's reputation among geographers and naturalists was established by the two expeditions, organised by the British Museum and the British Ornithologists' Union respectively, to Ruwenzori and to New Guinea, and by his delightfully written narratives of them.[1] On Ruwenzori he twice climbed peaks (one of which now bears his name) which he supposed with good reason to be the highest of the range. When the expedition came to an end, he and Carruthers made their way southward to Lake Tanganyika, thence westward to the upper waters of the Congo, and voyaged down the river to its mouth. A curious common feature of the two expeditions was the discovery in each of a race of pygmies. The results of the New Guinea expedition were disappointing, through no fault of the explorers. Wollaston returned there in 1912 with a party led by himself; the outbreak of the War frustrated his plans for a third expedition, and our hopes for a new book of travel from his pen. His "Life of Alfred Newton", at which he had laboured for several years, could not be published until 1921, and was then reduced to half its intended size.

For his work in the War—in the northern patrol, under Smuts in East Africa, on a monitor, and on the Murman Coast—Wollaston received the Distinguished Service Cross. In 1920 King's College elected him a fellow, and for a time Cambridge was his home. But two more journeys lay before him. He went as medical officer and naturalist on the first Everest expedition; and in 1923 he married, and set out with his wife to an almost unknown mountain range in Colombia. Quiet years followed. He served on the council and later became honorary secretary of the Royal Geographical Society; he had been the recipient of the Society's Gill memorial medal and the Patron's gold medal in 1914 and 1925. At the time of his death he had been tutor of King's College, Cambridge, for eighteen months.

It is difficult to imagine a man with greater power of inspiring affection and confidence than Wollaston; he was so completely honest, sensible, and straightforward. His wanderings were over; they had brought him fame and honour; their dangers had passed by him unharmed. Blessed in his home-life and with friends innumerable, all the signs foretold for him many years of peaceful happiness.

H. W. R.

[1] "From Ruwenzori to the Congo, a Naturalist's Journey across Africa", and "Pygmies and Papuans, the Stone Age to-day in Dutch New Guinea". It is not out of place here to refer to the admirable appreciation of Wollaston in Henry Newbolt's "Book of the Long Trail".

WE regret to announce the following deaths:

Prof. W. H. Bristol, formerly professor of mathematics at the Stevens Institute of Technology, Hoboken, and inventor of numerous recording instruments for pressure, temperature, and electricity, as well as of devices for sound amplifying, and talking motion picture apparatus, aged seventy years.

Dr. Allerton S. Cushman, founder and director of the Institute of Industrial Research in Washington, and author of papers on corrosion and other chemical subjects, on May 1, aged sixty-two years.

Dr. George Dimmock, of Springfield, Mass., known for his contributions to entomology, on May 17, aged seventy-eight years.

Dr. J. Arthur Harris, head of the Department of Botany of the University of Minnesota, whose interests lay in ecology and biometry, on April 24, aged forty-nine years.

Dr. Charles F. McKenna, president in 1910 of the American Society of Chemical Engineers, on April 25, aged sixty-eight years.

Dr. Thomas E. McKinney, from 1908 until 1928 professor of mathematics in the University of South Dakota, known for work on continued fractions and the theory of equations, on April 14, aged sixty-five years.

News and Views.

ON June 19, Dr. and Mrs. Robert Mond entertained a large number of distinguished guests at a dinner held at the Savoy in honour of Sir W. M. Flinders Petrie, who this season has completed his fiftieth year of exploration and research in Egyptian archæology. Addresses and messages of congratulation and good will were received from the British Academy and other scientific and learned bodies. It is no exaggeration to say, however, that outside the immediate circle present on this occasion, the whole world of those who are interested in humane studies now offers its tribute of veneration to a great scholar and research worker. To the historian of the future, Sir Flinders Petrie will not merely rank with the one or two great and familiar names in Egyptology; he will stand out as the first to set the study of Egyptian archæology upon a scientific basis—one whose work has served not only as a model and guide for all subsequent research, but also has made ancient Egyptian culture live in the eyes of a modern generation. The system of sequence dating which he elaborated as a classification and a means of assigning to their proper horizon the material objects of Egyptian culture from predynastic times to the close of its existence as a separate entity in the ancient world, equally with the order and method he exemplified in his own excavations and inculcated and demanded in the work of others, have laid archæological studies under a debt to him which it is difficult to estimate. By maintaining steadfastly the point of view of the anthropologist he has kept Egyptology in relation with wider studies and saved it from the aridity of the specialist outlook with which it was threatened.

IN 1875, as a young man of twenty-two, Sir Flinders Petrie began the study of the ancient monuments of Britain, and by 1880 he had published his "Inductive Metrology" and "Stonehenge". From 1880 onward he visited Egypt annually, publishing the reports on his excavations with minutely conscientious documentation and after the minimum of delay consistent with careful preparation. His discoveries range from predynastic graves to the Greek settlements of Naukratis and Daphnæ—Koptos, Naqada, Abydos Lahun, and many more, a lengthy list now landmarks in Egyptian archæology. Egyptian literature, art, social life, technical methods and appliances, magic and religion, in fact all sides of Egyptian life and culture, have been reviewed by his pen, and finally the results of his work were gathered together in his monumental history of Egypt. As workers in other fields well know, his interest in the problems of and methods of general archæology has been kept keenly alive. Further, it is not only by his own researches that Sir Flinders Petrie has served archæology. At home as Edwards professor of Egyptology at University College, London

—a post which he accepted in 1892—and in the field by practical instruction and supervision he influenced and moulded generations of research workers. In 1894 he founded the Egyptian Research Account, which became the British School of Archæology in Egypt in 1905. Through this organisation his excavations in Egypt continued until a few years ago, when local circumstances made it advisable that the field of operations should be removed to Palestine. In the organisation and administration of his research Sir Flinders has been loyally assisted since his marriage in 1897 by Lady Petrie. He received the honour of knighthood in 1923, and his work was further commemorated by the foundation of the Petrie gold medal, which is awarded for outstanding achievement in the study of general archæology.

In the last issue of the *Royal Naval Engineering College Magazine* is a short account of the history of the College, which was first opened on July 1, 1880, fifty years ago, and in which to-day all midshipmen and sub-lieutenants for the engineering branch of the Royal Navy receive their training. For a long time the training of 'engineer boys' and 'engineer students' for the navy was much on the same lines as that of dockyard apprentices, but owing to the recommendations of the Cooper Key Committee of 1875, H.M.S. *Marlborough* was allocated for a training school at Portsmouth in 1878, and two years later Keyham College came into existence. For some time the two establishments ran side by side, but from 1888 onwards all engineering education has been carried out at Keyham. The valuable character of the training given in the *Marlborough* and at Keyham was fully demonstrated during the War, out of which the engineering branch came with a fine record. Nearly all the senior engineer officers in the fleet and at the Admiralty and dockyards had passed through one or the other, in which there has always been a sound combination of instruction in both theory and practice. With the reorganisation of naval education by Lord Selborne and Lord Fisher, entries to Keyham ceased in 1905, and since then the College has seen many changes. Eight years ago, however, all midshipmen for engineering duties were sent there, and to-day there are some 180 midshipmen and sub-lieutenants in residence. As in former days, the instruction is given partly by naval engineers and partly by civilian instructors, and to these have been added a number of naval instructors. The course extends over four years, and the College is fully maintaining and adding to the prestige it enjoyed under the old regime.

"L'Affaire Glozel" slowly draws to an inevitable but undignified conclusion. By the irony of circumstance the solution is reached not by the reasoned arguments of the scientific archæologist, but by the empirical methods of the police bureau. The libel action brought by the Fradins, father and son, against those who had impugned the authenticity of the finds they had 'discovered' and exploited, it was obvious, would leave the main issue untouched, and might even have strengthened their position, already well established with the general public. It therefore seemed to the opponents of Glozel that the most effective counter was the institution of a criminal prosecution by the Société préhistorique de France on a charge of obtaining money from the public by exhibiting modern objects as antiques. The exhibits were seized by public authority and examined by M. Bayle of the Service d'Identité judiciaire. This officer found evidence of modern fabrication and affirmed *inter alia* that the bricks had not even been baked and contained substances of modern origin such as strands of cotton coloured by aniline dye, and pieces of moss and grass still retaining chlorophyll, etc. The assassination of M. Bayle has delayed the presentation of the report, which, however, is imminent and will, it is anticipated, be followed by the punishment of the culprit. The whole story is set forth with no little humour and some pungent comments on certain individuals in *Antiquity* for June by M. Vayson de Pradennes, whose intervention in the controversy in 1927, it will be remembered, was crucial. His article is an instructive document, not merely as a detailed survey of the course of events in the Glozel fraud, but in its bearing upon certain aspects of the forgery of antiquities in general.

Although the topical character of the article on Glozel and its bearing upon a sensational series of events gives this feature of the June number of *Antiquity* a special attraction at the moment, the remaining contributions do not fall below it in their level of interest. Prof. Eilert Eckwall writes on the early names of Britain, with no suggestion, however, that as yet any name earlier than of Celtic origin is known. Mr. Eslyn Evans carries further the investigation of the invasion of Britain at the later stage of the Bronze age by a wave of Celtic-speaking peoples, of which a suggestion was first put forward by Mr. Crawford. He here examines the origin and distribution of certain type-specimens of late Bronze age cultures. Dr. Cecil Curwen follows up an earlier communication on prehistoric agriculture by a paper on flint sickles, in which he discusses the interesting problem of the polish on the cutting edge of the flint teeth. The earthworks on Butser Hill, near Petersfield in Hampshire, are discussed at some length with the assistance of air photographs by Mr. Stuart Piggott, who argues that the earliest settlement is to be dated at about 2000 B.C. "Notes and News", from various contributors, include a note by Mr. M. C. Burkitt on a polished stone axe associated with kitchen midden material from South Africa. He points out that very few polished axes have been found in South Africa, and that this is the first time an association with a definite culture has been demonstrated. He also directs attention to the discovery by Prof. Drennan of a skull and femur of Australoid type in a sand quarry at Cape Flats, near Cape Town.

M. Albert Thomas, in his report as Director of the International Labour Office, refers to the relations between the Soviet Union and the international institutions of the League of Nations. Before 1929 there appeared to be a possibility of definite collaboration in scientific investigation, but in that year a decided change took place. An offensive against 'bourgeois science' has been developed in Russia, which has taken various forms. Scientific institutions have been reorganised on Marxian lines or have been abolished. Non-communist specialists and technicians have been deprived of their posts, and numerous congresses have been organised to frame new sciences based on Marxian principles. M. Thomas comments that collaboration has been rejected even in the scientific field between Soviet institutions and the international institutions of the 'bourgeois and capitalist' countries, because this would involve the separation of science from politics and a distinction between the examination of the actual situation and Marxian analysis.

