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Crystals and Cells.

UNTIL very recent years, the addresses of presidents of Sections of the British Association were never made subjects of formal discussion. The address delivered on Monday, August 11, by Sir William Bragg to Section A (Mathematical and Physical Science) of the British Association meeting at Toronto departed from the former custom in being an introduction to a joint discussion with Section B (Chemistry), on crystal structure. Sir William Bragg explained how X-rays have made it possible to analyse the structure of crystals, thus opening up the chemistry of the solid. The X-rays tell us the number of molecules in the crystal unit and the mode of their arrangement, on which, of course, many properties of the substance depend. It may be noted that just as there are *atoms* of silicon and of oxygen, and a *molecule* of silicon dioxide, so there is a *crystal unit* of quartz consisting of three molecules of silicon dioxide arranged in a particular way. There are thirty-two classes of crystals, according to the kind of external symmetry which they display; but now that he can look into the interior of the crystal, Sir William Bragg finds that there are 230 different modes of internal arrangement. This is a new kind of crystal-gazing.

It has often been asked why a crystal should grow ("Lapides crescunt," said Linnæus) in a solution, especially when the substance in solution is different from that of the crystal, though crystallising in the same style of architecture. There is a welcome beam of light in Prof. Desch's paper on the crystal surface, for it shows that the aplomb of the atoms on the space lattice of the interior, where they are held in position by forces symmetrically disposed, is not shared by those on the surface layer, where there is surface tension and a welcoming, so to speak, of support by accretion from without. At high temperatures, it is noted, the surface tension may be sufficient to cause rounding of the sharp angles of a crystal.

The key-note of the Toronto meeting seems to be "control," for we find Prof. F. W. Gamble, in his presidential address, telling the zoologists that "zoological problems have become problems of control," not so much in the way of restraint as of "quickening." "The infinitely varied animal fabric appears to be the exquisitely balanced individual expression of processes that quicken and restrain." "If to succeed is to come up from below, the actual animal life that succeeds must be but a fraction of the submerged recessive life that experiment reveals. These recessives when artificially bred are no mere cripples, nor disconnected with the evolution of normals. They show us something of the depths of animal nature, and help us to realise that

but for the grace of organic regulation we should be even as they. But the study of such analysis as a branch of zoology leads to an even more striking result. Not only does it reveal the existence of these sub-normals, but also it accounts for the defection of certain expected offspring. There are non-viable combinations of living substances. These entering the egg that should by expectation produce a male, render the egg incapable of development. That family will be one of daughters only. The existence and the control of lethal factors is one of the most significant discoveries of the underworld."

Prof. Gamble is a strong swimmer and he led his audience into deep waters in his discussion of Prof. Child's hypothesis of metabolic gradients. That is to say, there is in an animal like a Planarian worm a gradation in the intensity of chemical change or metabolism from the head backwards. The rate increases again at a point far down the body and then falls to the tail-end. The second, smaller peak marks the place where the worm divides transversely in its asexual multiplication; it marks the site of the future head of the coming daughter! Prof. Gamble regards the suggestiveness of the evidence in support of the gradient hypothesis as exceeding its conclusiveness for the time being. He goes on to discuss with insight the periodicity of vital functions, the problem of nervous control, the control of environment, and the lightening of the eyes that will come when people take zoology seriously.

In his address to Section M (Agriculture), Sir John Russell discussed "Present-day Problems in Crop Production." One of the big conclusions that has emerged of recent years is that the plant is an even more plastic organisation than we thought; it can be moulded to a notable extent, though within certain—very uncertain—limits. One way of doing this is the Mendelian method of picking out desirable unit characters from plants in which they occur and assembling them in a new plant. The other way is selection, in which a desirable plant is caused to produce seed from which stocks are multiplied. A second generalisation is that the soil is not a fixed, constant thing, but is pulsating with change. The micro-organisms fluctuate continually, and even the mineral part of the soil is not constant in composition. "Modern research work shows that many of the properties determining fertility in soils are due to the soil colloids, and some of the most important are attributable to calcium complexes. These are unstable and are affected by the soil water."

Sir John Russell spoke of the control of the plant, the control of environmental factors (for example, by high-tension electric discharge), the control of soil factors, and the control of soil organisms. But he sounded another note, too seldom heard in these utilitarian days; he spoke eloquently of the value of science for its own sake. "How many farmers know anything about the remarkable structure of the soil they till, of its fascinating history, of the teeming population of living organisms that dwell in its dark recesses, of the wonderful wheel of life. . . ." "No one knows much of these things; but if we knew more, and could tell it as it deserves to be told, we should have a story that would make the wildest romance of human imagination seem tame by comparison, and would dispel for ever the illusion that the country is a dull place to live in." This is well said. Trust the agriculturist, fundamental utilitarian as he is, to be loyal to the life that is more than meat.

A familiar experience at meetings of the British Association, especially if one wanders out of "one's own Section," is a coercive abandonment of facts and conclusions which one had treasured as absolutely certain. This holds for the Toronto meeting. Thus it used to be common teaching that the earliest Pre-Cambrian rocks represented the original crust of the earth, formed as it cooled from a molten to a solid condition. This was a comfortable view, for it gave one, so to speak, a geological jumping-off place. But Prof. A. P. Coleman has punctured our illusions in his paper on "Pre-Cambrian Climates." For it seems that there was before the Cambrian a long period of desert conditions and a making of red sandstones; before that was a time of cool moist climate and a making of grey carbonaceous slates; and before that there was a Huronian Ice Age. "Below this, after a profound break, is the Sudbury or Timiskaming series, mostly of water-deposited materials, including 4000 feet of well-banded greywacke and slate, evidently of seasonal origin. This gritty but well-established material and some boulder conglomerates make one suspect a cold and perhaps glacial climate." So the story runs; and the Pre-Cambrian basis, once regarded as primordial, is shown to have behind it a stupendous history.

It is well known that two forms of digestion—intra-cellular and extra-cellular—occur among animals. Intra-cellular digestion, where the food is taken into ingestive cells and then digested, occurs, as Mr. F. A. Potts points out, in sponges, stinging animals, flat worms, and molluscs, often accompanied, however, by the extra-cellular method where the secretion of a digestive juice dissolves the food in the cavity of the food-canal. The latter is the exclusive method in Annelids, Arthropods, Echinoderms, and some smaller phyla. "In the Gastropod Molluscs digestion in the flesh-eating forms is mainly extra-cellular; in the

vegetarians it is largely intra-cellular." In some cases of specialised diet the intra-cellular method is prominent, as Mr. Potts illustrates by the case of the wood-boring Teredo. In some wood-eating Arthropods like termites, in which there is no intra-cellular digestion, the function has been taken over by symbiotic Infusorians.

In an interesting study of sex-development in fowls, Dr. F. A. E. Crew propounds the view that the genetic constitution of the individual determines what may be called the internal environment in the direction of "femaleness" or of "maleness." "In an internal environment of 'femaleness' the embryonic gonad becomes an ovary, in one of 'maleness' a testis. The bird has an ovary because she is a female, a testis because he is a male. The type of plumage is determined by the type of metabolism which obtains at the time of its development, and is not a response to any specific influence of an internal secretion elaborated by the differentiated gonad." The physiological theory of sex, championed by Geddes and Thomson long ago, is having its innings.

Dr. F. A. Dixey's paper on the minute scent-distributing structures in white butterflies is of noteworthy interest. There are secretory cells and distributing scales. The scent-distributing scale is usually a rather highly specialised structure, often in the form of a flattened lamina provided distally with a fringe of chitinous filaments, and proximally with a fine flexible footstalk. The latter expands into an accessory disc, very varied in size and character. The disc is inserted into a specialised socket, within or beneath which are found the cells that secrete the scent. Everything is so minute that it is difficult to be sure how the scent escapes. Dr. Dixey finds no convincing evidence of pores, and inclines to Weismann's view, that the scented material passes from the secretory cells into the disc, the footstalk, and the lamina.

The physiologists continue to discover new rôles for hormones. Thus Prof. W. B. Cannon and Dr. A. Querido find that adrenal secretion is increased in animals when there is liability to lowered temperature by heat loss. The increased secretion brings about an increased metabolism, a chemical calorigenesis, quite apart from the muscular movements of shivering. So the animal has two distinct lines of defence. In another paper by Prof. A. T. Cameron, Dr. T. Ingvaldsen, and Dr. J. Carmichael, evidence is brought forward to support the view that the internal secretion of the thyroid is a compound of thyroxin with some other radical which considerably increases its activity.

Prof. H. Wasteneys and Mr. H. Borsook have succeeded in effecting the enzymatic synthesis of protein in peptic digests of albumin. The maximum synthesis so far obtained has been 39 per cent. There is "incontrovertible evidence" that the material synthesised is of the order of complexity of native proteins. The enzyme responsible for the synthesis was found to be inseparable in every respect from the enzyme effecting the hydrolysis of proteins.

Every one is familiar with the feeling of having seen the same thing before, though one knows that it could not be so. This is the phenomenon of "déjà vu," which Grasset and Freud have explained as due to the activation of an unconscious memory of a real event, a fantasy, or a dream, which in some way resembles the coincident, conscious perception. The problem has been rediscussed by Dr. J. T. MacCurdy, who has found a somewhat analogous pathological phenomenon —the perplexity case—apparently with a similar obsessive suggestion of familiarity. As often happens, the pathological throws light on the normal.

Prof. G. H. Parker has been able to determine the amounts of carbon dioxide excreted by the lateral line nerve of the dog-fish, the sciatic nerve of the frog, and the ventral nerve cord of the lobster. The quiescent frog nerve produced on the average nine-thousandths of a milligram of carbon dioxide per gram of nerve per minute. In active nerve this was increased by about twelve per cent. Weight for weight, the resting frog nerve produces about the same amount of carbon dioxide as the resting human body does.

These, however, are scarcely more than random comments upon a few of the extraordinarily interesting series of addresses and papers presented at Toronto. A more adequate survey of the wide range of subjects brought before the various Sections must be reserved for later issues.

The Metallurgy of Iron and Steel.

(1) *Lehrbuch der Eisenhüttenkunde: verfasst für den Unterricht, den Betrieb und das Entwerfen von Eisenhüttenanlagen.* Von Prof. Dr. Bernhard Osann. Zweite neubearbeitete und erweiterte Auflage. Erster Band: Roheisenerzeugung. Pp. xi+923. (Leipzig: Wilhelm Engelmann, 1923.) 29*s*.

(2) *The Metallurgy of Steel.* By F. W. Harbord and J. W. Hall. (Griffin's Metallurgical Series.) Seventh edition, thoroughly revised. Vol. 1: Metallurgy; by F. W. Harbord. Pp. xii+545+41 plates. Vol. 2: Mechanical Treatment; by J. W. Hall. Pp. xv+553+42 plates. (London: C. Griffin and Co., Ltd., 1923.) 32*s*. net each vol.

WHILST primitive methods of making malleable iron or steel were mainly conducted in such a way that the product was obtained directly from the

ore without a preliminary fusion, almost the whole of the modern product is obtained in the first instance as pig-iron, a readily fusible mixture of iron with carbon, silicon, and other elements derived from the ore and the fuel, these impurities being afterwards removed by processes based on differential oxidation. This round-about method has proved in practice to have such great advantages, both chemical and economic, that it has become the universal practice. Attempts now being made to re-introduce the old direct process in a greatly improved form have to contend against the fact that smelting in the blast-furnace, at first sight a crude device for extracting iron from its ores, has reached a condition of high efficiency, making it very difficult for a new process to prove any superiority in economy, whatever its apparent theoretical advantages.

In spite of the fundamental importance of the blast-furnace, it has received less attention from scientific metallurgists than the processes for converting its product, the crude pig-iron, into steel. It is true that the pioneer work of Playfair and Lowthian Bell, which gave a scientific basis to the chemical process of ore reduction, has been followed by many interesting researches on the equilibrium between iron, its oxides and the oxides of carbon, but even these reactions are not yet perfectly understood, and most improvements in the operations have been made empirically. Such scientific work as has been done is mostly German, and Prof. Osann's book (1) is greatly superior to works which are little more than catalogues of plant.

The new edition of this treatise, which is the first volume of a comprehensive work on the metallurgy of iron, is of very great interest. Its attractive form and its 550 admirably clear illustrations will make it popular, and it contains information of a detailed kind on the construction and working of the blast-furnace and on such closely connected subjects as the preparation of coke and the utilisation of blast-furnace gas. Certain limitations should be recognised. German, and to some extent American, practice is described, but references to the practice in other countries is only occasional, and not always accurate; the map of the British coalfields on p. 115, for example, failing to show coal in either Yorkshire or Lancashire, and being erroneous in several other respects.

With very few exceptions, all references to literature are taken from *Stahl und Eisen*, so that the remarkable work of the Geophysical Laboratory of Washington on the constituents of slags, the equilibrium diagrams of which are reproduced, is attributed to the writer who abstracted the publications for that journal. The interesting survey of the economic conditions of iron production in the principal countries of the world is dated 1913, the author stating that the present conditions are so chaotic as to make a systematic review impossible.

In addition to its character of an encyclopædia of the construction and use of the blast-furnace, the work is remarkable for the amount of space given to calculations. An effort has been made to give a quantitative treatment of every aspect of the industry, and this part of the work is to be highly commended. The student will find it a profitable exercise to work carefully through a number of the calculations given by Prof. Osann, and in so doing will be impressed by the necessity for maintaining exactly the balance between a number of factors, on which the efficiency of the furnace depends. The English reader will do well to compare the important paper by F. Clements in the Journal of the Iron and Steel Institute for 1920, in which he will find the quantitative data for English blast-furnaces, worked out in detail with all the necessary information for determining the efficiency. With such material before the student, there is no longer any excuse for the academic neglect of the subject of the smelting of pig-iron which has so long prevailed.

There are some defects in the arrangement of the book, a subject being sometimes cut up into separate sections, which are scattered through different chapters without apparent reason. The full table of contents and good index make this defect less serious, although irritating. Casting in the pig-bed only receives a few lines, although machine casting in moulds is rather more fully described, and it is not clear why so essential a part of the process should be neglected. The physical chemistry of the work is rather weak, and occasionally some bad mistakes are made, as in the account of "mixed crystals" on p. 622, but a real attempt has been made to give an account of the chemistry of iron smelting, and the survey of the chemistry of slags is more satisfactory. Revision of the purely scientific sections by a physical chemist would be of advantage; but with this reservation the book may be recommended to metallurgists generally.

(2) The seventh edition of this, the most important English text-book on the manufacture of steel, is greatly enlarged, and now forms two massive volumes, which are sold separately. Since its last revision, progress in the design of plant, in methods of working, and above all in the scientific understanding of technical processes, has made changes in the presentation of the subject to students very necessary. To revise a work of such wide scope, full of illustrations and tables, is naturally a difficult matter, and it is perhaps not surprising to find

that the revision of the first volume, especially, leaves much to be desired.

To give a clear and systematic account of the industry as it exists to-day would have meant the complete re-writing of much of the book, and the easier plan, of interpolating new material at intervals and revising portions only, has been adopted. The consequence is that whilst the new edition of Harbord and Hall must retain its place as the standard work of reference on the metallurgy of steel, the serious student or practical steel-maker will often turn to it in vain for information as to the practice or knowledge of the present day, and at other times will find descriptions of processes or statements of theory which are antiquated, using the word in the relative sense which is natural in connexion with a subject which makes such rapid advances.

The defect is most noticeable on the scientific side. The accounts of the physical chemistry of the iron-carbon system, and of the influence of temperature and other conditions, including the presence of foreign elements, show the grafting of fragments of new knowledge on to the old stock, whilst the student of to-day needs a clear summary of the state of existing knowledge, incorporating the discoveries which have been reached by modern methods. In a work which is less historical than practical, it is disappointing to find so much space given up to dead controversies, the interest in which has disappeared owing to the introduction of new methods. For example, the rival views as to the nature of β-iron and its part in the hardening process have ceased to be of interest since magnetic observations and, above all, the method of X-ray analysis have removed all doubt on the subject. For the same reason an account of the modern method of preparing micro-sections would have been preferable to the long record of methods employed by successive investigators with less perfect technique. Moreover, the scientific study of the relations between the components of molten pig-iron and the oxidising agents which bring about its conversion into steel has made immense progress, which receives no attention in the work before us, the old thermochemical equations which served as a rough guide representing only a part of the story. A good survey of this important field is still lacking, although English chemists have contributed much by their investigations.

Closely connected with this subject is the question of the distribution and influence of segregated impurities and of non-metallic inclusions, the importance of which in determining the quality of steel is now fully acknowledged. The evils due to these causes may be largely eliminated by the choice of suitable methods of casting; but on this matter scarcely any information is given, and the student will have to refer to other works. Another section calling for drastic revision is that dealing with alloy steels. This branch of the industry has developed so rapidly as to make the information given in earlier editions obsolete, and it would have been better to omit the accounts of early work, except so far as is necessary to present the historical aspect of discovery, and to replace them by a modern statement of the alloy steels actually found in use, with a scientific account of their heat treatment and of its relation to constitution. The fact is that the steel industry has passed beyond the stage of empirical control, and has become scientific, and no text-book can be regarded as quite satisfactory which does not indicate the connexion between science and practice. It is to be hoped that a bold effort will be made in the preparation of the next edition to remove obsolete matter, and to replace it by descriptions more nearly representing the actual state of metallurgical science.