At the meeting of the Royal Statistical Society on June 17, the retiring president, Mr. A. W. Flux, delivered an address on a comparison between the food supply of the United Kingdom in the five years ending 1928 and in the five years ending 1913. For the earlier period, the results of the investigations of the Food (War) Committee of the Royal Society were available, and for purposes of comparison Mr. Flux applied a similar procedure to the five years ending 1928. The examination of the results of the two sets of data showed that no large change in the effective supply of food has occurred, having regard to the numbers for whose maintenance the supplies sufficed. The number of persons whose food supplies were the subject of the two inquiries was substantially the same at the two dates, but the different age constitution of these numerically equal populations renders the needs of the post-War population greater than those of the pre-War population. The 45¼ million of the pre-War population was computed to be the effective equivalent of 35 million adult men, while the equal post-War population was computed to be equivalent to 36 million adult men. The available supplies of food reduced to their energy equivalent gave 4000 calories per day per equivalent adult man. In the make-up of the food, fat had a somewhat larger importance in the later period than in the earlier, while proteins and carbohydrates had a somewhat smaller importance. Dairy produce and vegetables, and, still more, fruit, showed important increases, while meat and cereals both decreased, the latter in greater proportion than the former. In the later period the energy value of the food was derived in the proportion of forty per cent from home produce and sixty per cent from imported produce.

The British Polar Exhibition will be open at the Central Hall, Westminster, from July 2 to July 15. The exhibition, which is under the patronage of H.R.H. the Prince of Wales, is designed to illustrate the achievements of British polar explorers, especially those of recent times. Numerous exhibits have been lent by museums, learned societies, and private collectors. Among expeditions that will be represented are those of *Erebus* and *Terror*, *Alert*, and *Discovery* to the north, and *Southern Cross*, *Discovery*, *Scotia*, *Nimrod*, and *Aurora* to the south. One section will be devoted to relics, ship-models, flags, paintings, and photographs; another to modern work with apparatus and specimens, and a third will be occupied by firms supplying polar equipment. A lecture on north polar exploration will be given on July 2, and one on south polar exploration on July 10. The Scott film recently acquired for the nation has been lent by the trustees and will be shown most evenings and two afternoons. An authoritative polar handbook, with short articles on discovery, meteorology, geology, whaling, birds, diet, etc., and illustrated by maps, will be on sale. A number of recent books on polar work will also be on sale. The organisers are giving their services voluntarily. If, after costs are met, there is any surplus revenue, it will be given to institutes or societies engaged in geographical research.

The report of about 150 newspaper representatives from various countries upon the sixth *Achema*, or Great International Exhibition of chemical apparatus, at Frankfurt-on-Main, indicates the striking progress which has been made in developing commercial international relationships since the first exhibition of its kind was held ten years ago in Hannover. The press delegates were addressed by Dr. Bretschneider, the organiser of the exhibition, who explained that the primary object of the *Achema* was to promote co-operation between chemists and engineers. The exhibitors this year include many foreign firms, and a prominent feature of this exhibition is the historical section, which includes a model of Liebig's laboratory at Giessen in 1842 and a selection of manuscripts and books. In one section many optical and electrical measuring instruments are displayed and automatic devices for the analysis of gases and liquids, balances designed to record the weight of a dust particle, ultramicroscopes for the detection of molecular movements, and X-ray apparatus for the resolution of crystal structure. An attempt is made to demonstrate in striking fashion the great economies which can be effected by the adoption of standard sizes for the component parts of chemical apparatus. Another section is devoted to the artificial silk industry, the various machines used in all stages of its manufacture being displayed. In the other sections may be seen acid-proof blowers of earthenware, condensing plant constructed of fused quartz, a material which until fairly recently was only used on the small scale, fire-proof building materials, rustless steel, and huge containers constructed of aluminium, nickel, and other metals. The press regards the exhibition as an event of outstanding international importance, since it brings out the vast significance of the present state of development of chemical industry, which plays a leading part in modern civilisation.

All workers in scientific and technical fields will welcome the new scheme initiated by the Council of the Association of Special Libraries and Information Bureaux (26 Bedford Square, W.C.1.) to form a panel of expert translators. The scheme will be doubly welcome by reason of the undertaking that the members of the panel will consist only of individuals or associations who have satisfied the Council as to their abilities, not merely to translate literally, but also to interpret the finer shades of differentiation in scientific and technical terminology. The difficulty of obtaining such experts has long been recognised. Faced by a sudden emergency necessitating expert translation, the would-be employer has generally been compelled to rely on the commercial translating bureaux, which are rarely provided with quite the right type of expert required; or alternatively has placed the work in the hands of an individual qualified in the subject concerned but not up to the standard in the particular language involved. It is scarcely conceivable, however, that exactly the right type for each particular problem does not exist, and the only requirement for bringing the work and the worker together would appear to be an organisation on the lines proposed by A.S.L.I.B. This Association has done much towards rationalising the bibliographical realm, and this latest of its activities will meet an urgent and growing need.

By the co-operation of the British Post Office Telephones, the Canadian Marconi Company, and the Bell Telephone Company of Canada, Sir Ernest Rutherford, speaking from his home in Cambridge, was able to address the meeting of the Royal Society of Canada in Moyse Hall, McGill University, Montreal, on May 20. According to the *Montreal Gazette* for May 21, he congratulated the Society on the efficient manner in which it had encouraged the advance of learning in the Dominion since its foundation in 1882, and its president, Dr. A. S. Eve, on his conspicuous services to McGill University, for which Sir Ernest expressed his warm feeling. The reception by loud speaker was extremely powerful, in the early stages somewhat blurred but quite clear later. Sir Arthur Currie jokingly remarked to Sir Ernest that many of his old students present expected that his voice would be more mellowed by age and honours, while Sir Ernest repudiated Sir Arthur's suggestion that he had not replied to his last letter.

During the present week, June 21–28, the North-East Coast Institution of Engineers and Shipbuilders and the Institution of Engineers and Shipbuilders in Scotland have been holding their joint summer meeting in Holland, the programme including visits to some of the most important shipyards at Flushing, Amsterdam, and Rotterdam. One of these is the Fijenoord Company, which has been in existence since 1823, and which recently completed the motor ship *Baloeran* of 16,000 tons, this being the largest passenger vessel ever built at Rotterdam. Nearly as old as the Fijenoord Company is the Werkspoor Company of Amsterdam, a firm which in 1910 constructed the first reversible marine Diesel engine, and which up to the present time has constructed Werkspoor Diesel engines of a total of 365,400 I.H.P. The firm has also recently supplied large screw pumps for the Medemblik and Den Oever pumping stations on the Zuyder Zee Reclamation Works. These works, a visit to which was included in the programme, were described by Mr. J. W. Thierry in a paper to the British Association in 1928, and in *Engineering* for May 23 and June 30 and succeeding issues he is giving further particulars of these important undertakings, which will ultimately add more than half a million acres of land to Holland. Among other places visited was the Nautical Technical Institution and Museum at Rotterdam, founded in 1916 by private subscription for furthering the interests of shipbuilding and nautical science, but which is open to the public.

For the latter part of the meeting, the headquarters of the Institutions was at Scheveningen, a seaside town on the coast, off which took place the action between the English under Monk and the Dutch under Tromp when the latter was killed. Here on June 25, two papers were read, one on the "Interior Architecture of Ships", by Prof. P. A. Hillhouse and Mr. A. M. Gardner, and the other on "Transportation of Oil by Sea", by Mr. J. McGovern, the President-elect of the North-East Coast Institution. The world production of petroleum, said Mr. McGovern, had increased from 70,000 tons in 1860 to 213 million tons in 1929, while the present fleet of oil tankers had a carrying capacity of approximately ten million tons, the ships forming about 11 per cent of the total world tonnage. Though oil at first was carried either in barrels or in wooden ships especially altered for the purpose, the prototype of the modern oil tanker was the *Gluckauf*, built by Messrs. Armstrong in 1885. In this ship boiler riveting was adopted throughout. But the general design of oil-carrying vessels followed that of the ordinary cargo ship until Sir Joseph Isherwood introduced the longitudinal system of framing, which resulted in increased longitudinal strength with a reduction in the weight of material. His patent was taken out in 1906; the *Paul Paix* was built on this system in 1908, and was the forerunner of the 943 oil-tank vessels built or ordered according to the Isherwood plans. In recent years, owing to the carriage of benzine, or oil containing sulphur or acids, corrosion has increased, and unless the metallurgist or chemist can produce more suitable steel or protective coating it would appear that the life of some tankers would be limited to ten or fifteen years.

The annual report and accounts for 1929 of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W.15, has been issued. The work of the Institute is reviewed, including research work and malaria expeditions. The total receipts from donations and subscriptions show an increase of £2500, and income over expenditure a surplus of £2467, but as the Institute has no endowment fund, the balance of £12,000 in hand must be regarded as a reserve against contingencies.

A useful little catalogue (No. 12) of second-hand books of botanical interest, including some rare herbals, has been issued by Mr. J. H. Knowles, 92 Solon Road, S.W.2.

Applications are invited for the following appointments, on or before the dates mentioned:—A full-time graduate science assistant master at the Hammersmith School of Building and Arts and Crafts—The Education Officer (T.1), County Hall, S.E.1 (June 30). A senior mathematical master at Swindon College—The Principal, The College, Swindon, Wilts (July 1). Assistant lecturers in chemistry, physics, botany, and pharmacy at Cardiff Technical College—The Principal, Technical College, Cardiff (July 2). An assistant for metalwork and mechanical drawing at Darlington Technical College—The Chief Education Officer, Education Office, Darlington (July 4). A lecturer in physics and electrical engineering at Handsworth Technical College—The Principal, Handsworth Technical College, Handsworth, Birmingham (July 4). Civilian education officers in the R.A.F. educational service, one with a degree in engineering and one with a degree in history—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1 (July 5). A full-time teacher in engineering, a full-time teacher in physics, and a visiting teacher for engineering economics, at the West Ham Municipal College — The Principal, Municipal College, Romford Road, West Ham, E.15 (July 5). An honours graduate to teach pure and applied mathematics at Loughborough College—The Registrar, Loughborough College, Leicestershire (July 5). An assistant lecturer in education with special qualifications in the teaching of science subjects at the University College of the South-west of England—The Registrar, University College, Exeter (July 7). A technical assistant to the adviser in agricultural economics at Armstrong College — The Registrar, Armstrong College, Newcastle-upon-Tyne (July 7). Geologists on the Geological Survey of Great Britain —The Director, Geological Survey and Museum, 28 Jermyn Street, S.W.1 (July 9). An assistant lecturer in economics in the University of Birmingham—The Registrar, The University, Edgbaston, Birmingham (July 11). A lecturer of botany at the University College of Wales, Aberystwyth—The Financial Secretary, University College of Wales, Aberystwyth (July 14). A demonstrator in mathematics at the Royal College of Science, South Kensington—The Secretary, Imperial College of Science, South Kensington, S.W.7 (July 14). An assistant lecturer in zoology in the University of Bristol—The Secretary, The University, Bristol (July 14). An additional lecturer in engineering at Chesterfield Technical College—The Principal, Chesterfield Technical College, Chesterfield (July 15). Two botanists for cacao research at the Imperial College of Tropical Agriculture, Trinidad—The Secretary, Imperial College of Tropical Agriculture, 14 Trinity Square, E.C.3 (Aug. 19). A professor of hygiene in the Egyptian University, Cairo, and a lecturer in dental surgery—The Dean of the Faculty of Medicine, Egyptian University, Cairo (Sept. 20). A headmaster of Christ's Hospital, Horsham—The Clerk, Christ's Hospital, 26 Great Tower Street, E.C.3. A whole-time lecturer in geography at St. Mary's College, Strawberry Hill—The Principal, St. Mary's College, Strawberry Hill, Middlesex. Instructors in electrical engineering, advanced building construction, and practical mathematics at the Kingston-upon-Thames Technical College and School of Art—The Principal, Technical College, Kingston-upon-Thames. A full-time assistant master for engineering at Erith Technical College — The Principal, Erith Technical College, Belvedere, Kent. Inspectors for the purposes of the Diseases of Animals Act, 1894–1925, under the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1. A professor of natural philosophy in the University of Aberdeen—The Secretary, The University, Aberdeen.

Our Astronomical Column.

Remarkable Meteors.—Mr. W. F. Denning writes that on June 9, at about 0^h 35^m A.M. G.M.T., a large fireball was seen from many places in the north of England. It presented a white nucleus which looked nearly as large as the full moon and lit up the country. About twelve observations have been received, from which it appears that the fireball was directed from the N.N.W. sky and was probably at a height from 60 to 50 miles. The radiant was not far from the horizon, but the data are somewhat conflicting and exact deductions are scarcely possible.

Fireball of June 15.—At 23^h 12^m P.M. G.M.T. a meteor equal Venus was observed by Mr. Kingman at Bristol. It passed from $261° + 21°$ to $305° + 59°$ and was directed from a radiant in Scorpio near $237° - 25°$.

An Early Perseid.—On June 15 at 23^h 22^m G.M.T. a first magnitude meteor with the very swift motion and bright streak characteristic of the Perseids was well observed. It shot from $359° + 75°$ to $142° + 74°$ and its direction conformed very nearly with the radiant point of the Perseids on the same night which is in the region dividing Pegasus and Lacerta at $342° + 32°$.

On June 16 at 1.30 A.M. G.M.T., when scarcely any stars were distinguishable in the misty sky, a fine meteor was noticed from Bristol as it ascended from the horizon in due west and sailing upwards disappeared when nearly reaching the zenith—velocity slow, duration 10 seconds.

Further accounts of these curious objects will be valuable for computing the real paths.

Occultations of Stars by the Moon.—The April issue of the *Journal* of the Royal Astronomical Society of Canada contains an article on this subject by Prof. E. W. Brown. He notes that the campaign of observations of occultations which is now being vigorously carried on in many countries, dates from a paper by Dr. R. T. A. Innes (1923), in which he showed the value of such observations for determining the errors of the lunar tables. Prof. Brown considers that since the introduction of the new lunar tables in 1923, the chief residual errors in the moon's position are due to irregularities in the earth's rotation. He gives two diagrams of the moon's residuals, one on a small scale from 1650 to 1930, the other on a larger scale from 1875 to 1928. In forming these he has omitted from his tabular places the " great empirical term " with period of about $2\frac{1}{2}$ centuries, as he considers that the cause of this, as of the smaller fluctuations, lies in the earth's rotation, not in the moon. A feature of the graphs is the abruptness of the sudden changes of direction. The dates of the more marked changes are 1780, 1898, 1917. Prof. Brown notes that these observations are eminently suited for amateurs. A 3-inch telescope suffices, and a clock or watch sufficiently good to give to the nearest second the interval between a wireless time-signal and the phenomenon.

Research Items.

Harvard-Boston Expedition's Excavations in the Sudan.—In *Sudan Notes and Records*, vol. 12, pt. 2, Dr. G. A. Reisner reports on the excavations which were carried out in the seasons 1927–28 and 1928–29 at the forts at Semna and Uronarti as part of a larger plan to examine all the old forts extending from Semna to Halfa. It is known that these forts of Semna and Uronarti were built before or during the twelfth dynasty, when trade, which in earlier times had suffered much from hostile tribes, had become organised and the country subdued by military expeditions. The northern Sudan was then occupied by officials who were little more than trading agents, transport was maintained mainly by water, and protected by fortified posts along the river. The desert tribes were a constant source of danger to the trading fleets. The excavations have served to throw light on the methods of navigation of the cataract and how traffic was controlled by land and water. The ramparts of the forts command a wide view, and signalling from fort to fort was possible. They completely dominate both land and water routes. Each was built on a hill and the plan was drawn to suit the configuration. Inside the thick outer wall of crude brick ran a street and the space inside the street was divided into blocks by cross streets. Each block was divided by walls into separate apartments, providing temples, dwellings for the commandant and officers, barracks for the men, storehouses, etc. Judging from the quarters and the cemeteries, in which the burials include women and children as well as men, the garrisons must have been small, perhaps from 50 to 150 fighting strength. The forts were all occupied in the New Kingdom, and later, many of the important objects discovered belonging to this period.

Inheritance in Man.—The Galton Lecture before the Eugenics Society is published in the *Eugenics Review* (vol. 22, No. 1). In it Prof. S. J. Holmes discusses natural selection in man, and reaches the general conclusion that under modern conditions selection is more effective in eliminating the less endowed than is usually supposed. He gives reasons for thinking that the intelligence quotient is, on the average, the most important single factor in survival, and that "the present economic order is much more deadly to people with dull minds". The death-rate tends to be high in proportion as the occupation requires little intelligence or skill. On the other hand, selection against many physical defects has been largely eliminated. Racial differences in susceptibility to disease exist. For example, negroes have a low death-rate, as compared with whites, from scarlet fever, erysipelas, diphtheria, measles, and skin diseases, but a high mortality from tuberculosis, pneumonia, and other respiratory diseases. From statistics of mortality rates, Prof. Holmes reaches the conclusion that the male is inherently the weaker sex, although a part of the higher male infant mortality is due to recessive sex-linked factors and a part to birth trauma. He finds that the male death-rate during the first year is high owing to faults of organisation, and that the male death-ratio from epidemic diseases is also high during this period.

Measurement of Ultra-Violet Radiation.—The simple method of measuring the biologically active ultra-violet rays of the sun introduced by A. Webster and Leonard Hill, and now used at many meterological stations, consists in the fading of a standard solution of acetone and methylene blue in a quartz tube. The degrees of fading are tested against a set of standard colour tubes, and each degree represents two to four times the dose of ultra-violet rays required to produce erythema of the white skin—two to four because skins vary in sensitivity. The standard solution exposed to the sunlight in the presence of air fades somewhat in a tube of glass which excludes the biologically active ultra-violet rays. There is, however, very little fading when air is excluded, and any error due to fading by long waved ultra-violet and visible rays can be excluded by exposing a control sample of the standard solution in a glass tube, and deducting the degree of fading of that from the degree of fading in a quartz tube. Dr. M. Bender, of the Institut für Strahlenforschung, Berlin, informs us that he has introduced a variation of method, namely, exposing a solution of acetone and determining the action of the ultra-violet rays on this by adding a standard solution of Fuchsin-Schwehlige-Säure and determining the depth of red-violet tint produced. He claims that this modification gives good agreement with cadmium cell determinations of the ultra-violet rays. A detailed account of his results will be published in *Strahlentherapie*.

Life History of the Pismo Clam.—Mr. William C. Herrington gives an interesting account of the bionomics of *Tivela stultorum* (Mawe) with special reference to its depletion. ("The Pismo Clam, Further Studies of its Life History and Depletion." Division of Fish and Game of California. *Fish Bulletin*, No. 18. Contribution No. 81 from the California State Fisheries Laboratory.) This huge heavy-shelled bivalve at eight years old may weigh from one to four pounds. It is found in abundance on the open sandy beaches of California, but only where it is exposed to constant washing and pounding of the surf extending from the intertidal zone out into the surf for an unknown distance and in places forming a successful commercial fishing. Prof. F. W. Weymouth ("The Life History and Growth of the Pismo Clam", 1923, No. 7 of this publication) has already described fully its habits and appearance. The present paper is specially concerned with the extent and cause of depletion, effect of present protective methods, relation of dominant year classes to fluctuations in abundance, age at sexual maturity, relation between size and number of eggs, growth rate and deviation from the normal in the growth of individual year classes. Spawning begins at the end of the second or third year. The eggs are very small and the average number in specimens from seven to ten years old is 75,000,000 per clam, the smallest producing the fewest eggs. The growth shows a distinct seasonal rhythm, rapid in summer and slow in winter. The large clams have been steadily dwindling in numbers in spite of the bag limit and the size limit. The growth rate does not appear to be affected by crowded conditions. There are great fluctuations in abundance, due principally to dominant year classes and the effects of the fishing. The greatest fall is in the tidal zone, especially in the Pismo-Oceano Beach, where so many visitors dig for clams and are the probable cause of the scarcity. Stricter protection of undersized clams is advised and regulations which will decrease the strain on the breeding stock, if the Pismo clam fishery is to be maintained.

Chondrocranium of the Lizard.—The morphology of the chondrocranium of *Lacerta agilis* is known to most students of zoology from the reconstructions of Gaupp of 31 mm. and 47 mm. stages. De Beer (*Quart. Jour. Micro. Sci.*, May 1930) has described the detailed development of the chondrocranium from the first cartilage to appear, namely, Meckel's cartilage, up to nearly the younger of Gaupp's stages. The employment of van Wihje's victoria blue staining technique enables the cartilage to be differentiated from the pro-cartilage and so makes the identification of the former more accurate than was possible by older methods. From his observations the author concludes that in all living reptiles, excluding Ophidia which are highly specialised, there is the same general form of a tropitrabic skull, with a trabecula communis, an interorbital septum, and a planum supreseptale, and in all the posterior portion of the orbital cartilage is more or less reduced. *Lacerta* has certain affinities with such Chelonia as *Emys*, *Chrysemys*, and *Chelydra*. In addition, the lacertilian chondrocranium has several points of similarity with that of *Sphenodon* and the crocodiles or, in other words, the Diapsida, which may be taken as suggesting that the Lacertilia have been derived from this group.

Colour Change in Fishes.—Mr. Charles Haskins Townsend, director of the New York Aquarium, has published a very interesting booklet entitled "Records of Changes in Colour among Fishes" (New York Zoological Society, 1929). Besides copious notes made from the fishes in the aquarium, there are many beautiful illustrations, both photographs and coloured drawings. The coloured plates are specially good, particularly those by Hashine Murayama, whose sketches are wonderfully alive. The colour changes are usually instantaneous, as many as seven quite different guises being observed. Some of the changes are due to uncomfortable surroundings or sickness, but most of them are adaptations to surroundings; sometimes a colour change may be attributed to anger or fear. The author has in previous works emphasised the fact that one colour description or drawing is not sufficient to identify a fish. The present work fully bears out this statement.