The second volume, dealing with the mechanical treatment of steel, is not open to quite the same objections. Such treatment is still mainly empirical, and the scientific calculation of stresses in rolling and forging has only been undertaken by a few persons, whose work is not very generally known. The account of modern plant is adequate, and constitutes a valuable collection of practical information. The chapter on wire, especially wire for ropes, fails to represent modern practice, but in the main new processes are well described. The position of this well-known text-book in metallurgical literature is a deservedly high one, and it has been thought well to direct attention to its shortcomings, in the hope that they will be remedied.

C. H. D.

High Frequency Spectra.

Spektroscopie der Röntgenstrahlen. Von Prof. Dr. Manne Siegbahn. Pp. vi+257. (Berlin: Julius Springer, 1924.) 3.60 dollars.

OF the many fields of physics which have been extensively explored during the past decade, none, perhaps, has yielded a greater contribution to our knowledge of atomic structure than that of X-ray spectroscopy. Since the classical experiments of Moseley in 1913–14, the development of the subject has been rapid, and we have now at our disposal a very extensive knowledge of the X-ray emission and absorption spectra of the elements. The time was therefore ripe for the publication of a volume devoted, almost entirely, to a discussion of the methods and results of

X-ray spectroscopy. The present monograph is all the more welcome as coming from the pen of Prof. Siegbahn, who has contributed more than any other to the development of the technique of accurate wave-length measurements in this region of the spectrum.

Prof. Siegbahn's attitude towards his subject is essentially that of the experimental physicist. His main object is to give a full account of the experimental data at present available, and from these to deduce the laws governing the emission of X-ray spectra. Theoretical considerations are introduced in the interpretation of these laws, but throughout the volume the experimental side is emphasised and theory allocated to a secondary position. In such a volume it is natural to find a very considerable section devoted to detailed descriptions of the various methods used in the experimental work. These descriptions, accompanied as they are by excellent drawings and plates, will prove invaluable not only to those who are interested in the determination of X-ray wave-lengths, but also to all who wish to be acquainted with modern X-ray technique. The author is an acknowledged authority on this subject, and anything he has to say in this connexion is well worthy of consideration.

The discussion of the K,L,M, etc. series follows more or less conventional lines. Very complete tables of the latest accurate measurements are given, both for the emission and for the absorption spectra. At present the accuracy of the determination of X-ray wave-lengths must depend on that of other physical constants, but it is no small achievement that, after so short a time, it should be possible in many cases to determine relative wave-lengths to six significant figures. The author emphasises certain experimental work which has so far not received attention in other books on the subject. Most noticeable, perhaps, in this connexion, is the account of the remarkable experiments of Lindh and others on the dependence of the absorption bands of such elements as chlorine and sulphur on their state of chemical combination. This is the first definitely established case of the influence of molecular combination on these phenomena. Now that it has been shown that the valency of the atom in the molecule affects the position of the edge of its absorption band, physicists and chemists alike will await with interest further work in this direction. The whole treatment of the absorption and emission spectra is excellent. Not only are tables of wave-lengths given but also of frequencies (ν/R and $\sqrt{\nu/R}$); a few obvious inaccuracies have crept into these tables, but they are not such as are likely to lead to any confusion.

An admirable section is devoted to the more theoretical side of the problem. Mathematical treatment has been avoided, but the description of the principles laid down by Bohr and Sommerfeld is sufficient to enable the reader to follow with interest the extraordinarily successful manner in which theory has kept pace with experimental progress. The existence of doublets of constant frequency difference, the connexion between one series and another, the variation of frequency with atomic number and other properties of X-ray spectra, are discussed and shown to be natural consequences of Bohr's atomic model. From the experimental data, Prof. Siegbahn demonstrates how it is possible to determine the various energy levels in the atom, and how the levels so determined provide a remarkable confirmation of the distribution of the electrons in the atom suggested by Bohr from other considerations. The fact that all the lines which these energy levels suggest as possible do not occur in the observed spectra is shown to lead to a selection principle similar to that which holds for the visible spectrum. The author has been most successful in his endeavour to present the theoretical aspect of his subject with a maximum of simplicity. The reader can scarcely fail to be impressed by the remarkable way in which a theory, formulated initially to explain the visible spectrum, is shown to be immediately applicable to a region of the spectrum where the frequencies of the radiations are some ten thousand times greater. Prof. Siegbahn makes it clear that much work still remains to be done before all the facts described in the earlier chapters are satisfactorily interpreted. Particularly interesting, as a suggestion of further lines of development, is his account of Wentzel's attempt to explain the more complicated K spectra of the lighter elements as due to the existence of atoms from which more than one electron has been removed.

In the concluding chapters the author deals with the "white" radiation and with the more indirect methods which have been applied to X-ray spectroscopy, especially with the determination of energy levels by means of β-ray spectra and ionisation potentials. The work in the latter direction has been most successful in helping to bridge the gap between the X-ray region and the extreme ultraviolet. In the form of appendices are given some useful tables and an excellent bibliography.

Prof. Siegbahn is to be congratulated on having produced a volume which is not only a necessary addition to the library of the X-ray specialist, but is also to be heartily recommended to all who are interested in the advance, experimental and theoretical, in one of the most productive fields of modern physical research.

Lord Avebury's Life and Influence.

The Life-work of Lord Avebury (Sir John Lubbock), 1834–1913. Comprising Essays by Sir Bernard Mallet, Sir Arthur Keith, Dr. A. Smith Woodward, Prof. J. Arthur Thomson, H. St. J. K. Donisthorpe, Dr. A. C. Seward, Sir Michael E. Sadler. Edited by his daughter, the Hon. Mrs. Adrian Grant Duff. Pp. vii+261. (London: Watts and Co., 1924.) 6*s*. net.

THE book under notice contains a short memoir of the late Lord Avebury, and a series of appreciations of his very numerous activities by seven experts. Lord Avebury was an interesting personality, and he covered so many and so varied interests that it requires a symposium to estimate the value of the work he did.

The first of these experts is Sir Bernard Mallet, who dwells upon the political and economic work Sir John Lubbock did whilst he was a member of Parliament. When he was first invited to become a candidate he summed up the objects he wished to achieve as follows: "(1) To promote the study of science both in secondary and primary schools, (2) to quicken the repayment of the National Debt, and (3) to secure some additional holidays and to shorten the hours of labour in shops." It is remarkable how by quiet and steady persistence he in time achieved those reforms which he set out to accomplish. His name will ever be associated with bank holidays. Sir Bernard sums up his power as a politician as follows:

Sir John Lubbock's whole attitude towards economic questions was characterised by the same sound judgment and common sense. He was, as I have mentioned, in full sympathy with the best economic opinion of his day on fiscal policy, Free Trade, municipal trading, and so on; and in his various addresses and articles on such questions his touch is so sure and confident that a reader might almost imagine that his views had been adopted wholesale from text-books. His scientific habit of mind, no doubt, combined with his practical experience of business, gave him more than ordinary facility in such matters: but he had furthermore the power observable in men of executive capacity of arriving rapidly and without any apparent process of thought at conclusions which, once formed, were apt to remain unquestioned in his mind. This probably accounts for his remarkable clearness in exposition.

Lord Avebury's remarkable achievements in anthropology are dealt with by Sir Arthur Keith. In the middle of the last century, from the late 'forties to the 'sixties, a small company of Englishmen with whom Lubbock was associated—he was quite a boy, for he entered his father's bank in 1849 at the age of 15—entirely revolutionised the idea of the history of man. Constant contact with Charles Darwin, a neighbour of his in Kent, had widened his outlook and that of his fellow-workers; and perhaps the most distinguished of the many distinguished pieces of work that Lord Avebury accomplished was in his "Prehistoric Times" and "The Origin of Civilisation"; both of these passed through repeated editions and are still classics. The words of Sir Arthur Keith are eminently true when he writes: "Let us have done, once and for all, with the prevalent notion that his books on the pre-history of man are the mere accomplishments of a clever compiler. He was an original thinker of a high order."

As a geologist Lord Avebury was chiefly interested in prehistoric man, and his geological publications were not highly specialised in other fields, but his knowledge of geology gave a good background to many of his widely read books. "The Scenery of Switzerland," for example, was much more than a mere compendium or abstract of the works of the Swiss geologists whom he quoted. He wrote from first-hand personal knowledge, and he always had an eminently readable style, so that this book has added greatly to the pleasure of the numerous frequenters of "the playground of Europe."

A very brilliant study of Lord Avebury's work as a zoologist is written by Prof. J. Arthur Thomson. Although his published monograph on the Collembola and Thysanura, an obscure group of insects, is still a standard work of reference, his chief fame rests on his amazing investigations into the behaviour of animals. He was, indeed, as Prof. Thomson says, "the pioneer of the experimental study of animal behaviour." His observations on the colour-sense of bees, the homing of ants and bees, and the behaviour of wasps started a new chapter in the history of experimental zoology. There is a special chapter dealing with his fascinating studies on ants by Mr. Donisthorpe.

Lord Avebury's researches in botany are dealt with by Prof. Seward, who recounts the ceaseless work which he did on the interrelation of insects and plants, the methods of pollination, the form of leaves, buds, and stipules, and last of all on seedlings. His love of beauty and his great gift of exposition are evidenced in all his writings, but nowhere more so than in his writings on the plants he loved so well.

Lord Avebury's business training doubtless enabled him to apportion his time so that no one minute was wasted. How one man could have got through so much, how he could have made so many researches and so faithfully investigated Nature in so many phases is difficult to understand. Doubtless he had many helpers. But this total output, as recorded and appreciated in this book on his life work, is literally amazing, especially when one remembers that he was actively engaged as a successful banker during most of his life.

Our Bookshelf.

The Cultivated Evergreens: a Handbook of the Coniferous and most important Broad-leaved Evergreens planted for Ornament in the United States and Canada. Edited by L. H. Bailey. Pp. xvii+434+48 plates. (London: Macmillan and Co., Ltd., 1923.) 31*s.* 6*d.* net.

THIS handsome volume was compiled for use in the United States and Canada by fourteen American experts in botany, horticulture, and allied subjects; but it will also be of service on the eastern side of the Atlantic, as nearly all the species dealt with can be seen in English parks and gardens. The great diversity of the British climate allows us to grow, in one part or another of these islands, an amazing number of exotic plants, imported from almost every region outside the tropics.

The greater part of the text is concerned with one class of evergreens, the Coniferæ; but the five genera, Larix, Pseudolarix, Taxodium, Glyptostrobus, and Ginkgo, which happen to have deciduous foliage, are not excluded on this account. The other class, comprising the broad-leaved evergreen trees and shrubs, seems to be more sparingly cultivated in the United States than in Great Britain; and only 25 species are selected for description, though some others are briefly mentioned. Acid soils, which are an essential requirement for the proper growth of a considerable number of broad-leaved evergreens, are the subject of a special article by Prof. F. V. Coville, whose experiments should greatly interest cultivators of Rhododendrons.

In the main part of the book, conifers are considered from nearly all points of view, except that of timber production. The use of the different species and varieties for ornament and shelter is the main consideration. A series of articles deal with their effects in the landscape, and their adaptability to different soils and situations. Other articles are concerned with modes of propagation, nursery management, cultivation, attacks of insects, diseases, injuries of all kinds, fungicides, tree surgery, etc. The information given on these subjects by the various experts contains many valuable hints on the choice, cultivation, and care of coniferous trees.

The botanical part of the work is due to Alfred Rehder, the systematist of the Arnold Arboretum. In this establishment there are fine collections, both of living trees and of dried specimens, which have enabled him to draw up accurate descriptions of the conifers in cultivation. He has also provided keys for the genera and species, which render identification easy, even in the absence of flowers and cones. The botanical descriptions are elucidated by nearly 100 engravings in the text. Conifers are very varied in form and colour; and their choice for landscape effect depends largely on a proper knowledge of the habit of each species and variety when fully grown. This is well illustrated by 48 full-page plates, which depict groups and individual specimens growing in New England. These plates are worthy of study by landscape gardeners.

A check-list of all the woody evergreens that are offered for sale in the United States is given at the end of the book, which will serve as a suggestive planting list. There is also an adequate index. We have no hesitation in characterising this handbook as a useful addition to the literature of conifers.

The Modern Theory and Practice of Pumping: a Treatise on the Application of the Reynolds-Stanton Law of Viscous Flow to Modern Pumping Problems and the Flow of Liquids through Pipes. By Norman Swindin. Pp. 364. (London: Ernest Benn, Ltd., 1924.) 42*s.* net.

THE first part of this work is devoted to a general consideration of viscosity, of the motion of viscous fluids, and of the resistance to flow in pipes, with special reference to the relationship between the many empirical formulæ of the exponential type which have been evolved in the past, and the dimensional formula of Reynolds.

The introduction deals briefly with the history of modern hydrodynamics, outlining the relationship between the behaviour of the perfect fluid of the mathematician and of a viscous fluid. Chapter ii. deals with industrial viscometry, with special reference to the liquids with which the chemical engineer may be required to deal. Chapter iii. gives a précis of Reynolds's discussion of the two manners of motion of a fluid, together with later extensions of the theory, and Chapter iv. gives examples of the application of the Reynolds's function in industrial problems. The treatment of this part of the book is excellent, and the various points of application to the problems of the chemical engineer are well brought out.

The second part of the work deals with the many types of pump in use for pumping corrosive, gritty, solid-laden, and viscous liquids such as are not in general handled by the hydraulic engineer. Chapters are devoted to the ram pump, the centrifugal pump, the rotary pump, the air-lift, the displacement pump, and to miscellaneous pumping appliances, particular attention being paid to those types which have been devised to meet special conditions.

While no great space has been devoted to a discussion of the theory of operation, this is adequate for the purpose in view. Special reference must be made to the section dealing with the air-lift pump. This forms one of the most satisfactory discussions yet published of this important but somewhat neglected type of installation. A chapter is devoted to pipe lines and fittings, and another to the pumping of oil for the oil fuel and petroleum industry. In view of the special difficulties involved in pumping such fluids through long pipe lines, this chapter is likely to be of much value.

The book should certainly find a place in the library of every chemical engineer, while engineers in general hydraulic practice will find much that is stimulating and of interest in its pages. It is well printed and excellently illustrated. A. H. G.

Thermochimie. Par Prof. F. Bourion. (Collection de Physique et Chimie.) Pp. xii+363. (Paris: Gaston Doin, 1924.) 25 francs.

THE science of thermochemistry owes most of its experimental data to the work of Thomsen, from 1853 onwards, in Copenhagen, and to the work of Berthelot in Paris from 1865. It was originally inspired by the

idea that the amount of heat liberated in a chemical action was a measure of the energy available from this source, but this is only correct at the absolute zero; at all other temperatures, therefore, endothermic actions can occur, and it is no longer possible to predict from the thermochemical data alone in which direction a chemical action will proceed. On the experimental side also, the science has been limited by a standard of accuracy far lower than can be attained in other physical measurements. This lack of accuracy is the more to be deplored since the heats of formation of organic compounds are based upon the differences between relatively enormous heats of combustion; and the most interesting data (*e.g.* the heats of formation of isomers) contain even larger percentage errors than the heats of combustion through which they are determined.

It is, however, of interest to know that recent developments, in the original laboratory of Berthelot, have led to a very great improvement in the degree of accuracy of the measurements. These are now being obtained within about 1 part in 1000 by using a completely enclosed apparatus, in which evaporation from the surface of the calorimeter and other disturbing factors are eliminated. It is therefore natural that interest in thermochemistry should once again have been aroused in France, and that the latest text-book on the subject should be of French origin. Prof. Bourion has not himself made any important contributions to thermochemistry, but he is familiar with the work that has been done by other investigators, and his book will obviously be consulted by all those who wish to know the present position of the subject.

La télégraphie sans fil: ses applications en temps de paix et pendant la guerre. Par Julien Verdier. Pp. viii + 412. (Paris: Gauthier-Villars et Cie, 1924.) 35 francs.

To every radio engineer who desires to learn the latest practical advances made in radio communication in France we can recommend this book. The historical introduction is not very good and has perhaps a national bias, while the theoretical chapter is too sketchy to be of use to any one but an expert. But the chapters describing practical applications, radio communication during the War, and the French radio stations, contain much novel matter. France has built the two most powerful stations in the world, Melun and Croix-d'Hins. The radio centre at Sainte-Assise is perhaps the most perfectly organised. Methods of using radio waves for discovering masses of metal near the surface of the earth are described. Many of the important radiograms issued during the War are now published for the first time, and the conversations between the Eiffel Tower and Nauen will be instructive to the future historian. The radiograms issued just before the Armistice are highly dramatic.

The French radio system is divided into three distinct services, (1) the Service of the Interior, (2) the Radio Maritime Service, and (3) the Colonial and International Service. The first, which is used for official, special press, meteorological, etc., messages and for time signals, relieves considerably the ordinary telegraph service. Broadcasting comes under this head. The Radio Maritime Service maintains communication with ships at sea and is regulated by the International Rules adopted at London in 1912. Full lists are given of the Colonial and International stations with which there is regular communication. In the last chapter, both the French and the International Rules for radio work are given in full.

Théorie générale sur les courants alternatifs. Par M. E. Piernet. (École d'électricité et de mécanique industrielles.) Fascicule 1. Pp. x + 100. (Paris: Gauthier-Villars et Cie, 1924.) 12 francs.