Larvæ of the Coleoptera.—In the *Bulletin of Entomological Research* for March 1930, pp. 57-72, will be found a useful paper by Mr. A. W. Rymer Roberts, consisting of a key to the larvæ of all the chief families of the Coleoptera. It is now more than twenty-six years since MacGillivray's paper on the same subject appeared and, in the interval, a large amount of exact knowledge of the larvæ of various genera and families has come to light. The foremost modern worker in this field, Dr. Adam G. Böving, has published a large amount of high-class research, and the results of his work, and those of other entomologists, have been freely drawn upon by Mr. Roberts in order to make his paper as complete as possible. It is obviously beyond achievement at present to provide a complete key of this kind because, in a few families, the larvæ are still unknown or too poorly described for inclusion. These necessary omissions, however, are so few that their effect on the value of Mr. Roberts's paper is almost negligible. Users of his tables will find the terminology adopted relatively simple, and there is, furthermore, an illustrated glossary of the terms employed. At the end of the paper the reader will find a guide to the more important literature on the subject up to and including the year 1929. The general classification followed is that used by Reitter in the "Fauna Germanica", which is a readily accessible work.

Microscopic Examination of Coal.—Under this title Mr. Clarence A. Seyler gives a very clear, straightforward account of methods of preparing microscopic sections of coal or of preparing polished, etched surfaces for examination in reflected light. It is published as No. 16 of the Physical and Chemical Survey of the National Coal Resources, by the Fuel Research Division of the Department of Scientific and Industrial Research (London: H.M.S.O.). Mr. Seyler states that the tissues which are met with still in a more or less intact form in coal are either secondary xylem or periderm, usually fibrous tissue with the cells considerably elongated in the axial direction. Usually the pieces lie in the coal in a horizontal direction, so that the plant axis lies parallel to the bedding plane. A full description is given of the methods by which the investigator can elucidate the plant structure by sections in directions transverse, radial longitudinal, and tangential longitudinal to the plant axis. No other method of preparation of material for microscopic examination is dealt with other than that of sections. Possibly, the new methods, using collodion or gelatine films, are not readily applicable to this material, but it would seem probable, especially where plant spores are the main recognisable material in the coal, that maceration methods would give results of value.

Chromosomes of *Prunus*.—In the genus *Prunus* the *n* number of chromosomes is 8. Dr. Darlington (*Jour. of Genetics*, vol. 22, No. 1) has made a further study of the cytology of this genus, in which he finds that the various forms of plums and damsons examined were all hexaploid. In meiosis they usually form bivalent chromosomes, but occasional quadrivalents occur. The wild *P. spinosa* is tetraploid and also forms occasional quadrivalents. It was found that in the hybrids of *P. domestica* ($6n$), *P. cerasifera* ($2n$), *P. triflora* ($2n$), *P. persica* ($2n$), and *P. Amygdalus* ($2n$), there is perfect chromosome pairing in meiosis, which is taken to indicate that the chromosomes in the haploid sets of these species are homologous each to each. *P. domestica* × *cerasifera* produces a tetraploid form which behaves like a true species, all the chromosomes pairing, but certain of the pairs also uniting to form quadrivalents. Various abnormalities of meiosis in these hybrids are also described, and classified under four heads, including omission of one or both meiotic divisions, the division of binucleate pollen mother-cells, and the double division of the chromosomes when they have failed to pair. From such conditions, *P. avium nana* having 24 chromosomes in its sporophyte may produce gametophytic nuclei with 96 chromosomes. It is pointed out that from the pairing of chromosomes conclusions regarding their relationship cannot always be drawn, and a relation between pairing and chiasma formation is suggested.

Terrestrial Magnetic Surveys.—The "Results of the Magnetic Observations made by the Ordnance Survey in England and Wales in 1928" (London: H.M.S.O., 1s. net) gives complete data for D (declination), I (inclination), and H (horizontal force) for 30 stations, reduced to the epoch 1929·5; six of these stations were repeat stations, and for these the secular variation is given. Preliminary declination results are given also for seventeen stations observed in 1929, fifteen being in the Scottish Lowlands, and two in the magnetically disturbed region near Melton Mowbray; three of the seventeen are repeat stations. The instruments used for D and H are a coil magnetometer designed by Dr. F. E. Smith; for I a dip circle is still used. The Swedish Hydrographic Service have issued a *Magnetic General Chart of Sweden*, 1930 (Jordmagnetiska Publ. Nr. 7, Stockholm), giving, on three separate maps, isomagnetic lines for D, I, and H. The observations on which the maps are mainly based were made with a Carnegie Institution pattern of combined magnetometer and earth inductor, the field work being done in 1928 and 1929; the stations chosen are to be repeat stations; at each of them, the local variation of vertical intensity is tested by a variometer of the Ad. Schmidt pattern.

Physics in Fuel Research.—In November last, Dr. C. H. Lander, Director of Fuel Research, addressed the Institute of Physics on "Physics in Relation to the Utilisation of Fuel" and this lecture has just been published by the Institute. Perusal of the reprint confirms the view that one can scarcely take a step in this, as in any industry, without involving some physical principle or process. They are here indicated at all stages from the mine to the chimney stack. To cite a modern example, it has been found that X-rays prove useful in investigating and controlling the cleaning of coal, while X-ray spectrometry is assisting in distinguishing the different forms of carbon in coke, which influence its reactivity. All processes of coal cleaning utilise differences in the physical properties of coal and dirt. The utilisation of fuel is obviously 'applied heat'. The combustion of solid fuel is essentially a problem of air supply, and especially with pulverised fuels it is a question of controlling the relative motion of a gas over a solid. Heat transfer involves the laws of radiation, conduction, and convection. The conditions in practice are usually baffling in complexity, but the application of physical methods of study is carrying us further than the empirical methods of the past.

Band Spectrum of Chlorine.—An investigation of the absorption bands of chlorine, described by A. Elliott in the June issue of the *Proceedings of the Royal Society*, is of interest in connexion with the nuclear properties of this element. Four bands assigned to the molecule $Cl^{35}Cl^{35}$, and two assigned to $Cl^{37}Cl^{35}$ have been analysed, and it has been found, by means of intensity measurements, that the nuclear spin of the atom Cl^{35} is 5/2 quantum units, and that the lighter molecule is about 1·45 times as abundant as the heavier. The latter number is decidedly less than the value 1·67 calculated from the direct measurements of the isotope ratio made by Dr. F. W. Aston, but whilst the discrepancy is possibly due to errors in the spectroscopic work, it is apparently not quite certain that it is not real, and due to a greater absorption per molecule by the system $Cl^{37}Cl^{35}$ than by $Cl^{35}Cl^{35}$.

Failure of Insulators due to Deposition of Sea Salt.—A new instrument called a 'klydonograph', which has been much used in the United States for the recording of lightning flashes and atmospheric phenomena, has been found specially useful in connexion with overhead electric lines. It is very important to know the causes of the sudden surges of electricity which cause breakdowns in high pressure electric supply systems. The principle of the instrument is based primarily on the phenomenon known as Lichtenberg's figures. Under electric stress, particles of certain kinds of powder, particularly sulphur, arrange themselves in a definite manner in the electric field. Later on, it was discovered that the emulsion of a photographic plate was affected in a similar way by electric stress. A voltage of 2000 across the electrodes is sufficient to give a record and by having a moving film a continuous record can be obtained. In a paper read by S. W. Melsom, A. N. Arman, and W. Bibby to the Institution of Electrical Engineers on April 10, interesting surge investigations on a 33-kilovolt line in South Wales which supplied a number of collieries and villages were made. They traced breakdowns to a salt deposit which occurred on the insulators of the line following dry south-westerly winds. The line was about twenty miles from the coast. With a dry wind the salt spray is taken up, dried in the air and carried for considerable distances as a fine powder. The salt powder impinges on the insulators and, helped by the electric stress, adheres firmly to them. So long as the dry wind continues there is little danger of a flash-over, but when the humidity of the air becomes normal the insulator gets covered with brine, which is a good electric conductor and leads to dangerous surges on the mains. It was instructive to find that the greater part of the surging occurred on that one of the three-phase conductors which was nearest the sea.

Electric Currents to the Ground.—A fresh estimate of the relative importance of the various agencies concerned in the transport of electricity between the ground and the air has been made by Dr. T. W. Wormell in the June number of the *Proceedings of the Royal Society* (pp. 585-589). The agents considered were four, the normal fine weather current and precipitation, which cause on the whole a downward movement of positive electricity, and lightning discharges and currents from points, the effect of which is in the opposite sense. The numbers given for the charges brought to the ground by these in a year (with special reference to conditions near the Solar Physics Observatory at Cambridge) are respectively +60, +20, −20, and −100 coulombs per square kilometre. These values are necessarily only approximate, but it seems very probable that the current carried by lightning and the point discharges together exceeds considerably the current carried down by rain, which is in the opposite direction, so that there is effectively a vertical upward current through a cumulo-nimbus cloud from the earth to the upper atmosphere. Dr. Wormell refers to two other investigations which confirm this result, and remarks that they are in entire agreement with the theory of Prof. C. T. R. Wilson that the fine-weather current into the ground over the whole earth is balanced by the currents maintained between the earth and the upper atmosphere by shower-clouds.

Recombination of Atomic Hydrogen.—A preliminary report of some remarkable results obtained in connexion with the recombination of hydrogen atoms to form molecules has been published by F. J. Havlíček in *Die Naturwissenschaften* for May 30. The reaction was studied in gas at atmospheric pressure, and it was found that the concentration of atomic hydrogen fell off exponentially with time. The time taken for the concentration to fall to a definite fraction of its initial value being thus independent of the initial concentration, it was concluded that the reaction was *monomolecular*, a result checked by the law governing the dependence of the decay constant upon temperature in the range between about 50° C. and 500° C. Details of the experiments are not given, but must be awaited with the greatest interest, as it is somewhat difficult to reconcile these facts, if substantiated, with the ordinary ideas of recombination taking place as the direct result of collisions.

Analysis of Silicates.—We have received from the Society of Glass Technology, Darnall Road, Sheffield, a copy of a brochure entitled "The Analysis of Glasses, Refractory Materials, and Silicate Slags" just published by the Society. It contains eight papers or abstracts, some having been read to the Society during 1927 and 1928, with the discussions, and in one case the paper has been modified in the light of later investigations. There is also an index. The details given are sufficient for the guidance of any competent chemist, and the critical comments provide a review of the limitations and difficulties of the methods described. The book, which is edited by Prof. W. E. S. Turner, is a useful contribution to the analytical chemistry of silicates.

Physics and Chemistry in the "Encyclopædia Britannica".

Physics.