THIS book explains clearly the principal theorems of the theory of polyphase currents. The mathematical student who has a knowledge of French will have no difficulty in understanding it. The theorems given form an excellent basis which he can use for extending his knowledge. It will be useful, however, to make a few criticisms. When defining the instantaneous power in a circuit (p. 13) the author talks about the quantity of energy *instantaneously* given to the circuit. He defines also the watt current and the wattless current. The reader gets the impression that the current has more to do with the power than the electromotive force. A formal proof is given of the "equivalent" sine wave, and it is concluded that it can in general be used instead of the actual wave. Many practical engineers do make this assumption, but in some cases it will lead to very erroneous results. The so-called "equivalent" sine wave has a different area from the actual wave. The magnetic flux induced in a transformer, for example, when the two waves are applied at the primary terminals, will be different and so also will be the consequent losses in the core. The experimental method of analysing a wave is described, but we do not think that the analytical method given will be of much use. In the last chapter the theory of rotating magnetic fields is discussed in a way that will appeal strongly to the mathematician. Much of this book might with advantage be included as practical examples to illustrate the theory in a mathematical treatise on the calculus.

A Shorter School Geometry. By H. S. Hall and F. H. Stevens. Part 1. Pp. x + 164 + iv. (London: Macmillan and Co., Ltd., 1924.) 2*s.* 6*d.*

THIS volume is much more than a revised edition of the well-known course of "School Geometry" by the same authors: there are differences alike in matter, plan, and presentation so substantial that it may almost be regarded as a new text-book. The authors have followed many of the recommendations put forward in the recent report issued by a Committee appointed by the I.A.A.M. We notice, however, that they have included in the text "proofs" of the fundamental congruence theorems but have excluded "proofs" of the fundamental parallel theorems. This is a curious compromise which it is unlikely will stand the test of time. Both groups of fundamental properties are treated informally in an introduction which runs to 42 pages and also includes some mention of similarity; the latter, however, might with advantage be discussed in greater detail. There is much to be said for developing informally the general principle of similarity with as much emphasis as is now given to the general principle of congruence. The exercises have been increased in number, particularly those of a numerical character: the clearness of the type and the diagrams deserve a special word of praise.

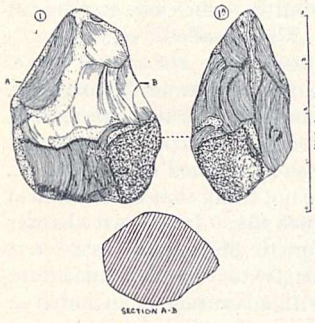
Letters to the Editor.

[*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.*]

Further Discoveries of Ancient Flint Implements at Cromer.

FOLLOWING upon the discoveries of flint implements referable to the Cromer Forest Bed Series of Norfolk, the Trustees of the Percy Sladen Fund very generously provided funds for the further examination of these and of other associated deposits. The first part of this research is now completed, and has, in my judgment, established the occurrence of flint implements of Early Chellean types at the base of the Cromer Forest Bed, and of Late Acheulean types in some of the glacial gravel above the Contorted Drift. As will be remembered, there was discovered upon the foreshore at Cromer a large series of ochreous specimens, which, while not actually *in situ*, was, from the whole circumstances of the case, referred by me to the lowermost horizon of the Forest Bed.[1]

It was obviously necessary to endeavour to ascertain by digging if similar ochreous flints occurred in place in some deposit beneath the beach, between the foreshore and the cliffs, at the site where the discovery was made. Such excavations were attempted, but, unfortunately, the water-logged condition of the sand and shingle forming the beach was such as to make impossible any digging in a downward direction, and the work had to be abandoned. Associated with the ochreous specimens upon the foreshore, was found another series of artefacts of a totally different character. These latter flints are usually of a glossy black colour—giving them an appearance of having been black-leaded—and their forms and flaking are clearly divergent from the ochreous pieces.



FIGS. 1 and 1A.—Early Chellean hand-axe from foreshore, Cromer.

The occurrence of large quantities of such flints upon the Cromer foreshore, beyond the seaward extension of the beach, is to be explained only on the supposition that, at one time, there existed a bed, or beds, containing these specimens, and that the action of the sea has gradually removed the ferruginous or other material forming the deposits, leaving only the heavier and insoluble residue of flints and other objects intact. This supposition is supported by the following facts. A prolonged examination of the contents of the beds forming the cliffs and the foreshore of the north-east coast of Norfolk has shown that the great bulk of the flints referable to these various deposits differ markedly, and that, for example, it is not possible to mistake specimens in the glacial gravels for those coming from the Forest Bed. Further, a considerable number of the foreshore specimens have, attached to some portion of their surfaces, the remains of a highly ferruginous sandy deposit, which clearly formed part of the bed in which at one time the flints were embedded. Moreover, upon the foreshore, exposed at low water at East Runton—about 2 miles westward of Cromer—there are to be seen large areas of a highly ferruginous bed, the sandy content of which corresponds precisely, in appearance, with that adherent to the specimens found at Cromer. Lastly, an examination of the East Runton deposit demonstrates that it contains implements and flakes comparable, both in colour and in technique, to the ochreous and to the black-leaded series of Cromer. The former assemblage is certainly not so deeply ochreous as that collected upon the Cromer foreshore, but this is a minor difference due, no doubt, to the fact that, at the latter place, the flint-containing bed was richer in salts of iron than that exposed at East Runton. The remains of this bed at this place are surrounded by large numbers of flints, such as occur upon the foreshore at Cromer, and it is abundantly clear that these specimens have been washed out of the deposit to which they lie in such close proximity.

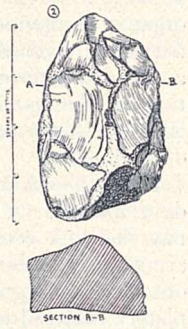
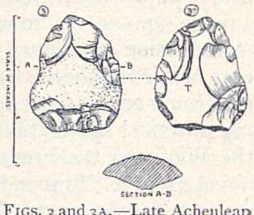


FIG. 2.—Early Chellean hand-axe from foreshore, Cromer.

There can be no doubt that this East Runton deposit, which rests upon the chalk, underlies (*a*) an accumulation, representing probably the Estuarine Gravel, containing large mammalian bones referable to the Cromer Forest Bed, and (*b*) the immense glacial deposits and chalk erratics exposed in the cliff at this spot. The implementiferous bed is about 18 inches in greatest thickness, and contains a large number of flints, many of which exhibit the well-known appearance of those found in the Stone Bed beneath the Weybourne Crag, together with pieces of quartz, fragments of bone, and some shells. In fact, at first sight, the deposit bears a very close resemblance to the Sub-Weybourne Crag Stone Bed, material from which it undoubtedly contains, but an examination of the contents leads me to believe that the accumulation must be referred to a later period than that of the Sub-Crag Stone Bed, namely, to the earliest Cromer Forest Bed Stage. Many of the flints found in the East Runton deposit exhibit well-marked striations upon their flaked surfaces.



FIGS. 3 and 3A.—Late Acheulean hand-axe from glacial gravel, Cromer.

In order to give students of prehistoric archæology an opportunity of forming a judgment as to the kind of implements found during my recent researches, I give here illustrations (Figs. 1 and 1A and 2) of two specimens of Early Chellean implements from the foreshore site at Cromer. Both of these are of the "black-leaded" variety. The majority of the Early Chellean "hand-axes" (of which I have now upwards of 40 examples), referable to the base of the Cromer Forest Bed deposits, are of the batiform type—having one face more or less flat, and formed usually by a single flake-removing blow, while the other face is convex and exhibits numerous flake-scars. This peculiarity applies both to the ochreous and to the "black-leaded" specimens. I illustrate in Fig. 2 an implement of the batiform type, while in Figs. 1 and 1A are shown two views of a specimen of a much rarer form, which approximates to the platessiform type, and is more or less rhomboidal in section.

[1] Moir, J. Reid. "The Great Flint Implements of Cromer, Norfolk." (W. E. Harrison, Ancient House Press, Ipswich.)

It is of much interest to note that Early Chellean implements, which correspond in all their main features to those found at Cromer, occur in the lower portion of the well-known palæolithic gravel at Warren Hill in north-west Suffolk. The specimens in this deposit, which show marked signs of transport, exhibit a different coloration and general appearance from the Cromer hand-axes, due to the differing conditions to which they have been subjected. The last-named specimens show a peculiar wearing down of their ridges, and outstanding portions, which is not usually found, so far as my knowledge extends, associated with river-gravel implements. With the hand-axes of the Cromer Forest Bed has been found a large series of scrapers of various kinds, and also many flakes—which, however, cannot be described in this communication, owing to limitations of space.

In the glacial gravel capping the cliff at Cromer, and at East Runton, have now been found two implements of Late Acheulean type. Both of these have been discovered by Mr. Guy Maynard, who on several occasions has accompanied me to Cromer. One of the specimens mentioned, a small and typical hand-axe, exhibiting "basket-work" patination, is illustrated in Figs. 3 and 3A (the surface marked T in Fig. 3A is of thermal origin). When the Cromer research is completed, I hope to publish a full and detailed account of the whole of the results obtained.

J. REID MOIR.

One House, Ipswich.

The Theory of Hearing.

I SHOULD like to express my agreement with the letters which Sir Richard Paget and Mr. Wilkinson have written (NATURE, July 19, p. 87) under the above heading. It seems to me that even if Prof. Scripture is right in stating that the movements of the vocal chords cannot be analysed, he is not justified in concluding that the aerial vibrations thus set up are not analysable either. There is, I believe, unassailable evidence that such a conclusion would be wrong; because all workers in this field from Helmholtz and McKendrick to Miller and Bevier are in agreement as to the success of such analysis. Their analyses differ somewhat, it is true, but individual and national peculiarities in vowel production probably account for these. With regard to the piano experiments, I fear that Prof. Scripture (NATURE, August 9, p. 194) has not appreciated the fact that his criticism of Sir R. A. S. Paget and Mr. Wilkinson, namely, that "what a person hears is chiefly what he expects to hear," applies with equal force to himself.

Returning to Prof. Scripture's main argument for one moment, I should like to put a number of questions to him. (1) What experimental proof has he for the statement that the equation for a single laryngeal puff is $y = a.e^{-et}$? (2) Are not the variations of pitch of the voice limited in most individuals to about two octaves? (3) Are the variations in pitch in speech more rapid than two octaves per second? If (2) and (3) are answerable in the affirmative, then the results of my experiments quoted in my last letter to NATURE would apply, namely, that a relatively small group of resonators will be affected at any one moment, and that the group thus affected will shift as a whole according to the change in pitch of the voice.

Lastly, may I give some notes on the important point raised by Mr. Wilkinson, namely, as to the damping coefficient of the ear resonators. To commence with, I should like to point out that two additional factors are involved in any attempt to determine the physiological behaviour of the ear, namely, (1) the least amplitude of vibration of resonators of different pitch which will just cause noticeable stimulation of the corresponding hair cells, and (2) the least perceptible difference between the amplitudes of the resonators set up by two immediately successive tones—in other words, the absolute and difference thresholds respectively. It is not difficult to see the importance of these two factors. Two examples will suffice: (1) The ability of an individual to judge if two tones of the same pitch have the same intensity is determined not alone by the difference in amplitude of vibration which these set up in the ear resonators, but also on the ability of the hair cells to perceive the difference. (2) The time taken for silence to follow the cessation of a tone depends not only on the rapidity with which the resonators return to rest, but also on the amplitude of the vibrations to which the hair cells cease to respond.

There are thus three quantities to be determined, the two thresholds mentioned above and the damping coefficient of the resonators. By methods to be described fully elsewhere, I have obtained the following provisional values for these quantities:

The absolute threshold is reached when the amplitude of swing of the resonators falls below 5·8 per cent. of the previous steady value.

The difference threshold is reached when the amplitude of swing of the resonators falls or rises by more than 2·6 per cent. of the previous steady value.

From the damping coefficients the following tuning and persistence coefficients were obtained:

Tone.	Tuning Coefficient.	Persistence Coefficient.
	Per Cent.	
128	9·0	6·5
256	7·5	8·0
512	6·3	9·5
1024	5·4	11·0

The tuning coefficients are the percentage difference of frequency between that pitch which is in tune with a given resonator and that which will produce one-tenth the amplitude of swing which the intune one would have done.

The persistence coefficient is the number of complete swings which would occur in the time taken for the amplitude of the resonator to fall to one-tenth its previous value.

From these values it is possible to make a number of calculations, which can then be compared with the results of experiment. For example, one can calculate the difference of pitch necessary for the differentiation of two successive tones or the time taken for silence to follow the cessation of a tone.

Tone.	Calculated just Perceptible Difference of Pitch in Cents.	Calculated Time to reach Silence in Hundredths of a Second.
128	1·5	6·9
256	1·3	4·3
512	1·1	2·5
1024	0·9	1·5

These calculated pitch difference values compare well with experimental ones given in the table below, except with 120 vibrations per sec., at which the calculated value is too beneficial.

Tone.	Observed just Perceptible Difference of Pitch in Cents.	
	Delezenne.	Külpe.
120	6	...
260	...	1·24
500	1·0	...
1000	0·84	...

The values for "the time to reach silence" would permit a shake or trill of the following number of tones per second to be clearly heard.

Tone.	No. of Notes per Second clearly audible.
128	14·5
256	23·0
512	40·0
1024	67·0

Unfortunately, I know of no extended experimental results by which these values can be checked. They fit, however, Helmholtz's statement that a shake or trill of 10 notes per second, which is clear for tones above about 110 vibrations per sec., ceases to be clear below that pitch.

With regard to the least and greatest differences of pitch between two tones for audible beats, the calculated and observed values appear to fit well. Perhaps I may finish this letter by asking Mr. Wilkinson if these values also fit in with the data at his disposal.

Lastly, being a physiologist, I cannot agree with Prof. Scripture's suggestion (p. 194) that the resonance theory is unthinkable to those who work with delicate human tissues. Neither can I take seriously his proposal that the resonance theory be abandoned and his own substituted. The resonance theory has so far passed every test that I have put to it. Why then think of abandoning it? If I had any doubts lurking in my mind concerning it, or if I thought that it had need to fear rivals, I might, with the editor's permission, tell Prof. Scripture exactly what I think of his theory. But, as neither is the case, I feel there is no need for me to do this. If I have a regret, it is that Prof. Scripture is not as familiar with resonators as he apparently is with delicate human tissues.

H. HARTRIDGE.

King's College, Cambridge.

On Early Sexual Maturity in the Molluscs, *Syndosmya alba* and *Cardium fasciatum*.

IN November 1920, good numbers of the mollusc *Syndosmya alba* round about 15 mm. in length and sexually mature were taken by dredging in the Black Deep near the Edinburgh Lightship. The occurrence of this bivalve, practically on the spot where munitions had recently been dumped, is a matter of much interest, so that observations on the life-history of this form are worth recording. It was suspected at the time that the specimens taken in 1920 were at least six months old, as estimated from material obtained in the sea experimentally, but recently the present writer had the good fortune to obtain a good fall of young ones of this species in a cage which had been in the sea in the River Blackwater in the Thames Estuary area about eight months, *i.e.* from October 22, 1923, to June 7, 1924. In this case the valves of *Pecten maximus* and *Ostrea edulis* were strung on tarred rope in pairs, so that pairs of the shells were in the same relative position as in life. In the cavity of these shells a certain amount of mud accumulated, and in this nidus young Syndosmya settled at some time later and grew to a size varying from 6·5 to 12·0 mm. in length. Individuals about 8·0 mm. in length were found to be approaching sexual maturity.

An artificial fertilisation was made on June 8, 1924, from a ripe male and female 11·5 and 12·0 mm. long, respectively, after the eggs had matured in the sea-water for one hour. It was found that in less than five minutes the ripe egg threw out a large very transparent membrane; in about three hours embryos in two to seven celled stages occurred, and in twenty-four hours a ciliated larva; in less than forty-eight hours a fully formed trochosphere developed with a fine apical tuft resembling the similar stage in the Gastropod, Patella. In a similar experiment male and female *Cardium fasciatum* 8·3 and 8·5 mm. long were obtained sexually mature, and yielded a thin-shelled veliger in the double egg-case in less than forty-eight hours, and a good shelled larva in four days.

Similar material of Syndosmya and Cardium had been obtained in previous years in a period of three to four summer months, but in circumstances where age determination was less certain.

It is a very difficult matter to grow animals of this kind in the sea and be absolutely certain of their age; in the experiment quoted above there is a faint possibility that some of the Syndosmya may have been washed between the shells, although the chance is very remote, as the cage in which the shells were fixed was specially raised 3 feet from the bed of the sea. An experiment has been devised, however, to obtain more information. A point of interest about the early trochosphere of Syndosmya is that it changes its direction of revolution in the egg-capsule in a rhythmical manner which apparently varies with the physical conditions.

At the same time as Syndosmya and Cardium were growing to sexual maturity, European oysters (*O. edulis*) settled in a similar situation and grew to a size of more than one inch long by one inch deep, while Portuguese oysters (*O. angulata*) grew to as much as 32·6 mm. long by 44·0 mm. deep, although the young oysters of both kinds were mostly less than half an inch long at the end of last year's growth. Thus, although the sexually mature Syndosmya and Cardium cannot be more than eight months old, there is good reason to infer that they may be much younger, especially as the shells showed mostly no indication of a winter ring. It is probable that both these forms mature in summer in about three or four months.

J. H. ORTON.

Marine Biological Laboratory,
Plymouth, July 24.

The Reported Transmutation of Mercury into Gold.