THE editors claim that the physics programme is one of the most comprehensive and authoritative of the different divisions of the "Encyclopædia Britannica". Anyone wishing to use the work in the study of this branch of knowledge, after reading the article "Science", which surveys the whole world of scientific achievement, would be well advised to refer to "Physics, Articles on", for the main subdivisions and separate headings. Sir Oliver Lodge, in the main article "Physics", discusses the history and development of the science which, by its derivation, means a study of Nature so far as it can be reduced by calculation and experiment to a few simple, or at least fundamental, laws. It was hoped at one time that the mechanical laws of Galileo and Newton would be all-inclusive. Efforts to apply them not only to matter but also to the ether, and even to life and mind, and thus to find a basis for a materialistic philosophy, have proved unsuccessful. So long as we are dealing with massive bodies or with great groups of particles, the Newtonian laws of dynamics are sufficient, and they reigned supreme till very near the end of the nineteenth century. Modern physics may perhaps be said to date from 1895, the year o. Röntgen's discovery of X-rays. This discovery not only provided the physicist with a new tool; it illustrated the idea put forward by Lorentz and Zeeman, and also by Larmor, that electric charges were the agents responsible for the generation of radiation.

Prof. Millikan, who writes on the "Electron" with authority, insists that one of the most important generalisations of all time is that of the electrical constitution of matter, for this conception underlies practically the whole of twentieth century physics. The growth of this idea was gradual, and illustrates the fact that, for the most part, the progress of science takes place by a process of infinitesimal accretion. In 1891, Johnston Stoney introduced the word 'electron' to designate a definite elementary quantity of electricity demanded by Faraday's laws of electrolysis—"Finally nature presents us with a single definite quantity of electricity which is independent of the particular bodies acted on". Stoney implies that every atom must contain at least two electrons, one positive and one negative, because otherwise it would be impossible for the atom as a whole to be electrically neutral. In 1897, J. J. Thomson showed that the mass of the particles constituting the cathode rays was of the order of a thousandth of the mass of the hydrogen atom. Later experiments have shown that the positive electron, while it has a charge of equal amount but opposite sign to the negative, is always associated with a *mass* about 1845 times greater. "The positive electron is sometimes called the proton, and the word electron, when used without any qualifying adjective is usually understood to refer to the negative electron, but it is important to remember that historically, derivatively, and logically the word *electron* means, as indicated above, the unit *charge*, and carries no implication as to mass".

The oil drop experiments of Millikan prove that all electrical charges are built up out of a definite number of discrete elements or particles all exactly alike, the value of the electron charge being $e = 4{\cdot}774 \times 10^{-10}$ absolute electrostatic units (the value quoted as "the latest determination" in the article "Physical Units" is quite out of date).

The dissection of the atom into electric charges is discussed by Prof. Niels Bohr ("Atom"), who gives an account of his own most important theoretical work on the building up of groups of electrons round a massive positive nucleus to form a neutral and stable system. He adds an interesting account of recent progress, dealing with the remarkable developments since 1925 associated with the exact quantitative treatment of the new quantum methods. A more detailed account of the "Quantum Theory" is given by Prof. W. Wilson, who contributes an article of exceptional lucidity. His description of the new wave mechanics and matrix mechanics is one of the best summaries with which we are acquainted.

The third great advance of the present century, supplementing and consolidating the electron theory and the quantum theory, is the theory of "Relativity". This is treated in his usual able manner by Sir James Jeans, who also writes on the "Kinetic Theory of Matter". The general nature of the principle of relativity is first described. "Just as Tycho's eight minutes of arc, in the hands of Kepler and Newton, revolutionised medieval conceptions of the mechanism of the universe, so Leverrier's 43 seconds of arc, in the hands of Einstein, has revolutionised our nineteenth-century conceptions, not only of purely astronomical mechanism, but also of the nature of time and space and of the fundamental ideas of science. The history of this revolution is in effect the history of the theory of relativity. It falls naturally into three chapters, a first narrating the building of the earlier physical theory of relativity, a second dealing with the extension of that theory to gravitation, and a third, which is still in process of being written, attempting to include electro-magnetism in the physical system presented by the existing theory of relativity".

Mr. Bertrand Russell discusses the philosophical consequences of relativity, and Prof. Einstein gives an important if somewhat difficult account of "Space-time", which is followed by a short description by Prof. Eddington of recent attempts to absorb the electro-magnetic field, and so provide a single background to all material activity—one unified field.

A few of the more interesting articles on physics may here be mentioned. Prof. Andrade, who is the associate editor for physics, contributes articles on the atomic "Nucleus", on "Radiation", "Rays", on "Vacuum" and on "Transmutation of the Elements". Sir Ernest Rutherford writes on "Radioactivity", Sir Joseph Thomson on "Electricity, Conduction of", and on "Electric Waves". Dr. Aston is specially qualified to discuss "Positive Rays" and "Isotopes", and Prof. A. Fowler to write the article on "Spectroscopy". The nature of "X-rays" is discussed at length by M. de Broglie, and X-ray spectroscopy by Prof. Manne Siegbahn, both of whom describe work with which they are themselves identified. The standard articles on the branches of the older physics are assigned to the late Prof. Callendar ("Heat"), Prof. C. G. Darwin ("Light"), Dr. A. B. Wood ("Sound"), Prof. H. A. Wilson ("Electricity"), Dr. E. C. Stoner ("Magnetism"). Among the articles on the technical applications of physics may be cited an interesting account of the applications of "X-rays" by Dr. E. V. Pullin, "Wireless Telegraphy" by Prof. Appleton and Dr. Eccles, and "Photography" by Mr. George Eastman and Dr. C. E. K. Mees.

The article on the "Wilson Cloud Chamber" deserves special mention, if only on the ground of the excellent reproductions of photographs of cloud tracks obtained by means of this apparatus. The paths of swift electrified particles are thus rendered visible, and it is possible to study the tracks of α and β particles and of electrons released by the action of X-rays. Of striking value are the photographs showing the expulsion of a proton by the impact of an α-particle (Meitner), and the forked tracks showing nuclear collision of an α-particle in oxygen and in helium (Blackett).

Science knows no national boundaries, but the policy adopted by the editors of asking foreigners to contribute articles on their own special subject suffers from several disadvantages, even when the author is recognised as one of the most distinguished specialists. When reading such an article, it is evident that the writer is often translating his thoughts from his own language into English, so that the mode of construction is essentially foreign, and in some cases the word chosen to represent a technical term is not that best suited for the purpose. The latter difficulty might perhaps have been avoided by more careful editorial supervision. One could, however, go further and say that it is not merely the difference in language which creates an obstacle; there may also be a difference in the very mode of thinking which raises a barrier between author and reader. In an original and independent contribution to science or learning, this is serious enough, but in an encyclopædia it is more than a drawback, it is almost a disqualification.

We must not end, however, on a critical note. Considered as a whole, these contributions to the study of experimental and mathematical physics reach a very high level, and are bound to have an important influence in the dissemination of accurate knowledge and in stimulating further scientific research.

H. S. A.

CHEMISTRY.

It will be within the recollection of many of those for whose education encyclopædias are published, that Kai Lung's remote ancestor spent his entire life in crystallising all his knowledge and experience into a few written lines, which as a result became correspondingly precious. The sentence "defined in a very original and profound manner several undisputable principles, and was so engagingly subtle in its manner of expression that the most superficial person was irresistibly thrown into a deep inward contemplation upon reading it". What an attractive encyclopædia the old gentleman and his co-compressionists could have produced! How immeasurably greater would his achievement have been if his sentence could have changed its shades of meaning and enlarged its philosophical perspective with advancing thought and maturing experience! That, in effect, is what a maker of encyclopædias is called upon to do. In a few short years the cut of the garments of a science such as chemistry appears impossible and even unhealthy, and the fabric itself gets moth-eaten in places; some of the embroidery, too, now appears superfluous. New discoveries are to be recorded, the ensemble has to be viewed afresh, new hopes arise while the epitaph is being written on the old.

Presumably the editors of the "Encyclopædia Britannica"—the encyclopædia of the English-speaking peoples, as it has been more exactly described—found it possible to revise a proportion of the chemical articles which appeared in the last edition, but it is evident that most of the matter has been entirely re-written. Let it be said immediately that by undertaking the onerous and responsible duties of chemical editor, Prof. G. T. Morgan has earned the thanks as well as the congratulations of both the scientific and the general public; so far as the chemical articles are concerned, the selection of the authors, all eminent exponents of their subjects, leaves nothing to be desired. The encyclopædia is not intended to be either a text-book for students of chemistry or a reference book for chemists; nevertheless, the authors of the articles on chemical themes are just those to whose views and to whose exposition of them chemists themselves would most willingly pay attention. In nearly every case (one cannot truthfully omit the "nearly") they have steered a middle course and appealed to the hypothetical intelligent layman who, with the man in the street and the average man, having been so long and so often the butt of our shafts of learning and wit, must surely now be possessed of a knowledge so encyclopædic as to render him independent of encyclopædias. As a working hypothesis it is reasonable to assume that the most renowned specialist is, in the view of another and different kind of specialist, just that ignorant but interested reader whose comprehension he must not underrate and whose curiosity he is anxious to arouse. Whether such an assumption were made or not, in the result we have that combination of clarity, brevity, and solidity that appeals to the scientific worker.

In such a collection of miniature monographs one does not expect uniformity. Indeed, chemistry itself is far from uniform in methods, in development, in language; from exponents of different phases of the science, therefore, similarity of approach, unanimity of appeal, and equality in the assumption of premises are not to be anticipated. As the same chemist is not usually deeply interested in both solutions and synthetic dyes, or in both gunpowder and glucosides, so the subject itself is too wide to admit of homogeneity in its revelation to the general public. Hence it would not be fair to say that the article on "Thermochemistry" (Mr. H. T. Tizard), for example, is less popular than that on "Valency" (Dr. N. V. Sidgwick), because the former makes sparing use of mathematics, or that "Dyes" is more technical than "Catalysis", because it incorporates a large number of hexagons. In point of fact, "Catalysis" (Dr. E. K. Rideal) is a good example of an authoritative article which appears to have been written for the 'brethren', and "Synthetic Dyes" (Mr. A. G. Green) of a highly technical subject treated in such a manner as to make the non-chemical reader feel that he has missed his true vocation. "Flame" (Prof. A. Smithells) is accompanied by photographs of types of flame structure; it is restricted to stationary flames. Among other articles which deserve to be mentioned in any description of the chemical service of the encyclopædia are such, for example, as Prof. G. T. Morgan's "Diazo-Compounds" and "Organo-Metallic Compounds", Mr. J. A. V. Butler's "Solutions"—pleasant as well as instructive reading—Prof. W. N. Haworth's "Carbohydrates", Dr. W. H. Mills' "Stereochemistry" (a lucid exposition of a difficult subject), Dr. T. A. Henry's "Glucosides" and "Alkaloids", Prof. R. Robinson's "Chlorophyll", Dr. A. D. Mitchell's "Ammonia", and Dr. S. E. Sheppard's "Photochemistry". One finds notable revisions, such as "Argon" by the late and the present Lord Rayleigh, and "Atomic Weights" by the late Prof. T. W. Richards.

A comprehensive general review of the science of chemistry is offered in an article extending over nearly sixty pages and contributed by Prof. H. B. Dixon ("History of Chemistry"), Dr. J. D. Main Smith ("Inorganic Chemistry"), Dr. E. Holmes ("Organic Chemistry: Historical"), Prof. F. Francis ("Organic Chemistry: Aliphatic Division), Prof. J. Read ("Organic Chemistry: Homocyclic Division"), Mr. R. H. F. Manske ("Organic Chemistry; Heterocyclic Division), Prof. H. M. Dawson ("Physical Chemistry"), Mr. B. A. Ellis ("Analytical Chemistry:

Inorganic) ", Dr. M. A. Whiteley (" Ultimate Organic Analysis "), and Mr. E. W. Yeoman (" Gas Analysis "). It is a substantial article, and a substantial contribution to the literature of chemistry. In a work of such magnitude as the " Encyclopædia ", the definition of boundaries must have presented considerable difficulties in seeking to provide for a thorough survey of the borderland between one science and another; those regions lying between chemistry and engineering, or between chemistry and economics, for example, have acquired an importance second to none in the industrial outlook, both of the English-speaking and of other peoples. Due regard has been had to such common issues, but only a careful and exhaustive analysis of the treatment of cognate subjects shared both with other sciences and with other human interests would show whether the impression that little of first importance has been overlooked is accurate. Ions, although discussed incidentally, have (except in regard to their catalytic action) scarcely been accorded their usual place of honour in chemical theory; whilst noticeable, this is doubtlessly completely devoid of significance.

Allusion to the relation of chemistry to other human interests invites reference to the article entitled " Chemical Warfare ", by Brig.-Gen. Sir H. B. Hartley and Mr. C. G. Douglas, where developments resulting from the use of gas as a military weapon by the German Army are described, together with measures adopted for protection against its effects. In view of its efficacy as an arm in the field, the probability of its proving equally potent when used in conjunction with aircraft against industrial centres or even against the civilian population, and the ease with which chemical industry organised for essential national requirements in times of peace can be converted into an arsenal in time of war, the possibility of the future use of military gases in spite of international agreements is one which, we are warned, is felt not to be remote. Until the danger is effectively removed by statesmen, it will remain all too obvious to chemists.

A. A. E.

The Climate of the Pleistocene Period.*

THE glaciation of northern Europe during the great Ice Age was due to a shift of the pole associated with appreciable variations of solar radiation.

The shift of the pole brought Europe into sufficiently high latitudes to permit of the formation of an ice sheet; but the large variations of climate during the Ice Age, as shown by the interglacial periods, were due to the oscillations of the solar energy.

If two complete cycles of solar radiation occurred during the Pleistocene period, it is possible to account for four advances of the ice in the Alps as demonstrated by Penck and Bruckner, but the interglacial periods were not all warm. The Günz-Mindel and the Riss-Würm interglacial periods occurred at the maximum of the solar radiation, and were, therefore, warm interglacial periods; but the Mindel-Riss interglacial period occurred at a minimum of solar radiation and was, therefore, a cold interglacial period.

At a maximum of solar radiation, that is, during a warm interglacial period, the climate of north-west Europe was warm and very wet, with a relatively small annual variation of temperature. As the intensity of solar radiation decreased, the mean temperature fell and the annual variation of temperature increased. At the same time the amount of precipitation decreased. The fall of temperature occurred sufficiently rapidly compared with the decrease in precipitation to cause the glaciers of the Alps to advance and for an ice sheet to form over Scandinavia. As the solar radiation still further decreased, the lack of precipitation caused the glaciers of the Alps to retreat. At the minimum of solar radiation, there was a cold interglacial period with low mean temperature, a large annual variation of temperature and very low precipitation. In fact, a truly continental climate.

With these changes of climate went a corresponding change in the flora, the sequence being: park land, forest, tundra, grass with sparse trees, and steppe. In this way it has been found possible to determine a sequence of climates and of fauna and flora for the whole Pleistocene period which is supported by the geological and archæological evidence available. In particular it is possible to arrange the sequence of human culture, the geological strata of East Anglia, and the history of the ice in the Alps into the scheme of climate change.

The two maxima of solar radiation were accompanied by increased precipitation in all parts of the world, so accounting for the two pluvial periods which are known to have occurred during the Pleistocene period.

* Summary of an address delivered before the Royal Society of Edinburgh on June 16, by Dr. G. C. Simpson, F.R.S.

The Mechanism of Variation.[1]

By Prof. HENRY H. DIXON, F.R.S.

THE fundamental work on the production of variants by means of X-rays and the γ-radiation of radio-active substances, which has been chiefly carried out during the last two or three years in America, is of profound interest to all students of biology. By these means H. J. Muller found it possible to increase 150 times the minute amount of natural variation which is only accessible to estimation by laborious searching through tens of thousands of individuals. It was observed that these variations were completely fortuitous, occurring in any characteristic, in any direction, some quite new, some known as occurring under natural conditions, some losses, some gains, but numerically proportional to the duration of radiation, or to the amount of air-ionisation produced by the radiation used.

Variations produced by this method are transmitted in breeding experiments to the offspring according to the known laws of heredity, so that there is no doubt that they are represented in the germ-plasm by factors or genes. They have been transmitted unaltered through fifty generations. Changes in the chromosomes, corresponding to observed disturbances in linkage, show that the radiation alters the characteristics through alterations in the architecture of the germ-plasm. Breeding experiments emphasise the random nature of the changes, since it has been shown that one gene, of two lying side by side in a chromosome, may be changed; while its *vis-à-vis*, not the thousandth of a millimetre distant, has remained unaltered. The same gene in adjacent cells may also escape modification.

This random, but minutely selective, action is just what might be expected to result from disturbances in the germ plasm due to the expulsions of electrons by the short waves of X-rays, γ-rays, and cosmic rays. The great preponderance of lethal variations observed over viable and useful ones is only to be expected when we reflect on the necessary bewildering complexity of structure of the genes and the randomness of the dislocations produced by the radiations.

Short-waved radiation (X-, γ-, and cosmic radiation) is then a *vera causa* of variation, and just as in the experiments of Muller, Stadler, Goodspeed, Olson, etc., all manner of variations are produced and even the same variations repeated, so in nature the similar, but less intense, radiation is responsible at relatively long intervals for similar variations.

With the aid of this fundamental new knowledge we have a ready explanation of many of the old-standing difficulties in the path of the evolutionist. The occurrence of similar morphological features in divergent lines of descent has produced much discussion and has been variously explained as due to homoplasy or innate tendencies, etc. According to this new departure, radiation acting on the germ plasm is responsible. The architecture of the germ plasm of the divergent lines of descent is fundamentally similar. Radiation causes all manner of fortuitous variations—mostly lethal, and a limited number viable. Hence in the lapse of time some of those which are viable and possibly advantageous recur in the diverging lines. In the same way many atavisms and instances of parallel development may be explained.

The possession of common morphological characters by the individuals of certain groups, otherwise considered to be genetically far apart, has led to the self-contradictory conception of polyphyletic groups and genera. Viewed in the light of this new principle, however, such resemblances are due to nothing else but the reappearance of the same variation conditioned by changes in the genes by the short-waved radiations of Nature. Inasmuch as the majority of these variations are lethal, the number of the viable ones are limited and must recur repeatedly as the phylogeny is extended.

Again, instances of discontinuous distribution must often find their explanation in this recurrence of the same variation in different localities.

In quite a different domain of evolutionary study, this principle may be called in to supply an explanation of the relatively high number of endemics which are said to occur on high mountains. Naturally, since variation is proportional to radiation, locations on mountain-tops being screened from cosmic radiations by a shallower atmosphere should exhibit a greater number of variations than similar areas on the plains.

It has often been pointed out that the uselessness of the intermediate stages in the development of a useful organ constitutes a serious difficulty in the theory of evolution based on the natural selection of accumulating minute variations. But the conception of variation arising from within due to intramolecular changes in the germ-plasm removes this difficulty. It is quite conceivable that a gene, if only it retains viability, will be so altered as to condition the production of a useful character or organ without any intermediate steps being necessary.

[1] Last spring when the work of Goodspeed and Olson called my attention to the causation of variation by X-rays, I suggested (NATURE, June 29, 1929, p. 981) that cosmic radiation is a factor in the production of variation by direct action on the germ-plasm. At the time I did not know that this suggestion had been made and had been experimentally substantiated by the brilliant work of the American investigators whose results are summarised in this communication.—H. H. D.

University and Educational Intelligence.

Belfast.—Mr. J. G. Semple, lecturer in pure mathematics at the University of Edinburgh, has been appointed professor of mathematics.

Cambridge.—The following reappointments are notified: Mr. L. E. S. Eastham, Trinity Hall, as university lecturer in advanced and economic entomology; Dr. T. M. Harris, Christ's, as demonstrator in botany; Mr. H. L. H. H. Green, Sidney, as demonstrator in anatomy; Dr. S. M. Manton, Girton, as demonstrator in comparative anatomy.

The vice-chancellor announces that the Quick professorship of biology will become vacant next November, when the period of three years for which Dr. Nuttall was last elected will have ended. A meeting for the election of a Quick professor will be held on July 16.

The vice-chancellor also gives notice that the Downing professorship of medicine is vacant by the death of Dr. Bradbury.

The Woodwardian professorship of geology will become vacant in October by the resignation of Dr. Marr.

At Trinity Hall, Mr. C. Forster Cooper, having resigned the office of bursar, has been elected to a non-stipendiary fellowship, and Dr. O. H. Wansborough-Jones has been elected to a research fellowship.

Leeds.—The foundation stone of the new library building presented to the University by Lord Brotherton of Wakefield was laid by the donor on June 24. The Duke of Devonshire, Chancellor of the University, presided, and the meeting was addressed by him and by the vice-chancellor, the librarian, and Lord Brotherton. The vice-chancellor remarked that "Through the munificence of the Lord Brotherton of Wakefield this University will in a short time be in the possession of a library building worthy of the highest aspirations of its scholars, its scientists, and its students, adequate to meet the requirements of the complete development of the University in the future, unsurpassed if not unrivalled by any similar institution in this country." A striking innovation is the fact that it will be possible to place a quarter of a million volumes on shelves that are open to the access of all readers. A generous donor has given to the University a fine collection of Icelandic books which will find their place on the shelves of the new library building. Lord Brotherton announced that it is his intention to house his own collection in the new library, to be held by the University in perpetual trust for the nation. It is his desire that access to the books shall be accorded to all properly accredited persons. With this end in view, Lord Brotherton is taking the necessary steps to endow the collection.

London.—The following doctorates have been conferred: *D.Sc. in Chemistry*, Mr. Harold Burton (Guy's Hospital Medical School) and Mr. C. W. Shoppee, an external student. *D.Sc. in Soil Bacteriology*, Mr. H. G. Thornton (Rothamsted Experimental Station). *D.Sc.* (*Engineering*), Mr. C. H. M. Jenkins (Imperial College—Royal School of Mines) and Mr. Burrows Moore (King's College). *D.Sc. in Botany*, Mr. C. R. Darlington, an external student.