IN your account of the reported discovery, by Prof. Miethe, of the transmutation of mercury into gold (NATURE, Aug. 9, p. 197) by the prolonged action of a high-tension electric current upon it, you seem to consider only one way, and that not the more obvious way, of effecting such a transmutation, namely, by striking out a hydrogen ion from the nucleus by some powerful method of disruption. There is another method of effecting such a change, namely, by attaching an electron to the mercury nucleus. Indeed, for some time before Prof. Miethe's announcement it has been clear to me that, by passing a sufficiently high tension discharge through mercury vapour, not merely that such a transmutation might occur, but that it was inevitable, unless our present views of atomic structure are radically at fault.

For consider the collision of high-speed electrons with mercury atoms. A small proportion of these

electrons must be directed upon the nucleus. If they possess sufficient energy to penetrate the external levels of electrons in the mercury atom, they must reach the positively charged nucleus and be captured by it. Since the loss of an electron (as a β-ray) by the nucleus of an element in the radioactive disintegration of an element results in the atomic number of the element in question being increased by one, the gain of an electron by an atomic nucleus must result in the diminution of the atomic number by one. This is quite general. In the case of an isotope of mercury of atomic number 80, the product will be an isotope of gold of atomic number 79. Upon existing knowledge it is simply a question of (1) the potential sufficient to drive the electron through the outer levels of electrons surrounding the mercury nucleus until it comes within the sphere of attraction of the powerfully charged nucleus; (2) whether the exceedingly small fraction of direct collisions with the nucleus that is to be anticipated will be sufficient to enable the gold produced to be detected.

As regards the first, it may be expected that the repulsion of the external shell of mercury electrons will diminish rather than prevent altogether the chance of the radiant electron reaching the nucleus; for once the shell is penetrated, the resultant force on the radiant electron must be on the average an attraction. Hence I had arrived at the conclusion that, not the transmutation, but the chemical detection of the gold produced, would probably be the more formidable experimental difficulty.

Of course, I need express no opinion on the correctness of the experimental results recorded, which naturally will have to be very rigorously confirmed by further work. I merely wish to point out that no atomic disruption is necessarily involved, and that, so far from conflicting with existing knowledge, the result in a sense follows naturally from it, the only question being one of the sensitiveness of the experimental methods of detecting gold.

FREDERICK SODDY.

Oxford, August 9.

The Transmission of a New Plant Virus Disease by Insects.

IN a paper read to the Imperial Botanical Conference held in London this year, I have described a variegated condition of a number of Graminaceous plants, characterised by chlorosis of the leaves in narrow broken stripes parallel to the veins and a reduction in the power of growth of the plant. In maize it has been recognised for many years as a factor limiting production in the coastal and midland areas of Natal, and was described as long ago as 1901 by Fuller (First Report, Government Entomologist, Natal). Similar conditions are found in sugar cane and a number of other grasses.

I have given evidence in the paper mentioned for the belief that this variegated condition is a disease of a type similar to the now well-known mosaic disease of sugar cane, maize and other grasses, but is not identical with it. These conclusions were at that time based upon general observations and lacked evidence of experimental transfer. Recent work upon insect-transmission of the disease occurring in maize affords confirmation of the conclusions originally reached.

In a series of experiments I have been able to demonstrate the ability of the adults of a Jassid leaf-hopper, an undescribed species of the genus Balclutha, to produce the disease in healthy maize plants when transferred to them from diseased plants. Hoppers taken from healthy plants have failed to produce the disease. All plants have been protected from outside infection for the whole period of the experiment, and no control plants have developed the disease. The role of *Aphis Maidis* Fitch as the vector of mosaic disease between sugar cane, maize, and certain grasses has been established by several workers, and has been confirmed by me under South African conditions. All attempts to secure infections of this new disease through the agency of *A. Maidis* have failed.

The experiments referred to have been carried out with leaf-hoppers collected in diseased maize fields. A proportion only of such individuals are capable of producing the disease, although the maize may be almost universally infected. No individuals, however, which have been once proved to be vectors, have failed to transmit the disease to all plants to which they have been subsequently moved.

Preliminary attempts to secure transmission of the disease from maize to sugar cane and grasses have not succeeded. It must, therefore, remain in doubt whether it is a single disease which occurs in the different hosts, although field observations and similarity of symptoms would point to this conclusion.

H. H. STOREY.

The Natal Herbarium,
Durban, July 8.

Isotopes of Mercury and Bismuth and the Satellites of their Spectral Lines.

IN his letter to NATURE (May 31, p. 781), Prof. Runge criticised the result of measurements on the satellites of mercury and bismuth lines in connexion with the isotopes, which I and my co-workers have communicated to NATURE (March 29, p. 459), as not convincing. It gives me much pleasure that our note has attracted the attention of such an eminent spectroscopist and mathematician as Prof. Runge. The aim of that note was to show that the wave-length differences $\delta\lambda$, according to our formula, which involves the masses of different isotopes, are found among the satellites of mercury and bismuth lines. Prof. Runge discarded i and j, and took wave-length differences of observed satellites at random, which is contrary to our view, as regards the selection. The example given by Prof. Runge seems to me to be *lauter Zahlenspielerei*.

Perhaps the lines we have cited have too many satellites to incur a criticism; there are, however, many lines with a small number of satellites, and in which the number of selections is but limited. I can cite many such examples, but as the result obtained on satellites of twenty principal lines of mercury has already appeared in the *Japanese Journal of Physics*, vol. ii., pp. 121-162, the publication of which was much retarded by the disastrous earthquake, I consider it needless to occupy the columns of NATURE with the details. We have obtained more than 130 coincidences with our formula, within the limits of errors of observation, in mercury lines from the yellow to the ultra-violet region, so that the probability of its validity is very great, and cannot be considered as due to mere chance. The report on bismuth lines will shortly appear in the above Journal.

If we completely separate the isotopes, investigate the difference between the satellites and confirm our result, the proof will no more be open to criticism. Only partial separation of isotopes is at present possible, but even this will help us to study the intensity difference of the satellites, by which the present question can be in some degree settled more directly than by the arrangement of the satellites.

H. NAGAOKA.

Institute of Physical and Chemical Research,
Komagome, Tokyo, July 2.

The Cooling Power of the Air in Trains, Trams, and Buses.

By LEONARD HILL, F.R.S., with the co-operation of M. BRAD
(from the National Institute for Medical Research).

THE body resembles a motor-car engine in that it is producing heat by the combustion, not of petrol but of food, and, just as the car has a radiator, so has the body—namely, the skin—in order to lose heat and keep at body temperature, that is, the temperature at which the living tissues have to live. During muscular exercise, about four times as much heat is produced as work, and when hard exercise is taken, such as climbing, the heat production of the body may be five times as great as when sitting at rest. The loss of heat is controlled, just as the production, by bodily mechanisms. To accelerate heat loss, the skin flushes with blood and perspires; clothes are thrown off and the body fanned. Over-warm stagnant atmospheres and over-clothing check the production of body heat and lead to disinclination to exertion, loss of appetite, and, in time, to debility. Cool surroundings and light clothing, on the other hand, increase the production of body heat, tone up the body, stimulate appetite, impel to activity, and generally improve health.

The ordinary thermometer indicates the average effect of the temperature of the surroundings on itself. Unlike the body it does not produce heat. If a fan is set to blow about the air of the room in which it hangs, its reading does not alter. The body, on the other hand, is very effectually cooled by the fan. The thermometer is, then, an untrustworthy guide to ventilation. The kata-thermometer has been introduced to remedy its defects. This instrument has a bulb which is warmed to just above the average temperature of the human skin, and its rate of cooling is measured during a drop of five degrees, namely, between 100° and 95° F.

In this way the power of the air in any locality to cool a surface approximately at skin temperature can be measured. The measurements are made in millicalories per sq. cm. per second. The bulb of the instrument is roughly the size of the end joint of the thumb. The big masses of the body are cooled less rapidly, having a smaller surface in proportion to their bulk. The kata-thermometer does not, then, actually measure the cooling effect of the air on the human body, but is a valuable indicator of comfortable and healthy conditions.

In rooms kept fresh and warm enough for sedentary work, the cooling power is found to be about 6. In stuffy rooms 4, or even less; in rooms rather cold for comfort, 8. Out-of-doors, where the wind blows, cooling powers are higher; for example, 10 on a genial summer day, 20 on mild winter days, 40 on cold winter days. The open-air worker is stimulated by much higher cooling powers than the sedentary workers, even when the temperature is the same indoors and out, owing to the movement of the air out-of-doors.

As we have said, an adequate cooling power of the air is required to keep "the fire of life" from burning too feebly, to tone up the muscles, invigorate the nervous system, and make keen the appetite and efficient the digestion and action of the bowels.

It has been shown that exposure of the naked body of children to sun and open air, with of course wise prevention of over-cooling, has a wonderful curative effect on states of debility, rickets, and surgical tuberculosis. An adequate increase of cooling power puts up the basal metabolism, that is the heat production of the resting body, even 50–100 per cent. We know that thousands of clerks, shop assistants, factory hands taken from lives spent in monotonous over-warm places, were changed from feebly developed, nervous, dyspeptic men into strong healthy soldiers by training in open-air exercises during the Great War.

Severely exposed to weather in the trenches, these men suffered far less from catarrhal diseases than those who continued in employment in cities. The soldiers caught "colds" not in the trenches, but when on leave and infected by close contact with "carriers" in the crowded places of cities. Americans overheat their houses and suffer from catarrhal complaints. The death-rate from pneumonia in U.S.A. has not gone down with that progress in medicine which has notably lowered the death-rates from most other diseases. While exposure to the open air, with the invigorating effect of cool winds and daily exercise, is necessary for all who want to attain full health and enjoyment of life, people, mistakenly attributing the origin of catarrhal disease to exposure to cold, have in the past demanded the over-heating of railway carriages and shutting of windows and the closing in of the roof-seats of trams. Suggestions recently have been put forward for the heating of trams, and the roofing over of the outside seats of buses has been discussed. There have been many who have wished, and some more courageous, who have struggled to secure the opening of windows in trains, and these last have been ridiculed in the Press as "open-air fiends" by journalists who are habituated to the stuffy over-warm newspaper offices of Fleet Street. Soldiers, however, hardened in the trenches, on returning from the Great War demanded greater opening of windows in trains, and this habit of open windows has of late become more general.

People are beginning to realise that catarrhal infections are spread by wrong conditions of the atmosphere indoors, and by repeated massive doses of microbes inhaled from "carriers" who sneeze and cough in close crowded places. Even comic artists and artists of patent medicine advertisements now try to illustrate the happenings of such infection. As tube trains and trams are closed up more than buses, and as people continue to dispute over the opening of windows in steam trains, it seemed worth while measuring the cooling powers of the air by means of the kata-thermometer in such trains with windows shut or open, and in tube trains, trams, and buses, comparing in these last the inside and outside. The temperature of the air was also taken and the velocity of the air movement calculated from a formula which allows the kata-thermometer to be used as a very sensitive anemometer. The following are the average results of observations made when conditions were best in the non-crowded

parts of the day, in mild or cool weather, during September and October of 1923.

	Dry Kata-thermometer Cooling Power. Millicals. per sq. cm. per sec.	Temperature. °F.	Velocity of Air Movement. Feet per min.
Central London Tube.			
In moving train . .	6-10	70-72	54-222
Hampstead Tube.			
In moving train . .	5-9	66-75	55-270
On platforms . .	7-16	63-72	168-425
North London Electric.			
In moving train . .	4-8	60-75	12-83
Bakerloo.			
In moving train . .	5-6	73-75	49-59
S.R., L.N.E.R., and L.M.S.R.			
Steam Trains—			
In moving train :			
Windows closed .	5-9	52-70	20-35
Windows open and facing engine .	9-19	48-66	125-320
Windows open and back to engine	7-12	50-67	49-96
Trams, L.C.C.			
Moving	4-8	67-72	12-126
Buses.			
Moving, inside . .	9-20	57-61	71-541
,, outside . .	10-31	50-60	232-1043

The standard dry kata-thermometer cooling power suitable for sedentary work in ordinary clothing is 6. Lower cooling powers produce stuffy sensations and require less clothing. If people used foot-warmers, and in some cases wore more clothing when at sedentary work, they could easily bear windows open and a cooling power of 8, or even 10, and have the great advantage of breathing cooler, cleaner air. A sanatorium ward is best kept at such a cooling power as 10. In travelling to and fro wearing outdoor wraps, people can, with advantage, be stimulated by wind giving much higher cooling powers than 6. The bus stands pre-eminent in this respect, and healthy people who enjoy a blow in the fresh air and recognise the good effect of this on health rejoice in the open roof-seats of the bus. The cooling powers outside the bus were 10-31 against 4-8 in the tram. It is regrettable that the roof-seats of trams were ever closed. Those of buses certainly should not be. A removable rain screen open at the sides is all that is wanted in bad weather.

Tubes and steam trains with closed windows and trams are relatively stuffy places, cooling powers 4-10, compared to outside of buses, cooling powers 10-31, and steam trains with windows open, cooling powers 9-19. The seat facing the engine in the steam train with window open is recognised to be much cooler than that with the back to the engine; by how much on cool autumnal days the figures show, 7-12 against 9-19. The cooling power at a seat facing the engine can be doubled or even trebled by opening the window.

The figures also show that movement of air and not temperature is the chief factor at work.

In steam trains with windows open and on the outside of buses, massive infection with the microbes from "carriers" is impossible.

The British Association at Toronto.

(FROM OUR CORRESPONDENT.)

Toronto, August 10.

OPPRESSIVELY hot weather during the first half of this year's meeting of the British Association at the University of Toronto has made the excursions into the neighbouring countryside particularly popular among the 2600 men of science and citizens who have enrolled as members to the present date. Thunder showers at night have, however, cooled down the hot lecture rooms and rendezvous periodically, and have thus made meetings possible without interfering with communication in the daytime between the score of University buildings utilised for them. The overseas party, numbering 573, was fêted on the way through eastern cities, and most members of it have been given hospitality in private houses in Toronto. Others, with more than three hundred men of science from the United States, are quartered in University residences. Hart House, which is the social and recreational centre of the male University life, has been thrown open to men and women, and the dining-room has been extended to seat six hundred. The Toronto Board of Trade has been responsible for the enrolment of more than one thousand citizens, and the balance of local members is drawn from adjacent towns, many coming in every day for the meeting, so that the hotels are full.

The Convocation Hall of the University of Toronto, seating eighteen hundred people, was packed on Wednesday night, August 6, when Sir Ernest Rutherford vacated the president's chair for his successor, Sir David Bruce. While lightning flashed across black skies outside the building, Sir Robert Falconer, president of the University, welcomed the visitors and said that Canada needed the stimulus which this visit of the British Association would afford. Prof. J. C. Fields, president of the Royal Canadian Institute, also expressed the welcome of the hosts in the name of the Institute. Prof. J. C. McLennan, chairman of the general and executive committees, moved the vote of thanks to Sir David Bruce for his address.

Representative overseas delegates were received by Cabinet ministers in the Parliament Buildings on Wednesday afternoon, August 6, when the Hon. George H. Henry, senior Government minister, extended the hospitality of the Province to the Association. Sir Ernest Rutherford replied on behalf of the delegates. On the evening of August 7, a reception was given by the trustees and directors of the Royal Ontario Museum of Archeology, and was attended by two thousand people, including nearly all the members of the overseas party. The guests were received by Mr. J. B. O'Brian, the Hon. Charles McCrea, the Hon. Dr. Cody, and Mrs. Cody. Many social events have been held, including luncheons, teas, dinners, etc., arranged by

local societies and numerous private individuals. Saturday, August 9, was devoted to excursions, of which those to the Niagara Falls district were most popular.

The popular and citizens' lectures have been thronged. On Thursday, Sir Henry Fowler lectured on metallurgy and its influence on social life; on Friday, Mr. Julian Huxley on control of growth; and on Saturday, Prof. Eddington on relativity. The first children's lecture by Sir William Bragg, on Friday, was most enthusiastically received. Popular meetings and lectures are being broadcast and picked up all over America. The scientific sessions are attracting wide attention, Toronto newspapers devoting several pages to them daily, while the Canadian press generally is giving prominence to them, also the leading United States journals. The meeting is in every way a successful one, and the attendance is satisfactory. Prof. J. L. Myres, general secretary of the Association, praised the local arrangements when speaking at a dinner tendered to visiting Freemasons by the University Lodge on Saturday.

A party of geologists is making a tour in northern Ontario on August 14-19; one of botanists is visiting Temagami Lake district on August 14-18; and one of agriculturists is to visit the Ontario Agricultural College, Guelph, on August 15. Three hundred members are taking part in the general excursions to the Pacific coast, leaving on Sunday, August 17, arriving at Vancouver on August 25, and returning to Toronto on September 3. There will be meetings at Saskatoon, Edmonton, and Vancouver, and halts at all points of scientific or scenic interest. The party goes out by the Canadian National Railway and returns by the Canadian Pacific. Many visitors from Great Britain are making lecture tours in the United States before returning home.

Prof. Horace Lamb has been elected by the General Committee president of the Association for the meeting next year in Southampton.

At a special convocation of the University of Toronto on Wednesday night, August 13, the degree of Doctor of Science, *honoris causa*, is to be conferred on Sir David Bruce, Sir Ernest Rutherford, Sir John Russell, and Sir Charles Parsons.

The three remaining addresses of presidents of Sections were delivered on Monday, August 11, and are described below.

Analysis of Crystal Structure by X-rays.