Prof. J. K. Catterson-Smith has been appointed as from Aug. 1 to the University chair of electrical engineering tenable at King's College. Prof. Catterson-Smith was educated at the City of London School, the South-Western Polytechnic, and the University of Birmingham. Since 1923 he has been professor and head of the Department of Electrical Engineering at the Indian Institute of Science, Bangalore, of which he has also officiated as director.

The International Committee and the Sub-Committees on Intellectual Co-operation of the League of Nations will be holding meetings in Geneva during the whole of the month of July. The sub-committee of experts on the instruction of youth in the aims and objects of the League of Nations meets on July 3. It is due to the past labours of this committee that so much educational work (including direct teaching) for the League is going forward in various countries. Two ' common chapters ' have been produced by the Secretariat at Geneva. These are intended to form the core of national text-books on the subject and will " probably assume a different form in various countries ". The British volume is to be produced under the auspices of the newly formed British National Committee on Intellectual Co-operation, to avoid its being of too official a character. After the other sub-committees have completed their labours, the thirteenth plenary meeting of the International Committee will take place on July 23. Its principal business will be the discussion of the report of the committee of inquiry into the working of intellectual co-operation which met at Easter. Considerable changes of organisation are foreshadowed, especially in regard to the Paris Institute. The number of subjects to be dealt with under the heading of intellectual co-operation have been considerably ' rationalised '. It is hoped that by a greater concentration of effort, more concrete results will follow.

Historic Natural Events.

June 30, 1908. **The Siberian Meteorite.**—A great meteorite fell in the upper basin of the Podkamennaia Tugunska River, Siberia, about 60° N., 71° E. The place of fall, as described in 1927, had the appearance of a huge crater, several kilometres across, surrounded by an amphitheatre of mountain chains and peaks. The area, formerly forest, was completely wrecked; lines of stripped tree trunks without branches or bark lay struck to the ground in parallel rows, their tops away from the centre of fall of the meteorite. Even where the pines were standing they were usually trunkless and branchless, and showed signs of having been burnt over an area tens of kilometres across. More than a thousand reindeer were killed, some disappeared entirely, burnt remains of others were found. The burning was not due to ordinary fire, but probably to the cloud of incandescent gases which accompanied the meteorite. The force of the impact threw the ground into flat folds, but the greatest damage was done by the air wave. At a distance of nearly 400 miles the noise and vibration resembled that of a nearby explosion. The air-wave probably passed completely round the world; it was clearly shown on micro-barographs in England, where its cause was at the time unknown, and it aroused great interest. It was described as a succession of four undulations, commencing with a range of about five-thousandths of an inch, lasting about a quarter of an hour, and then violently interrupted by a sudden, though slight, explosive disturbance which set up different and much faster oscillations for a similar interval.

June 30, 1908. **Brilliant Sky Glows.**—In central and western Europe and the British Isles, brilliant sky glows were observed on the night of June 30 and on several succeeding nights, especially July 1. The whole northern part of the sky, up to an elevation of about 45°, was suffused with a reddish hue, varying from pink to Indian red, while in the east the sky was a pale green. At midnight fairly small print could be read out of doors. It remained as light in the south of England as is normal in the north of Scotland at this season. There was no flickering or other indication of aurora, and the phenomenon appears to have been an abnormal prolongation of twilight throughout the night; there is little doubt that, as suggested by Mr. Spencer Russell, it was caused by the ' cosmic dust ' resulting from the fall of the meteorite described above.

June 30, 1926. **Floods in Yugoslavia.**—Heavy floods occurred in many parts of Europe towards the end of June and during July, and in Yugoslavia they were very extensive and prolonged. On June 30 and July 1 large areas in southern Serbia and Hertzegovina were under water, Nish, Veles, and Pirot being flooded and ripe crops destroyed. Parts of Belgrade were inundated by the Danube and Save. About a fortnight later further heavy rain and hail occurred, and the Danube and Save again overflowed, while in Rugovo, Montenegro, 40 people were killed by hail. Many dams burst their banks and numerous bridges were destroyed. Damage to the extent of about £10,000,000 was done.

July 2, 1893. **Cloudburst in Cheviots.**—A hill in the Cheviots, known as Bloody Bush Edge, was visited by a waterspout or cloudburst. The day was oppressive and about 10 A.M. heavy clouds gathered. These broke about 1 P.M. and " the whole hill and parts of the adjoining hills were covered with a sheet of water " (" British Rainfall "). The peat which forms the surface of the hill was ploughed up to a depth of about five feet, and the rocks beneath laid bare over a space of 30-40 acres. The River Breamish rose forty feet in sudden flood, swept away its bridges and destroyed long stretches of roadway.

July 3, 875. **Cloudburst in Saxony.**—In Saxony occurred a cloud-burst of great violence; Aschenbrunn, a place remote from all water, being washed away with all inhabitants and buildings.

July 3, 1863. **Hailstorm at Clermont-Ferrand.**—The day was exceedingly hot, and by 3 P.M. the sky was covered by an enormous nimbus cloud, with flashes of lightning in quick succession. About 6 P.M. a cloud approached rapidly from the west, at a height estimated as 5000 feet. It resembled a huge net in form, the portion represented by the netting showed violent agitation, and soon after the arrival of the cloud there was a heavy hailstorm lasting about five minutes, the hailstones being as large as nuts. During the fall of the hail there was no wind. The hail caused considerable damage wherever it fell, and M. Lecoq, who saw the storm and described it in the *Comptes rendus*, stated that the damage was limited to small patches, which were surrounded by undamaged zones, forming a network the meshes of which were irregular but roughly 60-100 metres apart. The distribution of the hail corresponded with the form of the cloud.

July 3, 1892. **Floods at Langtoft.**—A heavy black cloud with three pendants burst over the hills west of Langtoft in Yorkshire, and a great volume of water flowed into the valley, cutting two deep channels in the chalk. The village was flooded to a depth of eight feet, and great damage was done. On the same day heavy rain fell near Driffield, and this, added to the water from Langtoft, caused further floods.

July 5-6, 1911. **Low Antarctic Temperature.**—During Scott's last Antarctic expedition, a party travelling by sledge from Cape Evans to Cape Crozier met with very low temperatures as soon as they reached the Barrier. For more than a week the thermometer was below −60° F.; on the night of July 4-5 the minimum temperature was −71° F., and on that of July 5-6, −77° F. Although the air was comparatively still, little puffs of wind came eddying across the snow plain with blighting effect, and the party felt the cold severely in their canvas tent.

Societies and Academies.

LONDON.

Royal Society, June 19.—H. R. Robinson and C. L. Young: New results of the magnetic spectroscopy of X-ray electrons. New measurements are given of the energies and intensities of the secondary, tertiary, . . . cathode rays ejected by silver K-radiations from a number of elements. The results are discussed in their relation to current theories of the interaction of X-rays and matter and of the X-ray term structure.

Royal Meteorological Society, June 18.—C. E. P. Brooks and S. T. A. Mirrlees: Irregularities in the Annual Variation of Temperature in London. The late Dr. A. Buchan enumerated six cold and three warm spells which recurred about the same dates in each year in Scotland in the 1860's. To find whether these or similar spells occurred also in London, averages of temperature at Kew Observatory were found for each of the periods 1871 to 1900 and 1901 to 1929, and were combined into five-day means, a "spell" being defined as a period of five days. The details of the curves of annual variation obtained in this way were almost completely different in the two periods, and do not give the slightest support to the idea that there is any abiding tendency for any part of the year to be either cold or warm for the season. In particular, the famous 'Buchan cold periods' are abnormally warm as often as they are abnormally cold. The nearest approach to a regular cool period occurs in summer, when the annual rise of temperature ceases towards the end of July and gives place to a period of variable temperature which continues until the autumn fall sets in about the middle of August; but none of these oscillations occurs with sufficient regularity to enable any special dates to be picked out as definite warm or cold periods.—C. E. P. Brooks: The Climate of the first half of the Eighteenth Century. There has been no appreciable change of climate since 1750, but there is much evidence that the first half of the eighteenth century was abnormally dry in western Europe. Rainfall figures are discussed for 29 places, and the average deficiency of rainfall is calculated as 7 per cent in England, 15 per cent in France, and 9 per cent in Russia and Sweden. South-westerly winds were less frequent than now and north-westerly winds more frequent; the area of low pressure near Iceland was therefore probably less intense than at present. The deficiency of rain was greatest in the south of France, while Italy and Tunis were wetter than now, suggesting that the stormy area in the Gulf of Lyons was highly developed. The inquiry is extended to other parts of the world; the slow growth of the 'Big trees' shows that rainfall was slight in western U.S.A., and the Lake of Mexico was at a low level, but the Caspian Sea and the Nile floods were high and there were many floods in China. All these facts agree that the general atmospheric circulation, which governs the rainfall of western Europe and California, was weak; the southerly monsoons of Abyssinia and China, which override the general circulation, were abnormally strong and brought heavy rainfall to those countries.

PARIS.