In his address to Section A (Mathematics and Physics), the president, Sir William H. Bragg, gives a very useful summary of the present position and the limitations of the new methods of analysing crystal structure by means of X-rays. He first discriminates three distinct stages, namely, (1) the measurement of the angle at which X-rays of a given wave-length are reflected by a set of identically similar planes within the crystal; (2) the use of the angular measurement to find the spacing of the set of planes, and hence the linear dimensions of the crystal-unit cell; and (3) the combination of the spacings of three different sets of planes to afford the volume of the unit cell. From these fundamental determinations, and a knowledge of the specific gravity of the crystal, the number of atoms of various kinds contained in the cell are found; and, as the proportion of the various kinds is the same as in the molecule, the number of molecules, one, two, three, four, or rarely more, comprised in the cell is afforded. By the repetition of this cell, in accordance with the degree of symmetry developed, without any new features, the crystal is built up.

The final aim of the X-ray analysis is to determine the arrangement of the molecules, and of the atoms comprising the latter, in the crystal-unit cell. Sir William Bragg emphasises, however, that the only measurement which the X-rays make directly is that of the distance separating any atom in the crystal from any other nearest adjacent one which is of like kind and condition of environment, from which the outlook would be exactly the same and with similar orientation. Any other measurement of distance is an indirect one, made with the aid of some additional crystallographic (physical or chemical) reasoning. It is not possible to measure directly by X-rays the distance between two atom-centres within the same cell. For example, in the two-molecule crystal-unit of naphthalene we cannot measure the distance separating one carbon atom from another in the same dimolecular cell, even those of the two separate molecules (which are differently orientated); the measurements afforded are those between any atom and its nearest neighbours exactly like itself in the three principal (axial) directions; that is, belonging to different adjacent cells, these distances being the lengths of the edges of the unit cell. Fresh considerations, such as the knowledge that naphthalene has a centre of symmetry, are required even to define the distance between the centres of the two molecules in the cell; or as in the case of rock-salt, the knowledge of the full crystal symmetry is needed to give us the distance between adjacent sodium and chlorine atoms, the X-ray measurements only affording that between any two sodium atoms, or any two chlorine atoms. Hence, the work of the crystallographer is absolutely necessary, especially as to symmetry and the polarity due to lack of it, exterior angles and the crystal elements derived therefrom, and the physical properties, if the measurements by X-rays are to have their full value. It is a great gain that this has now been so clearly stated.

Sir William Bragg then shows how the X-ray work, combined with all these other available sources of information, is enabling us to fix on the particular one of the 230 modes of interior arrangement of atoms possible to crystals, which occurs in the crystal under investigation, and incidentally shows that all cases investigated have conformed to one or other of these modes. The lesser problem of allocating the crystal to its proper class among the 32 differently symmetrical classes of crystals has consequently been solved in most cases with comparative ease. But again, it must be emphasised that the X-ray measurements alone do not permit of so satisfactory a result being attained.

Sir William Bragg also makes it clear that the alarm exhibited, when the first X-ray results were published, as to the apparent disappearance of the molecule, was a "mare's nest." There is nothing whatever to suggest a complete disruption of the alliances within the molecule so successfully studied and brought to light by

the chemist, and it is now certain that the conclusions of chemistry are valid for and carried into the solid crystal as well as into the liquid, for the chemical molecule takes its place as such in the crystal structure with very little change.

It is thus in the combination of the results of the X-ray analyst with those of the crystallographer, the physicist, and the chemist that future progress in the elucidation of the structure of the fully developed solid —the crystal—must be looked for. In thus unambiguously setting forth the limitations of the new method by use of X-rays, and the absolute need of collaboration in the study of crystals and solids in general, the president of the Section has rendered a special service.

LIFE-CONTROL.

PROF. F. W. GAMBLE'S presidential address in the Section of Zoology is an example of strong, matured thinking. It is futuristic rather than a retrospect of the things done and thought in the biology of the immediate past. Seizing on the present methods of experimental embryology it sees in them something pregnant with results that must profoundly modify future biological speculation. Can those results be seen, even if only in a vision, and what may be their nature? The address is an innovation that must be welcome to members of the Section.

More and more biology pries into the nature of the process that makes a specific organism from an apparently undifferentiated egg. This process, whatever it is, must be potential in the egg, becoming kinetic from the moment when the spermatozoon—the "Orpheus that visits the cold Eurydice," the "winged key that unlocks the imprisoned one"—passes through the bounding membrane and sets up the releasing transformation that results in embryonic development. The process is not in the outer environment which, while nurturing in precisely the same way the eggs of a hen and a duck, yet makes of the one a chick and of the other a duckling. Past conceptions of the nature of the developmental process were curiously naïf; they conceived of the ovum about to divide as an assemblage of parts, jumbled together in some way, a chaos of parts but nevertheless parts that were preformed and extended. Something called the "organisation" was supposed to usher the parts into place, laying down, in ordered fashion, the organ-systems, organs and tissues of the embryonic body. Then came the study of aberrations of development to perplex and obscure this simple conception. The organisation existed in the undivided ovum, leading to the segmentation of the latter, so that a number of blastomeres came into existence, each normally giving rise to a different part of the embryonic (and so also the adult) body. Yet the experimentalist could literally shatter the organisation to bits and find that each bit became another organisation (for each blastomere could regenerate a whole embryo). He could divide it in an infinity of parts without impairing it. Thus the egg and its parts, or the embryo and its parts, were autonomous and capable of regulation. The study of the nature of the organisation became the study of life itself—and it became (to many minds) a problem incapable of solution on the classic physico-chemical hypothesis of the nineteenth century. To an increasing number of biologists life becomes an ultimate natural category sharing, with matter and energy, our conception of the universe.

Now among the pregnant methods of present-day embryology there is this: it has become possible to study the mode of operation of the organisation in the developing egg and in the adult, multicellular organism (and it is essentially the same in each of these cases). In the egg the organisation radiates from a focus: in the adult it radiates from an apex or head. The components of the radiation are from head to posterior body regions along the longitudinal nervous axis; from nervous axis to right and left in bilaterally symmetrical animals, and from nervous axis to the ventral regions (in vertebrates), or to posterior regions (in an insect). Along each of these radiative paths the intensity of the control exercised by the focal region diminishes with the distance; there are metabolic gradients and these are demonstrable by various chemical methods. The gradient expresses the degree of positive control which the head region holds upon the functioning of the bodily organs and tissues. This apical control is one of quickening, urging, and directing of physiological activities. The possibility of control is, so to speak, vested in the head, or apical region, which reaches out into the outer world by its distance receptors, ever seeking to increase its environment. Environment and organism, reciprocal activities, are one—that which we call ordered life.

Yet, because the intensity of quickening and directing diminishes with the distance from the focus, there can be physiological isolation of a bodily part—limited, of course, and it may be transient. In the absence of control the part rests—it may be periodically. While it rests its potential rises and when it again comes under the focal control its functioning quickens. So in reserve organic material, two kidneys or testes, one of which may be enough for normal bodily activity, there is periodic alternation of rest and activity. But in the rest consequent on the removal of control there is still the urge of life, for the potential of the part increases. Should the focal control not be re-established what happens? There is always the tendency to individualisation, and the organism may segment and multiply—thus in a dividing Planarian worm the metabolic gradient shows a peak at the region where segmentation will occur. So also we seem to be able to interpret the formation of malignant tissue. Removed from the control of the cerebrum, which blends the activity of the part with those of all other parts of the body the intensity of life may still increase during this resting phase. Then connective tissue, or mammary gland, or testis attains higher metabolic potential, and still drawing on the circulating nutritive materials it endeavours to function; it cannot do so in normal fashion because it is undirected, and it proceeds to proliferate, passing into the cancerous condition.

And here we see, stated as an inference from experimental results, something of the terribleness of life—that which is sinister because it is disorderly. There is a "submerged recessive life" charged with activity, ever seeking to expand or grow. Specific organisations deploy this in ordered morphological and functional varieties. Given this "grace of organic regulation" and the life that incessantly insinuates itself into inert

matter assumes the hierarchical forms that evolution shows us. Without it and we see in life something inchoate but, in a way, fœtid and malignant: something suggested to us by the cancerous tumour or the luxuriantly living and rotting tropical jungle. Here, and in the backwaters of organic evolution—the "living fossils" that are poised between extinction and stability, or the primitive and unprogressive human societies—we see the life of the future: the inextinguishable vital impulse that waits on the ordering control that will lead to its deployment in new organic forms.

Problems of Crop Production.

In his address as president of Section M (Agriculture), Sir John Russell reviews the present position of agricultural research as compared with that occupied when the British Association visited Toronto in 1884. Up to that time the man of science had been occupied with the problem of how to feed the plant. Agricultural science was regarded as simply a branch of chemistry; but, during the last forty years, many new problems involving the biological sciences had presented themselves for solution. These problems are related to the growth of the plant as affected by inherent and environmental variations. Sir John Russell points out that, whereas the great discovery during the early period was that the plant could be fed by "artificial" substances, the most pregnant discovery of the second period was that the plant is plastic; by methods which are under scientific control it can be modified in desired directions, and thus be induced to give results that mere feeding cannot accomplish. Following the pioneer labours of Bateson, astonishing practical results have been reached by such workers as Biffen in England, Nielsen Ehle in Sweden, and the Howards in India. But the science of genetics is only on the threshold of what it may yet accomplish.

Sir John Russell then goes on to review, in detail, recent advances that have been made in the sciences with which he is particularly concerned at Rothamsted. He emphasises the pressing need for subjecting the great mass of material that has now accumulated to statistical analysis. In regard to the numerous empirical data from "field" experiments, Sir John Russell is of opinion that no advance can be expected until some fresh opening is discovered by scientific workers. With regard to the more rigid data accumulated by laboratory workers, the view is expressed that the greatest field for discovery lies in the direction of linking up plant nutrition studies with those of the soil solution, the latter being explored in the light of the physico-chemical interactions between soil and soil water. On the more general issues Sir John Russell is insistent on the need for fuller co-operation between all classes of scientific workers—for team work which shall include workers of all nations. But when all is said and done, the great expenditure of time and money now being incurred in agricultural research can only be justified by abandoning the view that the economic end alone is worthy of the effort. The address closes with an eloquent appeal for a wider vision, for an effort to upraise country life by revealing to the countryman "something of the wonder and mystery of the open spaces in which he dwells."

Obituary.

Prof. J. Wertheimer.

THE death, on August 9, of Prof. Julius Wertheimer, at sixty-four years of age, deprives both science and technical education of a most active and stimulating worker. Since 1890, when he was appointed principal of the Merchant Venturers' Technical College, Bristol, he took a leading part in promoting scientific and technological instruction in the city, with the result that, when the University of Bristol was established in 1909, the faculty of engineering was instituted at the College, with Prof. Wertheimer as dean of the faculty and also professor of applied chemistry.

Prof. Wertheimer was educated at University College, Liverpool, and Owens College, Manchester, and was headmaster of the Leeds School of Science and Technology from 1887 to 1890. He was a fellow of the Institute of Chemistry, the Chemical Societies of London and Berlin, and the Physical Society of London. He was for ten years hon. secretary of the Association of Technical Institutions, and was the author of text-books of practical chemistry and of scientific and educational articles in various journals, including NATURE. His long experience and wide knowledge of all matters relating to technological education at home and abroad made him a very valuable member of many committees. He served on the Council and Senate of the University of Bristol, the Teachers Registration Council, the Education Committees of the Gloucestershire County Council, the Bristol City Council, the British Science Guild, and other bodies. In recognition of his services to science and education the degree of doctor of science, *honoris causa*, was conferred upon Prof. Wertheimer by the University of Bristol in 1911. He also received the honour of Officier d'Académie de France in 1906.

Miss Katherine A. Burke.

By the death of Miss Katherine A. Burke, University College, London, has lost an excellent teacher who was untiring in her devotion to the academic, social, and athletic life of the college. Graduating at Birkbeck College, Miss Burke began her career at University College, in 1898, as a research assistant of the late Sir William Ramsay, and she took a share in the research emanating from the chemical laboratory at about this time. Later, she was appointed to the chemical staff, and was the first woman teacher directly concerned with the teaching of the undergraduates of the college. Miss Burke's original work included research on thorianite, the oxides of chlorine, the Joule-Thomson effect, the chemical dynamics of the alkyl iodides, and the absorption spectra of alcoholic solutions of nitrates. The paper on chemical dynamics, with Prof. F. G. Donnan (Journ. Chem. Soc., 1904, 555), showed that the order of reactivity of the alkyl iodides varied with the type of chemical reaction investigated, and hence it was not possible to ascribe their reactivity

to a uniform cause, such, for example, as a dissociation of the iodides into ions. A research, published jointly with Prof. E. C. C. Baly and Miss Effie G. Marsden (Journ. Chem. Soc., 1909, 1096), on the absorption spectra of the aqueous alcoholic solutions of nitric acid and lithium, ammonium, and silver nitrates in relation to the ionic theory, afforded strong support for the theory of hydrated ions. It was found that the limiting conductivity and the persistence of the absorption band of these solutions showed a minimum at three per cent. of water. During the War, in addition to her work in connexion with the Voluntary Aid Detachment, Miss Burke found time to assist in the preparation of synthetic drugs, which were so badly needed at that time.

Towards the end of her life, Miss Burke's activities were absorbed in the social and athletic life of the college, particularly in connexion with the acquisition and organisation of the sports ground for women students at Perivale.

WE regret to announce the death of Mr. Charles Leudesdorf, fellow and vice-regent of Pembroke College, Oxford, registrar of the University of Oxford, and author of a number of papers on mathematical subjects, on August 10, at seventy-one years of age.

Current Topics and Events.

THERE has been brought before the Council of the British Association at the Toronto meeting a special report by the Committee on Zoological Bibliography and Publication, dealing with the question of undue restriction in the distribution of H.M. Government publications. The results of the inquiries of this Committee are of general interest to scientific workers, and may be briefly stated. On applying to the heads of certain Government Institutions, the Committee was informed that no restriction had recently been placed on the distribution of publications of the Royal Botanic Gardens, Kew, the British Museum (Natural History), or H.M. Geological Survey. On the other hand, it found that public libraries had suffered from a considerable cutting down of free or reasonably priced Parliamentary and Stationery Office publications (in respect of which some concession has since been made); that certain British scientific societies of standing are no longer able to obtain Government scientific publications in exchange for their own publications (though foreign scientific societies are not similarly handicapped); that free reprints to authors of papers published by the Government have almost disappeared; that there has been a cessation of the routine free distribution of agricultural leaflets; and that review copies of Government publications have been curtailed. These findings are in general agreement with the statements made in a leading article in NATURE, December 29, 1923 (vol. cxii. p. 925). The Committee considers that no loss would ensue were review copies to be furnished gratis to editors on application, and suggests that the Council of the British Association "might well represent to the Government that the publication of the results of research among people likely to appreciate them is no less important than the making of the researches themselves, and that to refuse the relatively small additional expenditure is materially to reduce the benefit of the original much greater expenditure." Bearing in mind the effective methods employed by other governments in the spread of their scientific achievements, no one is likely to quarrel with this exceedingly modest recommendation.

SCIENTIFIC men are indebted to Major A. G. Church for raising an important question in Parliament, namely, the assessment for income tax of professional men, more especially men of science, who are remunerated by a fixed salary and are therefore assessed under Schedule E. Professional men whose income is made up of fees, and who are, therefore, assessed under Schedule D, are allowed in the assessment of their incomes to deduct from their earnings expenses ordinarily incurred in the course of their work, including the cost of the renewal of technical works of reference, subscriptions to professional societies, the preparation and publication of memoirs —in fact, all expenditure required to maintain their technical efficiency. Such expenses are not as a rule allowed to those assessed under Schedule E. The Financial Secretary to the Treasury denied, however, the existence of such a distinction and offered to have any particular case investigated, in which further relief was believed to be due, provided the necessary particulars were furnished. The question was, as a matter of fact, brought before the Treasury two or three years ago, when it was intimated that such expenses might, for the purpose of assessment, be deducted from the salary received, when they were incurred in consequence of an express requirement of the employer. If, for example, on the appointment of a science lecturer it was stipulated he should carry out research, or that he should join the technical societies relevant to the subject he taught, or take other steps calculated to maintain his scientific position, the necessary expenses might be deducted in ascertaining his assessable income. It is for the colleges concerned to see that this requirement is satisfied.

THE Admiralty has announced the appointment of Capt. H. P. Douglas to the post of Hydrographer of the Navy in succession to Vice-Admiral F. C. Learmonth, as from October 1 next. Capt. Douglas has been employed in the surveying branch of the Navy since 1897, and held the appointment of superintendent of charts in the hydrographic department from 1910 to 1914. During the War, he was employed on special surveying staff duties at the Dardanelles and with the Dover Patrol, in addition to acting as the first director of the Navy Meteorological Service (1917). For his preparatory work in connexion with the raid on Zeebrugge he was awarded the C.M.G. He was assistant hydrographer of the Navy from 1919 to 1921, and has since been in command of H.M. Surveying Ship *Mutine*, and her successor,

H.M.S. *Ormonde*, on the Bermuda and West Atlantic Survey. He is the inventor of several instruments and diagrams for use in surveying and navigation. The post of Hydrographer of the Navy (instituted in 1795) was originally tenable at their lordships' pleasure, and for an unspecified term. Admiral Beaufort, still remembered in connexion with the "Beaufort scale" of wind velocities, occupied the position for twenty-six years (1829–1855), and the late Rear-Admiral Sir William Wharton for twenty (1884–1904). Since the latter's time, however, the tenure of the post has been limited to five years, its successive occupants having been Admiral Sir A. Mostyn Field (1904–1909), Admiral Sir H. E. Purey-Cust (1909–1914), Vice-Admiral Sir J. F. Parry (1914–1919), whose grandfather, Sir W. E. Parry, the celebrated Arctic explorer, was Hydrographer in 1823–1829 and the present Hydrographer, Vice-Admiral F. C. Learmonth, who, before taking up his appointment as Hydrographer, was Director of Fixed Defences from 1914 to 1919, and in that capacity won unstinted praise from Lord Jellicoe for his work in the production of net defences, both for the British fleet and for those of the allies.

THE Council of the National Institute of Agricultural Botany announces that it proposes to place upon the market this autumn about 2500 quarters of a new seed wheat, Yeoman II., bred by Prof. R. H. Biffen; and tenders as to quantity are invited from established dealers in seed corn. The seed wheat will be sent out in sacks closed with the Institute's seal, none other being genuine, at the rate of 6*l*. 6*s*. per 4½ cwt. Yeoman II. is intended to take the place of the older Yeoman wheat, partly because pure seed of the latter is now difficult to obtain owing to admixture with other wheat, partly because Yeoman II. is a better wheat in several respects. Both wheats are products of the same cross, Browick × Red Fife, and are similar in type. The yielding capacity of Yeoman II. has been tested out at ten different centres on varying soils throughout the country, with thoroughly satisfactory results. Comprehensive milling and baking trials made by impartial judges of the National Association of British and Irish Millers indicate that the bread made from the flour of Yeoman II. is of exceptionally good quality and is "incomparably superior to anything obtainable from average ordinary English wheat." In favourable seasons the loaves approximate closely to those from "No. 1 Manitoba" wheat. It is strongly advocated that from the different points of view of growers, millers, and consumers, Yeoman II. should take the place of the older form. It is particularly suitable for growing on medium and heavy soils which are in good heart, and is specially recommended for the eastern, midland, and southern counties of England, the best results being obtained with early sowing.

A TALK on "Life of the Sea-shore," by Mr. T. Howard Rogers, broadcast from the Birmingham Station of the British Broadcasting Co. on July 29, was the first of a series which will be continued until the end of the year by members of the Birmingham Natural History and Philosophical Society. On August 9, Mr. O. T. Elliott dealt with "Germs—Beneficial and Otherwise," and the second and concluding part of his lecture will be given on August 16. Other talks which have been arranged are: "Butterflies," by Mr. J. H. Grant (Sept. 9); "The Earliest Known Life of the Earth," by Mr. Frank Raw (Sept. 17); "Flies," by Mr. Colbran J. Wainwright (Sept. 23); "Fossils," by Dr. L. J. Wills (Oct. 7); "How we get our Time," and "The Moon," by the Rev. E. S. Phillips (Oct. 14); "Plant-animals," by Dr. W. T. Elliott (Oct. 21); "Fairy Rings," by Dr. Jessie S. Bayliss Elliott (Oct. 28); "Algeria," by Capt. C. K. Shepherd (Nov. 4); "Shells," by Mr. H. Overton (Nov. 11); "Life of the Ocean," by Mr. T. Howard Rogers (Nov. 18); "Saturn," by Mr. S. C. Parish (Nov. 25); "Aquaria," by Mr. G. T. Calvert (Dec. 2); "The Modern School-boy," by Mr. F. W. Pilditch (Dec. 9); and "The Life-story of the Eel," by Dr. A. J. Grove (Dec. 30). The subjects are being dealt with in an interesting and non-technical manner; and it is hoped that these instructive talks, which are addressed primarily to young people, will arouse interest in, and foster a taste for, natural history and kindred scientific subjects, and prove a helpful contribution to the valuable educational side of the programmes broadcast by the B.B.C.

IN connexion with the Exhibit in Gallery II. of the Government Pavilion at Wembley, by the Cambridge School of Agriculture, illustrating fertility and sterility in domestic animals, an excellent explanatory memorandum by Mr. J. Hammond has been issued by the Ministry of Agriculture and Fisheries. Sterility in the male is illustrated by microscopic preparations showing the semen of a sterile bull devoid of spermatozoa owing to the atrophy of the seminiferous cells—a condition which may follow inbreeding and other types of mismanagement. The reproductive process in the female is illustrated by a preparation of the reproductive organs of the cow, and the memorandum gives a short but clear summary of what is known of the physiology of these organs. Incidentally, mention is made of the striking demonstration of the control exercised by the corpus luteum over the ripening of the next Graafian follicle, that is obtained by expelling the corpus luteum from the ovary by simple pressure through the rectal wall, the result of this operative procedure being to bring on the next heat period before the time at which it would normally occur. Various causes of sterility in the cow are dealt with in the memorandum. The exhibit dealing with the sow illustrates the curious secondary limitation of fertility which occurs in this animal through degeneration and elimination of some of the embryos during the period of pregnancy, the potential brood of about 20 being reduced in this way to an average of about 8 or 9. In the rabbit such absorption of fœtuses is produced experimentally by removal of corpora lutea during early pregnancy, but in this case all the fœtuses disappear instead of only some of them as is the case in the sow. A similar result is seen in a rabbit which mates while still suckling a large litter, very active lactation having itself an

atrophic influence on the corpora lutea: in this case the effect may be prevented either by reducing the number in the litter to one or two, or by special feeding. The exhibit is one of much interest, and it will serve a good purpose by directing attention to the enlightened policy adopted by the Government of recent years, of encouraging research in external institutions such as Universities and independent laboratories.

Mitteilungen, No. 6, for June 1924, of the Society of German Men of Science and Physicians, are largely occupied by a discussion of the participation of Germany in international congresses. Léon Bourgeois is quoted as having said in 1913: "Coordonnons nos recherches, unissons et centralisons nos efforts, ne nous laissons distraire ni diviser par rien . . ." That was in the earlier days of tuberculosis inquiry, to which Koch, Ehrlich, and Behring have since contributed. Fritz Haber has spoken explicitly as president of the German Chemical Society meeting on May 12. He notes a mellowing of relations and a wish for closer scientific intercourse, expressed in particular by the United States, England, Russia, and Japan, as, for example, the invitations of the British Chemical Manufacturers and of the World Power Conference. The facts are given in greater detail in a paper on "International Scientific and Technical Congresses," pp. 53 to 67 of *Mitteilungen des Verbandes der Deutschen Hochschulen*, May 1924. The editor invites further reports directed to Johannisstr. 7, Münster in Westphalia. A list of 84 congresses is reviewed. Germans have joined in discussing physiology at Edinburgh, psychology at Oxford, orthopedics at Amsterdam, plant diseases at Wagening, serum at Copenhagen, pedagogy at Montreux, international law at Brussels, psychic sciences at Warsaw, dentistry in Paris, meteorology at Utrecht, gardening at Amsterdam, sociology in Rome, milk at Washington, philosophy in Naples, applied mechanics in Delft. Co-operation is absolutely necessary for the future of science, but much patience is required, for pressure in any direction might hinder more than help. The fullest list of international societies of all sorts is the "Répertoire des Organisations Internationales," published in Geneva for the Société des Nations. The director, Section of International Bureaux, League of Nations Secretariat, asks for information as to new societies or changes in older ones.

PROF. DR. RICHARD ZSIGMONDY, of Göttingen, has been elected a corresponding member of the Vienna Academy of Sciences.

A PROFESSOR of science is required at the Royal Military Academy, Woolwich, particulars of which can be obtained by written application from the Under Secretary of State, War Office (S.D.3), Whitehall, S.W.1. The completed form must be returned by August 21.

THE Department of Scientific and Industrial Research invites applications for the post of superintendent of its Chemical Research Laboratory. Candidates should have had experience of, and be distinguished in, some branch of pure or applied chemistry. Particulars of the duties of the post and a form of application are obtainable from the secretary of the department, 16 Old Queen Street, S.W.1. The latest date for the receipt of applications is September 30.

A SHORT time ago the question was raised in NATURE as to the possibility of registering priority in scientific discovery, on the analogy of a patent registering priority in invention. The device of sending in contributions under seal need not be forgotten. Even if afterwards published in some more finished form, the sealed documents should afford proof of the stage already reached at the date when they were handed in. The Academy of Sciences in Vienna reports the receipt of papers on the reproduction of lantern slides by an electrical method, on the action of Röntgen rays on organism, and a new treatment of carcinoma, a proof that the equation $x^n+y^n=z^n$ has no solution in rational numbers when n is greater than 2, and several other matters.

WE have received from the Russian Academy of Science of Leningrad the June issue of *Electritchestvo*. In honour of the centenary of Lord Kelvin it is called the "Lord Kelvin Number," and is devoted to articles in appreciation of his various activities by eminent men of science and engineers. The address presented at the Commemoration Celebration in London is quoted. "All Russian scientific men and engineers send their greetings to the Mother Country" of Lord Kelvin. "May the same spirit of sincere fellowship, which unites to-day the scientific workers of the whole world, form closer bonds between them for the benefit of humanity." Prof. Steklov, the vice-president of the Russian Academy of Science, writes an appreciation of the wonderful creative genius of Kelvin and his constant searchings after new physical laws. He, more than any one, tightened the bonds between pure science and engineering. Prof. Ossadchy, vice-president of the Gosplan, gives a résumé of Kelvin's work on telecommunication, and points out how its development was strongly influenced by his ideas. Prof. Châtelain, the president of the Russian Section of the International Electrotechnical Commission, discusses Lord Kelvin's work in the domain of electrical engineering. Its exceptional value lies in the fact that Kelvin laid sure foundations on which later workers have built a noble superstructure.

MESSRS. W. HEFFER AND SONS, LTD., Cambridge, announce for publication in the autumn a translation, by T. R. Parsons, of "Practical Physical and Colloid Chemistry for Students of Biology and Medicine," by Prof. L. Michaelis, of Berlin, which work was written to meet the needs of biologists and physicians desirous of becoming acquainted with the more important applications of physical and colloid chemistry to the problems of life and disease.

In order to show French textile manufacturers that it is no longer necessary to purchase their machinery outside France, M. A. Renouard has an article of 69 pages in the May Bulletin of the Société d'Encouragement. It is well illustrated and shows that, since the War, French textile machinists have introduced improvements into spinning frames, looms, and other machines which place them in the front rank.

The Department of Mines of the Queensland Geological Survey is issuing a series of reprints dealing with Industrial Minerals, giving a brief summary of the occurrences, treatment, uses, values, and production of these minerals, with special reference to Queensland resources. Nine of these pamphlets have been issued dealing respectively with salt, asbestos, mica, molybdenite, platinum, nickel, graphite, manganese, and arsenic.

In the Annual Report of the Raffles Museum and Library, Singapore, for the year 1922, Major J. C. Moulton gives a list of 44 specialists whom he has induced to assist in naming the collections of the museum. Progress has been chiefly marked in the insect collections, and many papers describing new species contained in them have been published. "As a result the museum is becoming more widely known as a *live* institution, and an increasing number of inquiries have been received from many distant parts of the world concerning the fauna of Malaya." It is to be hoped that this good work will continue in spite of Major Moulton's transference to a higher post.

Report No. 27 of the Industrial Fatigue Research Board records the results of investigations into the following industries: the textile, metal, boot and shoe, pottery, glass, and laundry, and into some repetition processes. It is thus a compilation by means of which the findings of different investigators in different industries can be conveniently compared. The various recommendations have been grouped under the following headings: (*a*) working conditions, (*b*) working methods, (*c*) administrative. It is only by the slow accumulation of data from many fields that generalisation of scientific value can be made. We are yet far from generalisation, but these studies show the direction in which available evidence points and suggest further developments.

Our Astronomical Column.

The Opposition of Mars.—At midnight on August 22-23, Mars will be nearer the earth than it has been for more than a century. The conditions are, in fact, the best possible for a close approach. These conditions are attained when opposition occurs a week before Mars passes perihelion, from the fact that the earth is then nearer to its aphelion.

At these close oppositions, Mars considerably outshines Jupiter, and its ruddy light renders it a very striking object. It is 10° further north than in June 1922, so that the conditions for observation in England are not quite so hopeless as they were then.

Unfortunately, these very near oppositions have seldom been so fruitful in telescopic discoveries as those occurring somewhat later in the year. Thus Schiaparelli's work on the canals was mainly done in 1879 and 1881, though he was observing in 1877.

The late Prof. Lowell, whose long-continued scrutiny of the planet under all possible conditions adds weight to his opinion, explained this by August oppositions occurring at the dead season of canal development, when the supply of moisture from one polar region had exhausted itself, and that from the other had not commenced. It is interesting to learn that his widow is visiting Flagstaff; her presence will doubtless encourage the observatory staff to make the most of their splendid equipment. The 24-inch Alvan Clark refractor, and the seeing conditions at a height of 7000 feet in the Arizona desert, are universally admitted to be unrivalled. Prof. W. H. Pickering is remaining at Mandeville, Jamaica, until after the opposition.

Sun-spot Activity.—A noticeable feature on the sun's surface since August 1 has been a well-defined circular spot, in latitude 6° north, which passed through the centre of the disc between August 6 and 7. The history of this spot has been followed on the Greenwich photographs since July 9, when a large bi-polar group commenced to develop in a small area of faculæ seen at the east limb of the sun on July 6. The total area of the group reached 1/2000 of the sun's visible hemisphere about July 13, after which the rear components disappeared, leaving the leader to continue uninterruptedly in the following rotation. No pronounced magnetic disturbance occurred at Greenwich when the spot was near the sun's central meridian.

The period embracing a solar minimum is well known as one of transition; the passing cycle is represented by sporadic spots near the equator, whilst the spots of the coming cycle are appearing in higher latitudes (20°-35°). The last solar minimum is now definitely concluded, and although small equatorial spots might have been expected, a spot group of this extent and length of life is remarkable. It will afford additional data for determinations of magnetic polarities at Mt. Wilson, which are of added interest at this phase of the solar cycle in view of the observed reversal of polarities.

Two Notable Variable Stars.—The June Monthly Notices of the Royal Astronomical Society contain papers on the well-known variables Mira Ceti and β Lyræ.

The former is discussed by Dr. W. J. S. Lockyer, the star having been observed both for magnitude and spectrum at the Norman Lockyer Observatory, Sidmouth, last winter. The maximum was attained on January 29, in accord with Leon Campbell's prediction; the star was unusually faint, only rising to 4·9 mag., whereas it attained 2·2 mag. in 1906; it seems to have been the faintest maximum since 1886. The bright hydrogen lines were also feebler than usual; a discussion is given of their relative brightness. The more prominent dark lines were also studied, and indicated the presence of calcium, manganese, iron, aluminium, strontium, chromium, titanium. It was noted that there were several instances of the intervals between absorption lines having previously been mistaken for bright lines, and that apparently the only bright lines present are those of hydrogen.

Miss M. A. Blagg contributes a long paper on Baxendell's observations of β Lyræ, which ranged from 1840 to 1877. She concludes that the period is increasing, and gives the following formula for principal minimum: Julian Day $2398590{\cdot}57 + 12{\cdot}908\,E + {\cdot}0000037\,E^2$. She also finds a subsidiary variation with a period of 6·576 days; the fact of its being so nearly half the principal period increased the difficulty of analysis.

Research Items.

AN AMERIND TYPE FROM CHINA.—Prof. Seligman figures in *Man* for August two examples of Chinese art of the T'ang period which provide a striking corroboration of the view put forward by Dr. Hrdlička on several occasions, notably at the Nineteenth International Congress of Americanists (*vide* Proceedings XIX. Int. Congress Americanists, p. 565), that a type identical with, or close to, the American Indian occurs over a wide area in Eastern Asia. The first of these is a whistle, roughly spherical in form, of a well-baked whitish paste, representing a head, of which the face and scalp are covered with a dull light green glaze. This might perhaps have been regarded as a freak, had it not been for a second and more striking specimen in the Eumorfopoulos collection. This is a small figurine of much the same quality as the whistle, and also covered with green glaze. In both cases the features are distinctly Amerind in cast, while the treatment of the hair suggests the lank locks of the characteristic American Indian type.

MOLLUSCAN PROBLEMS.—The crystalline style of molluscs has always puzzled biologists, and even now there is no clear indication of its full functions. Robson performed a useful service in collecting together all records of its occurrence not only in Lamellibranchs but also in Gastropods, and any comprehensive view of its function must apply to both these groups. Many writers have shown recently that the style contains an amylolytic ferment in certain forms, but other equally good workers have not been able to find significant quantities of ferment in the style of other species. There is therefore room for a comprehensive piece of work on this aspect of the question, since generalisations from results of experiments on a few animals are not yet valid. Huxley suggested long ago that the style probably revolved in the stomach, and Nelson has seen the revolutions in a few bivalves, but more observations are again needed, as also of the use of the style to draw into the stomach the food-entangling mucus-strings as described by Orton and Worsnop in the oyster. The ready solution of this organ in unfavourable conditions in some forms and its high resistance to solution in others indicates that the style may have somewhat different functions even in closely related animals. We shall therefore not be in a position to dogmatise on the function of the style in molluscs until a great deal more information has been collected. Another old molluscan problem, which was regarded as of great moment at one time, namely, the question of the possibility of the intake of sea-water, has apparently been settled. Pelseneer long ago acknowledged the occurrence of a water system in the foot of Naticidæ, but completely separated from the circulatory system and used for distending the foot in burrowing, and similar cases have been recorded by Lewis and by Mitra, who was also one of the first workers to demonstrate the existence of a ferment in the crystalline style. But no case of direct communication between the blood system and the exterior has yet been demonstrated, and seems unlikely to occur. There still remains, however, the problem of the possible absorption of water into the system, either over the whole exposed surface or portions of the surface of the body of a mollusc.