Academy of Sciences, May 12.—Ernest Esclangon: The determination of the position and elements of an object (planet or comet) by three observations corresponding to a small arc of the orbit. A mathematical discussion of a method which assumes only that the arc described by the object round the sun during the interval of the observations is a small angle, and this without any hypothesis as to the arc described by the earth in the same interval.—Gabriel Bertrand and Mlle. Y. Beauzemont: The variations of the content in zinc of animals with age: the influence of a milk diet. Earlier work by Bertrand and Vladesco showed that in mammals the proportion of zinc present is at a maximum at birth, gradually diminished during the period of milk feeding, the milk being very poor in zinc, and increases again after weaning. Several American workers having recently published results which appear to contradict these conclusions, a critical discussion of the American work is given, and fresh experimental evidence produced supporting the authors' original conclusions.—André Blondel: The application of the mutual impedances to the study of the regimes of networks out of equilibrium.—Maurice Lugeon: The origin of granite. In opposition to the view that granitic rocks are due to igneous intrusion from below, it is suggested that during folding movements the mechanical energy has been transformed into its heat equivalent, and the formation of granitic rocks is due to this enormous liberation of heat.—Charles Mourain was elected a member of the Section of Astronomy in the place of the late H. Andoyer.—G. Vrançeanu: The groups of applicability of non-holonome varieties.—Paul Alexandroff: The theory of dimension.—L. Pontrjagin: A fundamental hypothesis of the theory of dimension.—E. D. Pompéiu: A functional equation which occurs in a problem of average.—J. Dieudonné: The circles of multivalence of limited functions.—Georges Valiron: A class of functional equations.—L. Kantorovitch and E. Livenson: The projective ensembles of M. Lusin.—Henri Poncin: The flow of heavy fluids.—Emile Merlin: A very general case of the motion of a heterogeneous perfect fluid in rotation, presenting striæ in the form of spirals.—Henri Marcelet: The spectrographic analysis of the fluorescences of some vegetable oils observed under the ultra-violet rays. As ocular comparisons of fluorescent colours are rather uncertain, a spectrographic method has been used. Both the emission and absorption spectra were studied and these were found to be quite different. Some technical applications are suggested.—Swyngedauw: The theory of balanced dynamos utilised for the measurement of the losses in pulley belts.—S. Rosenblum: The fine structure of the magnetic spectrum of the α-rays. The measurements were made with the large electromagnet of the Academy of Sciences (Bellevue), with modified arrangements giving a higher order of accuracy than in the first experiments. The velocities are referred to the velocity of the α-radiation of thorium-C as unity, and have an accuracy of one part in a thousand.—E. Carrière and Janssens: The determination of fluorine as calcium fluoride. Improvements on a method previously described.—Travers and Avenet: The estimation of thiocyanates in coke oven effluents.—Lespieau: Phenyltrimethylene. This was obtained in an impure state by the action of zinc on the compound $CH_2Br . CH_2 . CHBr . C_6H_5$. Purification was effected by cautious treatment with a weak solution of potassium permanganate. Its physical and chemical properties are compared with those of allylbenzene and propenylbenzene.—A. Seyewetz and Brissaud: Water of crystallisation in mineral and organic compounds.—R. Clogne, Mlle. A. Courtois, and Cazala: The proportion of arsenic in the wells of Choussy de La Bourboule and the fixation of this arsenic in the organism. The proportion of arsenic found varied according to the season between 5·8 and 6·5 mgm. per litre. Tadpoles were readily acclimatised to this water. The amount of arsenic absorbed increased the proportion found in the tadpoles by more than 70 per cent.—Paul Becquerel: The latent life of fern spores in a vacuum at the temperature of liquid helium. The spores, previously dried for six months over barium oxide, were cooled for a period of eleven hours to −270° C., in a bath of liquid helium. No difference between the spores thus exposed and those kept at the ordinary temperature could be observed, the germinating power and appearance and structure of the prothallus being similar in both cases. —**H. Lagatu and L. Maume**: The comparative chemical evolution of vine leaves removed from different heights of the branches.—**J. Chaussin and E. Blanchard**: The physico-chemical regulation in the internal medium of some agricultural plants.—**Robert Lemesle**: Observations relating to *Fusarium anthophilum*, a parasite of *Scabiosa succisa.*—**Louis Bounoure**: The presence of distinct germinal cells in the blastula of the reddish brown frog.—**J. de Lépiney**: The biology of the pilgrim cricket (*Schistocerca gregaria*).—**L. Doljanski, J. J. Trillat, and Lecomte du Noüy**: The action of the X-rays on cultures of tissues *in vitro*. Previous work on the effect of X-rays on tissue cultures *in vitro* has tended to prove exceptional resistance of the latter. The author considers that these results were due to faulty technique. The experiments described show that the lethal dose is reached after five minutes' irradiation.—**Raoul M. May**: Water and the phosphorus combinations of the nerve in the course of degenerescence.—**Edouard Chatton, André Lwoff, and Mme. Marguerite Lwoff**: *Phoretophyra nebaliæ* and the interpretation of the evolutive cycle of the ciliated Fœttingeriideæ.—**Radu Codreanu**: The internal phase of the evolutive cycle of two forms of *Ophryoglena*, endoparasitic Infusoria of the larvæ of ephemera.—**G. Ramon**: The reciprocal relations of the diphtheria antitoxin and the antigen (toxin and anatoxin).

Official Publications Received.

British.

Proceedings of the Royal Society of Victoria. Vol. 42 (New Series), Part 2. Pp. 69-256+plates 2-22. (Melbourne.)

Canada. Department of Mines: Mines Branch. Abrasives. Products of Canada, Technology and Application. Part 4: Artificial Abrasives and Manufactured Abrasive Products and their Uses. By V. L. Eardley-Wilmot. (No. 609.) Pp. vii+144 (19 plates.) (Ottawa: F. A. Acland.) 20 cents.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1227 (Ae. 382): The Wing Flutter of Biplanes. By W. J. Duncan. (T. 2831.) Pp. 60. 3*s*. net. No. 1277 (Ae. 423): Stability Derivatives of the Bristol Fighter. By Dr. A. S. Halliday. (T. 2854.) Pp. 14+14 plates. 1*s*. net. No. 1294 (Ae. 443): Centre of Pressure Travel of Symmetrical Section at Small Incidence. By F. B. Bradfield. (T. 2892.) Pp. 9+7 plates. 9*d*. net. (London: H.M. Stationery Office.)

Department of Scientific and Industrial Research: Forest Products Research. Bulletin No. 5: The Moisture Content of Wood, with Special Reference to Furniture Manufacture. By S. T. C. Stillwell. Pp. vi+27. (London: H.M. Stationery Office.) 2*s*. net.

The Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1930. Pp. 16. (Glasgow: The University.)

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Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1929. Pp. vi+146. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

British Antarctic Expedition, 1907-1909. Reports on the Scientific Investigations. Meteorology. By Dr. Edward Kitson. Pp. 188. (Melbourne: Council for Scientific and Industrial Research; London: Official Secretary, Australia House.) 8*s*.

The Journal of the National Institute of Agricultural Botany. Vol. 2, No. 3. Pp. 177-308. (Cambridge: W. Heffer and Sons, Ltd.) 2*s*. 6*d*. net.

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1930, June 7. Pp. 19. (Greenwich.)

Department of the Interior: Natural Resources Intelligence Service. The Province of New Brunswick, Canada: its Natural Resources and Development. By L. O. Thomas. Pp. 168. (Ottawa: Natural Development Bureau, Department of the Interior.) Free.

India: Meteorological Department. Scientific Notes, Vol. 2, No. 12: The Association of the Mid-Monsoon Indian Rainfall with Pressure Distribution over the Globe. By Rao Saheb Mukand V. Unakar. Pp. 13-19+4 plates. (Calcutta: Government of India Central Publication Branch.) 10 annas; 1*s*.

Annual Report of the Calcutta School of Tropical Medicine, Institute of Hygiene and the Carmichael Hospital for Tropical Diseases, 1929. Pp. 116. (Calcutta: Bengal Government Press.)

Home Office. Criminal Statistics, England and Wales, 1928: Statistics relating to Crime, Criminal Proceedings and Coroners' Investigations for the Year 1928. (Cmd. 3581.) Pp. lxix+197. (London: H.M. Stationery Office.) 4*s*. net.

Miscellaneous Publications of the Royal Alfred Observatory. No. 10: The Cyclone Season 1928-1929 at Mauritius. By R. A. Watson. Pp. 4+30 charts. (Mauritius.)

Foreign.

U.S. Department of Agriculture. Leaflet No. 60: Porcupine Control in the Western States. By Ira N. Gabrielson and E. E. Horn. Pp. 8. 5 cents. Miscellaneous Publication No. 71: Weather Forecasting from Synoptic Charts. By Alfred Judson Henry. Pp. 80. 20 cents. (Washington, D.C.: Government Printing Office.)

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol. 40, Fascicule 4: Table générale des matières contenues dans les volumes 1-40 des Mémoires. Pp. 435-500. (Genève: Georg et Cie.) 5 francs.

Cornell University Agricultural Experiment Station, Ithaca, New York. Bulletin 499: The Effect of Dusting-Sulfur upon the Germination of the Pollen and the Set of Fruit of the Apple. By L. H. MacDaniels and J. R. Furr. Pp. 13+1 plate. Bulletin 500: Legumes as a Source of Available Nitrogen in Crop Rotations. By T. L. Lyon. Pp. 22. (Ithaca, N.Y.)

Proceedings of the United States National Museum. Vol. 77, Art. 11: The Herpetological Collections made by Dr. Hugh M. Smith in Siam from 1923 to 1929. By Doris M. Cochran. (No. 2834.) Pp. 39. (Washington, D.C.: Government Printing Office.)

Methods and Problems of Medical Education (Seventeenth Series). Pp. iv+279. (New York: The Rockefeller Foundation.)

Proceedings of the Imperial Academy. Vol. 6, No. 3, March. Pp. ix-xi+93-129. Vol. 6, No. 4, April. Pp. xiii-xiv+131-185. Supplement to Vol. 6: A Concordance to the History of Kirishitan Missions (Catholic Missions in Japan in the Sixteenth and Seventeenth Centuries). Compiled by Masaharu Anesaki. Pp. iii+225. (Tokyo.)

United States Department of Agriculture. Miscellaneous Publication No. 74: An Annotated List of the Important North American Forest Insects. Compiled by F. C. Craighead and William Middleton. Pp. 31. (Washington, D.C.: Government Printing Office.) 10 cents.

Japanese Journal of Astronomy and Geophysics: Transactions and Abstracts. Vol. 7, No. 3. Pp. iv+83-145+19-44+23 plates. (Tokyo: National Research Council of Japan.)

Catalogues.

Bulletin No. 2: Spectrum Analysis. Pp. 23. (London: Adam Hilger, Ltd.)

Acetylcholine B.D.H. in the Treatment of Raynaud's Disease, Arteritis, Arterial Hypertension and similar Complaints. Pp. 8. (London: The British Drug Houses, Ltd.)

English and Foreign Literature: a Collection of Miscellaneous Books. (No. 30.) Pp. 108. (Newcastle-on-Tyne: William H. Robinson.)

Photography Simplified: Development. Pp. 12. (London: Burroughs Wellcome and Co.)

Diary of Societies.

FRIDAY, June 27.

Royal Society of Medicine (Otology Section) (at Nottingham), at 2.—Papers by Dr. M. Evans, Prof. G. Guida, Dr. Densham, and L. Yates. Discussion on the Proceedings of the Committee for the Consideration of Hearing Tests.

SATURDAY, June 28.

Royal Society of Medicine (Orthopædics Section) (at St. Vincent's Orthopædic Hospital, Eastcote, near Pinner), at 3.

Royal Society of Medicine (Otology Section) (at Nottingham) (continued).

TUESDAY, July 1.

Royal Society of Medicine, at 4.30.—Annual General Meeting.

FRIDAY, July 4.

Geologists' Association (at University College), at 7.30.—Dr. C. T. Trechmann: The Relation of the Permian and Trias in North-East England.—J. J. Hartley: The Volcanic and other Igneous Rocks of Great and Little Langdale, Westmorland.—*Paper to be taken as read:*—P. Jessop: The Agates and Cherts of Derbyshire with a Brief Account of the History of the Lower Carboniferous Limestone of the Peak District.

Association of Economic Biologists (at National Institute for Research in Dairying, Shinfield, near Reading).

CONGRESS.

June 21 to 28.

Royal Sanitary Institute (at Margate).

Friday, June 27, at 10 a.m.—Meetings of Sections and Conferences.
C.—Maternity and Child Welfare (including School Hygiene).
E.—Hygiene in Industry.
F.—Veterinary Hygiene.
II.—Representatives of Port Sanitary Authorities.
III.—National Health Insurance Services.

SUMMER MEETING.

June 30 to July 4.

Institution of Mechanical Engineers (at Bristol).