THE TWINNING AND MONEMBRYONIC DEVELOPMENT OF PLATYGASTER.—Messrs. R. W. Leiby and C. C. Hill contribute an interesting account (*Journ. Agr. Res.*, Washington, vol. 25, No. 8, 1923) of the development of *Platygaster hiemalis*, a hymenopterous parasite of the Hessian fly. The female deposits a group of four to eight eggs in the egg or in the young larva of the host. During maturation two polar bodies are formed in the egg, and these unite to form a single polar nucleus in the anterior region of the egg. Maturation is stated to be identical in fertilised and in unfertilised eggs. After maturation the male and female pronuclei fuse to form the cleavage nucleus, which lies in the posterior part of the egg. In the unfertilised egg the female pronucleus is found in a corresponding position. The portion of the egg containing the cleavage nucleus becomes differentiated and forms the embryonic region; the remainder of the egg containing the polar nucleus is homologous with the trophamnion and paranucleus of previously described polyembryonic insects—its function is to nourish the embryos until they are young larvæ, and can feed for themselves upon the host. The embryonic nucleus and the polar nucleus each undergo division into two and then four. The embryonic region in some of the eggs then divides to form two embryonic regions which become separated from each other—each carrying with it two of the four paranuclear masses. This separation results in the production of twin germs, each of which develops into a larva. The embryonic region of other eggs does not separate into two, and such eggs produce a single larva. The twinning development, here described for the first time, illustrates a simple type of polyembryony.

RAINFALL IN AUSTRALIA.—The rain map of Australia for 1923 compiled by the Commonwealth Meteorologist shows the distribution of rain for the year and for each separate month. There are also a number of charts showing the areas with rainfall above the average in recent years. The chief maps are based on the records of some 1300 well-distributed stations. About 22 per cent. of the continent had a rainfall above the normal, but the excess was mainly in the west, south-east, and Tasmania, while in 1922, when the area of excess reached about the same percentage, it was mainly in the north. In Queensland and parts of northern New South Wales, the dry conditions which had prevailed in 1922 continued and intensified into conditions of severe drought. It was only in June and December that the rainfall was at all satisfactory. In south-eastern Australia the fall was poor during the first half of the year. Conditions during the cereal-growing period were very favourable throughout most of the wheat region, but in northern New South Wales and Queensland crops failed on account of the drought.

OPALESCENCE AT AND NEAR THE CRITICAL POINT.—M. A. Audaut, in the May-June number of the *Annales de Physique*, describes a very comprehensive investigation of this phenomenon for five liquids with high critical temperatures. He measured both the diminution of the intensity of the transmitted light, and the intensity of the light scattered at right angles to the line of incidence, and found that the critical opalescence has the same intensity for a given substance when the experimental conditions are the same, and is not due to dust or impurities. Slow change of temperature and thorough stirring are necessary to obtain well-defined opalescence, a rate of one degree change per hour having been adopted. The opalescence was found to be a function of the temperature, of the wave-length of the light employed, of the amount of substance in the tube, the "filling," and

of the nature of the substance. The appearances observed at different temperatures and with different fillings agree with the theory of Einstein and Smoluchowski, which explains the opalescence as due to molecular agitation, using the analogy of Brownian movements. There is a critical filling, with maximum opalescence, which in this case is found at the same temperature with rising and with falling temperature; this temperature coincides with the critical temperature, which can be determined with accuracy by measurements with different fillings. The method gives for ether and ethyl acetate 193·3° and 249·8° for the critical temperatures, and 0·259 and 0·306 for the critical densities. The number, N, of the molecular aggregates concerned per c.c. can be deduced by means of the theory from the observations of the opalescence; for ether, at 2·5° above its critical temperature, two values were obtained for N: 62×10^{22} and 58×10^{22}.

ADSORPTION AND CATAPHORESIS.—In the *Comptes rendus* of the Paris Acad. Sci., June 23, M. K. v. d. Grinten describes observations made with the ultramicroscope on a suspension of fine particles of the same glass as that employed in the construction of the trough containing it. Platinum electrodes 40 cm. apart were placed in the trough, and the potential difference between them was 10 volts. The velocity of the particles near the glass walls was in the opposite direction to that of those midway between them; the velocity of the latter, near the positive pole, was double that along the wall near the negative pole. When the thickness of the trough is more than 0·5 mm. the velocity of the particles in the middle region no longer varies with the thickness. This indicates that the liquid in the middle region remains at rest and the measured velocity is the true velocity of the particles with respect to the liquid. If electrolytes are added the cations of which are adsorbed, the velocity of the particles diminishes, and reverses for a certain concentration of the electrolyte. Methyl violet (*violet crystallisé*) was used as the added electrolyte, and the maximum number of molecules adsorbed per sq. cm. of glass sheet was found to be $1{\cdot}6 \times 10^{14}$. At small concentrations the adsorption grows rapidly with the concentration, but from the concentration $n/10000$ on it grows less rapidly towards the maximum, when it is concluded that a monomolecular layer is formed over the whole surface of the glass. The curve showing the relation of the cataphoresis velocity to the concentration, and that showing the relation of the number of adsorbed molecules per sq. cm. to the concentration, have the same form; starting from concentration $n/10000$, the two curves rise almost perpendicularly to the X axis. Similar results were obtained with suspensions of selenium. It appears then that each particle in the suspension is covered with a monomolecular layer when a certain concentration is reached.

WHAT IS MATTER?—In the issues of *Die Naturwissenschaften* for July 11, 18, and 25, Prof. H. Wehl, of Zurich, passes in review the various answers which have been given to this question. Of these the older "substance theory" has played its part and disappeared, leaving the "field theories" of Mie and others and the "dynamical theories" in possession of the stage. Some form of dynamical theory gives, according to Wehl, the greatest insight into the question, and he outlines his own view as follows: Matter is an agency which generates a field, the field a medium which propagates the action of one body on another. An "active mass" m generates about itself a field $m/4\pi r^2$ and a "passive mass" m' placed in this field is acted on by force $mm'/4\pi r^2$. By a proper choice of units the passive and active masses of a body may be made identical, and the conception of the field as a flux from the active mass gives the inertia of the mass as due to the field it generates about itself.

DEVELOPMENT OF PHOTOGRAPHIC LENSES.—Those who are interested in the history of the development of lenses for photography will find in the August number of the Royal Photographic Society's Journal an exceptionally valuable contribution by Prof. Moritz von Rohr. Since the publication of his "Theory and History of the Photographic Objective" in 1899, he has found many new facts, and it is these that he here records. He refers to work by C. Scheiner in 1618, J. G. Leutmann in 1719, Thomas Young in 1800, Coddington, Airy, and others, in the prephotographic period. Then follow accounts of A. S. Wolcott's pioneer work in 1843 (who appears to have been the first to produce a symmetrical doublet and a revolving diaphragm), a symmetrical doublet with plane cemented surfaces by H. Fitz, and the efforts of American opticians (1860–66) in the production of wide angle lenses. The great theoretical importance as well as the practical efficiency of the negative lens used by Piazzi Smyth to flatten the field of the portrait lens in his small camera that took plates one inch square is discussed. The author has obtained from Mr. J. Stuart two letters written by Monckhoven (1865–67) recommending Thomas Ross to take up the manufacture of H. A. Steinheil's $f/8$ aplanats. A full translation of these letters is given, and the originals were presented to the Royal Photographic Society. The paper concludes with a long list of references to the sources of information.

CHEMISTRY OF INSULIN.—*Chemistry and Industry* of July 18 contains an account of a paper by Mr. F. H. Carr, of British Drug Houses, on the manufacture of insulin. An account of what is known of the chemistry of insulin, the most important property of which is its action in causing the disappearance of glucose from diabetic blood, at the rate of 3 grams of sugar per 0·0001 gram of insulin in two hours, is first given. Insulin appears to be sparingly soluble in water at its isoelectric point of $P_H = 5{\cdot}2$, but readily soluble at other points near neutrality, precipitated by half saturation with ammonium sulphate and sodium chloride and other reagents, insoluble in absolute alcohol, free from phosphorus, tryptophane, and tyrosine when pure, but containing organic sulphur. Insulin from ox-pancreas gives the biuret reaction, but that from skate-pancreas does not. It does not pass a collodion ultrafilter and is destroyed by pepsin and trypsin, and therefore appears to be of protein-like structure. Insulin is extracted from animal pancreas, which is the part of the body in which it is mainly stored, and recent experiments show that it is present in a more easily separable form in many fishes near the gall bladder. The method of manufacture is rather complicated, but depends essentially on extracting the disintegrated pancreas, rendered acid to P_H 2·5 or alkaline to P_H 7·0, with 65-70 per cent. alcohol, in which little enzyme is dissolved, cooling to $-5°$, filtering or centrifuging, concentrating at low temperature to one-tenth the volume, extracting the fat, precipitating the proteins with absolute alcohol or ammonium sulphate at P_H 5 and further separation of the separated proteins with alcohol and picric acid. The large scale operation is continuous, and a flow sheet is given. As a result of improvements, the selling price of insulin has been reduced from 25*s.* to 2*s.* 8*d.* for ten doses. The really wonderful results of insulin treatment in advanced cases of diabetes are set out.

The Fourth International Congress of Refrigeration.

THE fourth International Congress of Refrigeration was held in London in June last. The Congress was organised by a committee of the British Cold Storage and Ice Association, working in conjunction with the Institut International du Froid. This International Institute is an organisation in which each State, Dominion, or Colony, signatory to the International Convention, is represented by delegates appointed by the participant State in a number proportioned in accordance with the amount of annual subsidy, varying from 1000 to 12,000 francs. It is interesting to note that forty-eight countries have signed the International Convention.

The Institute devotes its energies to further the science of refrigeration; to encourage the study of the best solutions of questions relating to the conservation, the transit, and the distribution of perishable produce; to the publication of all information relating to the world's frozen-food situation.

The study of the above-mentioned subjects is pursued by sixteen separate commissions. The function of the International Congresses is to coordinate and afford a common meeting ground for the members of these commissions and to all interested in refrigeration.

The work of the London Congress was subdivided between seven sections dealing respectively with: 1. Scientific Questions—Physics, Units, and Biology. 2. Refrigerating Materials—Machines, Insulating Materials and Testing. 3. General Applications of Refrigeration—Food, Agriculture, Ice, etc. 4. Refrigerated Transport—Railway and Steamship. 5. Legislation. 6. Education and Propaganda. 7. General Economics and Statistics. Thus one section would embrace the subjects coming within the purview of a number of separate commissions.

The meetings of the Congress were well attended by those engaged in the practical side of refrigeration. The title "Congress of Refrigeration" failed to attract many physicists, although Section 1 had on its programme a fine series of papers from the Leyden Cryogenic Laboratory.

The character of the papers will be realised from the following titles selected at random: "Organisation of the Work of Commission No. 1" (Kamerlingh Onnes). "Report on the Freezing Point Temperatures of Organic Substances suitable for Use as Reference Points for the Low Temperature Scale" (Jean Timmermans). "The Isotherms of Hydrogen, from $-217°$ C. to $-240°$ C." (J. C. Swallow). "Report on the X-ray Investigation of the Constitution in the Liquid and Solid States of Substances at Low Temperatures" (W. H. Keesom). "Low Temperature Investigations in the Service of Cosmical Physics" (L. Vegard).

The papers of a biological character submitted to Section 1 were rather disappointing, and it was evident that the majority of the contributors did not regard the Congress as the place to discuss purely scientific matters. It is a pity that this outlook should prevail, for it is obvious that an international congress which gathers under one roof the diverse interests concerned can exert an enormous influence on the progress of refrigeration on both the theoretical and the practical sides. Hence, on the purely biological side of the science of refrigeration there is but little which calls for comment, so far as the present Congress is concerned.

Some of the most interesting of the papers on the practical side were those dealing with the transport of refrigerated produce by land and sea and those on special applications of refrigeration. Of the papers dealing with the marine side, one might be mentioned —"Special Methods of Construction of Ships and Refrigerating Appliances for Vessels employed on Long Voyages" (A. R. T. Woods).

As regards land transport, the paper on "The Influence of Refrigeration in the Preservation of Fruit with Special Reference to South African Export Varieties" (I. B. Pole-Evans and Edgar A. Griffiths) is noteworthy, as it records the results of experiments on special trucks carrying fruit a distance of 1000 miles through semi-tropical heat.

The paper on "Temperature and Metabolic Balance in Living Plant Tissues" (F. Kidd and C. West) is a useful sketch of some recent work in America and Germany.

The work of the Insulation Sub-Committee of the Food Investigation Board was summarised in a paper of about eighty pages with the title "The Scientific Study of Heating Insulating Materials" (Sir Richard Glazebrook and E. Griffiths).

An interesting contribution on one of the special applications of refrigeration was that on "The Application of Refrigeration to the Ventilation of Mines" (F. A. Willcox and J. D. Farmer).

Mr. W. B. Hardy, director of the Food Investigation Board, gave an admirable sketch of what he considered to be the correct function of the Food Investigation Board and the work of a research station. He pointed out that of the problems which an industry presents, some are fundamental and far-reaching, others special and local. He quoted two examples to illustrate what the Board conceived to be their special province of work. One was the problem of the freezing of beef and most white fish. Can these materials be so frozen as to recover their original state on thawing? When beef is thawed after being frozen, its texture is impaired, and it drips a fluid rich in dissolved nutritive material. This is due to that separation of water from other constituents which is a common feature in the freezing of solutions. Is it possible so to modify the whole cycle of physical events compressed in freezing and thawing as to bring this separation of water under such control as will lie within the four corners of a possible commercial process? No answer is yet forthcoming, because the theory of the freezing of tissues is yet in its infancy. Animal tissues are colloidal structures, and of the effects of low temperatures on colloids little is known. This is a fundamental problem because its solution involves the whole theory of the freezing of tissues. If and when it is solved, and it may be years before that difficult end is attained, any feat of freezing should be possible, or, to be more exact, the possibilities and impossibilities of freezing as a mode of preserving animal or plant tissues should be capable of fairly exact delimitation.

The other problem put forward by Mr. Hardy was purely physical. The Board were consulted as to the following:

A certain store was cooled by a fan driving air over calcium chloride brine, the cold air being then supposed to circulate throughout the chamber. Meat stored there became discoloured and unpleasant to sight and touch. This was ascribed to putrefactive organisms—to bacteria, in short. The solution of the problem proved simple. Bacteria as the *causa vera* were readily ruled out. The wind from the fan produced an invisibly fine spray of brine which settled on the surface of the carcases, where the calcium chloride reacted with the red colouring matter hæmoglobin to produce methæmoglobin. The scientific interest up to this point is small, and the problem,

though of some practical interest, does not rise above the level of the ordinary works laboratory. A study of the air currents in the chamber, however, revealed the fact that the fan, though seemingly placed where it would circulate the whole body of enclosed air, did as a matter of fact merely puddle in its own neighbourhood, producing powerful vortices on the surface of the brine. This and many similar instances have convinced the Board that the principles which underlie the movement of air in a space partly occupied by solid masses, such as the cargo in a hold, or the carcases in a store, are not clear, and therefore they have arranged that this general fundamental inquiry shall be prosecuted at the National Physical Laboratory.

This example will serve to show how the particular leads to the general; but general solutions are not reached readily, and, therefore, if each particular problem is regarded only as the door to the general, the number of problems which can be undertaken by the small staff at the disposal of the Board is limited.

The papers on the practical engineering aspect of cold storage were so numerous, and the impression which the Congress left upon one was that the progress made on the purely technical side has been so considerable, that it threw into strong relief the inadequacy of our knowledge on the fundamental problems of biology.

A Congress such as the one under review, with its strong international backing, should have been the occasion for a frank review of the situation and for discussions on the fundamental problems with which the industry is faced. The proceedings of these successive congresses could be made to serve as definite landmarks in the history of the science of refrigeration by epitomising the advances made in the intervening years both in pure and applied science, in so far as they relate to the preservation of perishable food-stuffs, and by formulating the general plans of attack on the new problems.

EZER GRIFFITHS.

Mechanism of Cell Growth.

IN the higher plants, new cells are formed and new tissues arise by the activity of certain definitely localised and clearly characterised tissues, the meristems. In the Dicotyledon, these are found at the apex of root and shoot, that is, at either end of the growing axis; in addition, two continuous cylinders of meristem, the cork phellogen and vascular cambium, run lengthwise through the axis and contribute to its subsequent increase in girth. Within these meristems proceeds the construction of new protoplasm, with subsequent mitotic division into new cells as nuclear and cytoplasmic substance accumulates. In such a plant, then, the fundamental metabolic synthesis inseparable from growth, with the subsequent multiplication of the cells of the embryonic tissue, can be visualised as proceeding in strictly localised regions, and the question as to the conditions which promote such growth and division can to some extent be investigated experimentally. Within recent years the meristems have been examined from this point of view. It is clear that if their investigation gives any information as to the condition favouring such a fundamental process as the growth and multiplication of embryonic cells, this information may have very general importance and illuminate a wide range of problems.

From this point of view, an article by Friedl Weber in *Die Naturwissenschaften* for April 18 is of exceptional interest, as it reviews the recent plant physiological approach to these problems from a wide angle and with a wealth of documentation (for citation to original papers referred to below, reference must be made to Weber's paper).

The best known contribution to the conditions governing meristem activity is Haberlandt's theory as to the circumstances which give rise to a new meristem when the plant is wounded and a cork phellogen arises as a result. In this case, cells that have differentiated, and ceased to grow, return again to the embryonic state, and Haberlandt traces this to the effect upon these cells of growth-promoting hormones released from the injured cells. Weber examines the view sympathetically, and has himself used it to explain the forcing of buds from their winter's rest by freezing, narcotics, and various other methods by the assumption that the efficacity of the treatment depends upon the release of such hormones as the result of "physiological wounds" within the bud. Schillings' experiments, however, in which stems of flax and hemp, bent so that they droop earthwards, grow vigorously in the region of the flexure, tell strongly against Haberlandt's view, as this stimulus to growth disappears, although the injury does not, when the shoot is supported in the erect position after bending. But the greatest disadvantage of Haberlandt's view is that it throws no light upon the normal meristematic activity of the uninjured plant.

From this point of view, therefore, Weber finds a wider significance in the views recently developed by Priestley and Woffenden. These investigators similarly start from an examination of wound cork, but the conclusions they reach that its formation depends upon, first, a blocking of the wounded surface, and then an accumulation of sap in the walls and intercellular spaces below this block, enable them by consistent use of the same developmental factors to give a causal explanation of the position of the normal cork phellogen clothing root and stem. Weber then proceeds to a discussion of the more general suggestion as to the conditions for activity of the intercalary meristems of the Dicotyledon recently advanced by Pearsall and Priestley. These authors have pointed out that these two cylinders of meristem appear to be functioning across two reverse gradients of hydrogen ion concentration, the vascular cambium lying between acid xylem within and relatively alkaline phloem without, whilst the cork phellogen has within it the cortex at about $P_H 6$, but outside it cells, the walls of which are bathed in fatty acids with a reaction of $P_H 3$. Weber examines in the light of a wealth of relevant data the suggestion of Pearsall and Priestley that protoplasmic synthesis, and therefore meristem activity, takes place, across this gradient, at the iso-electric point of the cell proteins, the protoplasm at this reaction losing water to cells on either side which, being at other points on the hydrogen ion gradient, swell and vacuolate, withdrawing water from the meristem.

Weber points out that many other physico-chemical properties of the colloidal state of protoplasm are involved in addition to the power of absorbing water, and emphasises that the delicate equilibrium of these properties, which alone permits of protoplasmic synthesis and mitotic division, probably will only be maintained over a limited range of hydrogen-ion concentration. From this point of view, he re-examines Kühns' classical experiments upon nuclear and cell division in Amœba, and directs special attention to the experiments which, by micro-dissection or

by other methods, throw light upon protoplasmic viscosity, and show that alterations of viscosity are quite generally characteristic of mitosis and the activities of embryonal cells.

From the same point of view, Weber points out that high temperatures, narcotics, and other factors influencing mitosis are factors capable of influencing protoplasmic viscosity, as shown by Heilbrunn in his experiments upon sea-urchin eggs. Similarly, Koernicke has shown that under X-rays, and Hartmann that at high temperatures, all the cells of the meristem of the root apex vacuolate. Weber also points out that the rounded nucleus characteristic of the embryonic cell suggests a different and more plastic physical state of nuclear protoplasm, so that the shape is more controlled by surface tension than in the case of the variously shaped nucleus of the differentiated cell that has ceased to divide.

Weber marshals much evidence to show that the hydrogen-ion concentration of the medium can affect the physico-chemical state of the protoplasm, and directs attention to Spek's interesting suggestion that at mitosis, a base, the bye-product of nuclein synthesis, escapes into the cytoplasm with consequent swelling of the plasma colloids and as a result a stimulus to increased nuclein synthesis, so that the process is autocatalytic. Spek explains the cessation of cell division as brought about by a change in permeability permitting increased entry of salts, which neutralise the action of the base released from the nucleus. Certainly in the mitosis of sea-urchin eggs the influence of the hydrogen-ion concentration of the medium has been established as in the experiments of Vles and his co-workers. Lyon has shown that the carbon dioxide production during mitosis varies at the different stages recognised by the cytologist, whilst Jacobs has tried to correlate these striking fluctuations in carbon dioxide output with the equally striking viscosity changes. As Weber points out, such fluctuation of carbon dioxide output will influence the difference between the reaction of the egg plasma and the outside medium.

The rhythm of cell division may find some explanation in the respiratory production of carbon dioxide. Thus Lapicque has shown that the reaction of the medium in which Spirogyra is growing is affected by carbon dioxide production in the dark and its disappearance during photosynthesis in light, and Weber suggests that here may lie the explanation of the fact that cell division in this plant occurs only at night.

Starling is cited for the view that the problem of cancer is the problem of the control of cell growth. Recent studies of cancer with physico-chemical methods enable Weber to refer to investigations indicating that the cancer cell owes its peculiar growth qualities to the medium, the tumour plasma, in which it lies, and that one important factor of this medium is hydrogen-ion concentration.

Weber thus brings a very wide range of phenomena of great general interest under review, and points out in conclusion that the suggestion of Pearsall and Priestley, that the hydrogen-ion concentration is a material factor in meristematic growth, admits of experimental investigation, Heilbrunn, Meier, Endler, and Robbins, amongst others, having suggested methods for determining the iso-electric point of the protoplasm.

Cambridge and the Royal Commission.

PROVISIONAL SCHEME.

THE University Commissioners have communicated to the University of Cambridge a provisional scheme for the inauguration and organisation of teaching in the University on the general lines of the recommendations of the Royal Commission. They propose to draft necessary statutes and ordinances themselves to carry out their scheme, but publish their proposals in outline in order to give members of the University an opportunity of expressing their opinion about the proposals.

It is proposed to constitute as from October 1, 1926, eleven faculties in the arts group and seven in the science group. In the science group there are to be agriculture, biology, engineering studies (including aeronautics), geographical and ethnological studies, mathematics (including astronomy and geodesy), medicine, physics, and chemistry. The faculty of biological studies is to be divided into two sections, each with separate departments: A. (1) botany, (2) genetics, (3) geology, and (4) zoology. B. (1) biochemistry, (2) experimental psychology, (3) human anatomy, (4) parasitology, (5) pathology, (6) physiology. The faculty of physics and chemistry is to include the following departments: (1) astrophysics, (2) chemistry, (3) mineralogy, (4) physics.

The separate faculties will be composed of official university and college teachers in the appropriate subjects (including fellows of Girton and Newnham Colleges) and others appointed by the Board of the Faculty. The Board of a Faculty will consist of the professors in the subjects concerned, a certain number of nominees of the faculty, of the Board and of the Council of the Senate, together with representatives of cognate studies. The average number of members of a Board, according to the detailed scheme suggested by the Commissioners, is sixteen.

The new General Board of Studies is to consist of four members elected by the group of arts faculties, four members elected by the group of science faculties, four members of the Council of the Senate, and two persons nominated by the Council, with the vice-chancellor as chairman. The number of university lectureships (and demonstratorships) would be determined by the University for each faculty on the recommendation of the Board of the Faculty and of the General Board. The appointments would be made by a standing committee for each faculty of the vice-chancellor, the head of the department, three members of the Board of the Faculty appointed by the Board, and two persons appointed by the General Board. The normal tenure would be for three years in the first instance, and, on renewal, so long as the lecturer was doing his work satisfactorily, until the retiring age of sixty-five.

According to the scheme, all fees for lectures announced by the General Board would be paid to the University into faculty or departmental funds, the lecturers to be paid a basic wage by the faculty for an obligatory minimum of teaching work, with a scale of increments on the basic salary, with continued tenure of a post, and with additional payments for extra work done. It is contemplated that the University will be able to inform the faculties, before they finally create their new lectureships, how much money, if any, the University can put at the disposal of each faculty board in addition to the fees credited to it.

A great amount of work must lie before the Commissioners and various bodies of the University in getting the scheme into working order; a great amount of work must have been done on it already. It represents the completion of a process which has

been going on for a considerable time by which the organisation of the teaching and the actual teaching itself has been slowly but steadily passing out of the hands of college lecturers into those of university staffs. The creation of the large scientific laboratories and departments has accelerated the change, which is already half completed. The University takes more conscious control of developments and changes in studies. It remains to be seen whether improved organisation will mean better efficiency or whether the initiative of individual colleges fostered in the past may be crushed by the burden of machinery. As ever in such cases, it all depends on the quality of the men who become responsible for driving the machine.

Among other proposals which the Commissioners contemplate is permission for a professor to be continued in office after reaching the age of sixty-five up to, but not beyond, the age of seventy. They also contemplate throwing open all professorships, readerships, lectureships, and examinerships to women. This proposal to put women teachers on the same footing as men in the matter of the organisation of teaching removes one of the serious grievances remaining for women at the University. Even though they may not vote in the final decisions of the Senate on matters of educational policy, they will be free as members of a faculty to take part in the more important preliminary discussions which ultimately determine the changes of policy. The Commissioners do not propose to force upon the University, against its expressed wish, the admission of women to membership and to a share in the government of the University. That is to be left to the University itself to settle.

University and Educational Intelligence.

BRISTOL.—A prospectus of the Faculty of Engineering, which is provided and maintained by the Society of Merchant Venturers in the Merchant Venturers' Technical College, Bristol, has just reached us. Courses of study are available at the College for persons intending to engage in civil, mechanical, electrical, or automobile engineering, and particulars of these courses are given in the prospectus. The ordinances and regulations relating to degrees and diplomas in engineering subjects are included, and some particulars of the Bristol sandwich-system of training engineers are also given. The prospectus can be obtained from the registrar of the Merchant Venturers' Technical College, Bristol.

CAMBRIDGE.—Mr. W. S. Thatcher has been appointed Censor of the Non-Collegiate Students.

LEEDS.—With the view of encouraging the revival of the University Extension movement, the West Riding Education Committee has decided to make towards the cost of an approved course of extension lectures such a grant as will cover the actual deficit incurred, or 75 per cent. of the total expenditure, on condition that at least 30 persons undertake to enter for the whole course, and that the lectures are open to the public at a charge not exceeding 3*d*. per single lecture. The fees for lectures range from 22*l*. 10*s*. for a course of 6 to 76*l*. 10*s*. for 24, and the only other charges besides incidental local expenses, such as hire of hall and advertising, which are borne by the local committee, are the lecturer's travelling expenses and a fee of not less than two guineas (varying according to the number of candidates) for the examination, if one is held. The panel of lecturers includes 33 members of the University staff, of whom 8 are professors. The range of subjects is very wide: the following are specimen headings—Greek ethics, archæology and architecture, phonetics, the Irish literary movement, social psychology, riches and poverty, Spanish art, How the Empire is governed, French history since 1815, the gases of the atmosphere, fresh-water biology, types of respiratory structure, the antiquity of man, radio-activity, application of colloid chemistry to industry, British birds, enzymes, bacteriology from the medical, public health, and chemical points of view, personal hygiene.

AN advisory chemist in the faculty of agriculture, University College, Reading, is shortly to be appointed. Particulars are obtainable from the Registrar of the College.

THE trustees of the Busk studentship in aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 while flying an experimental aeroplane, have appointed Mr. John Cowan Stevenson, of the University of Glasgow, to the vacant studentship.

A DEMONSTRATOR is required in the mathematics and mechanics department of the Royal College of Science, South Kensington. Candidates must possess engineering experience, and send their applications to the secretary of the college not later than September 5.

APPLICATIONS are invited by the Director of the School of Medicine, Cairo, for the professorships in the school, of Physics, Clinical Medicine, and Clinical Surgery; also for the post of lecturer in physics in the institution. In the latter case candidates must be of Egyptian nationality. Applications must reach the director by September 15 at latest.

APPLICATIONS are invited for the appointment of lecturer in physics and the directorship of the Viriamu Jones Physical Research Laboratory of the University College of South Wales and Monmouthshire. Applications (six in number) and testimonials must be received not later than September 10 by the Registrar of the College, Cathays Park, Cardiff.

THE University of Calcutta "Poverty problem study" organisation which has been at work for some years has succeeded in promoting the formation of a limited liability company for the establishment in the Paresnath Hills of co-operative educational colonies, such as Capt. Petavel, Principal of the Kassimbazar Institute, has been advocating in his university lectures on the "Poverty problem." The Company proposes to set up an agricultural college "where professors and students will be provided with sufficient land for self-support and education." Each student on completion of his course, and having obtained a university diploma, would be helped to acquire, as a member of a colony, a plot of ground with bungalow, well, bullocks, plough, etc. The scheme is described in the first number of a new periodical, "Bread and Freedom," edited by Capt. Petavel.

INTERCHANGE of teachers between universities within the Empire is one of the subjects that were discussed at the recent Imperial Education Conference in London organised by the League of the Empire. One speaker described as an object lesson to the universities of the Empire the Chicago University summer school, which attracts professors and lecturers from all parts of the United States as well as from abroad. We have lately received a University of Colorado Bulletin which gives an account of this University's summer quarter, extending from the middle of June to the end of August. This year the staff includes no less than fifty instructors from other

institutions, among whom are professors and other members of the staffs of universities in twenty other States. Many are, no doubt, attracted by the University's advantages of climate and picturesque surroundings. A permanent camp is maintained during the summer quarter at Arapahoe Falls in the Rocky Mountains, about 25 miles distant, for the benefit of university students and teachers.

ADULT education in Ireland was the subject of an address by Mr. George Fletcher, of the Department of Agriculture and Technical Instruction for Ireland, at the annual congress of the Irish Technical Instruction Association on June 4. For many years there have been complaints that the effectiveness of technical instruction in Ireland is much less than it might be, because the standard of general knowledge of the students is low. It is mainly on the ground that it would remedy this defect that Mr. Fletcher urges the inauguration of schemes for the extension of University teaching in towns and for the establishment of community centres with village halls in rural districts. Hitherto there has been no movement in this direction in Ireland comparable with the University Extension movement in England. The Royal Dublin Society, a few years ago, allocated 200*l.* for the initiation of courses of lectures; a panel of lecturers was framed and syllabuses were prepared, but the work had barely begun when travelling became almost impossible, and the scheme was abandoned as impracticable. Its resuscitation has now been recommended. It is thought that the transfer of Technical Instruction from the Department of Agriculture and Technical Instruction to the Department of Education, which took place on June 2, 1924, may tend to the establishment of conditions favourable for voluntary enterprises in the field of adult education.

"NON-UNIVERSITY resources for graduate study and research" formed the subject of two interesting papers read before the Association of American Universities last November and published recently. President Wilbur, of Stanford University, argued in favour of all new research projects being brought directly into the domain of some university or group of universities, and also against the constitution of "research professorships" and special research institutes isolated from "the great normal university current." In certain fields the Pasteur Institute, the Rockefeller Institute in New York City, and other organisations for research independent of universities have not only achieved conspicuous success but have also "set the pace" for university research work. This kind of development of research is, however, less advantageous to the community than development within the universities, for the following reasons: its overhead expenses are greater, it does not provide such good opportunities for the training of young research students, or for the benefits of membership of a faculty and association with members of other faculties, and it tends to involve a more urgent pressure to produce visible results. President Wilbur directed attention to the recent decision of the Tanners' Council to place its research project at the University of Cincinnati, the Council having come to the conclusion that "the university atmosphere is the right place for research." This view may be compared with Sir Frank Heath's pronouncement at the May conference of British universities to the effect that modern demands seem to point to the necessity for at least four types of organisation for research: universities, central research institutes, industrial research laboratories run by the industries themselves, and laboratories of individual firms.

Early Science at the Royal Society.

August 17, 1664. The engine to measure refractions was produced, examined and approved of, and Mr. Hooke the inventor of it, appointed to begin at the next meeting to try experiments in it; as also to give a description of this engine to be kept in the Register-book.—Dr. Goddard was desired to describe his instrument with strings and pulleys intended for a hygroscope, and to take notice of the uselessness thereof, as it had been hitherto contrived, and to think upon another way.

1687. Sir John Hoskyns communicated the following receit of one Simeon Pauli for a varnish to coat and preserve dried plants; infuse in spirit of wine the seeds of wormwood; and then dissolve therein as much gum elemi as it will take; and with this varnish cover the plant. This was thought to be a good means to preserve insects from perishing.

August 18, 1670. Mr. Hooke reported to the society, that he had already found so much, as to suspect some parallax of the earth's orb, and conceived, that it would be more sensible half a year after. He said, that by a perpendicular tube he observed the stars, which pass our zenith, at different times of the year, and by noting, whether the same star be at those different times of observation at the same distance from the zenith or not; concerning which he affirmed, that a certain star was then less distant from the zenith than it had been a month before.

August 19, 1680. The subject of filtration and rising of liquors in small pipes was debated. The difficulty of them appeared; viz., first, from the imperfect exhaustion; and secondly, from the uncertainty of the rising of the same liquor in the same pipes at several times.—Dr. King related that he had observed six or seven sorts of animals, a thousand of any of which were less than a globule of blood.

1663. Mr. Hooke gave in a picture of the stones taken out of the heart of the earl of Balcarres. The lord viscount Brouncker promised to get the same done in plaister.

August 20, 1662. Dr. Wallis's written discourse about Dr. Goddard's experiment of weighing glass canes with the cylinders of quicksilver standing in them according to the Torricellian experimt. was delivered in; but because the understanding thereof depended greatly upon the schemes annexed to it, the reading of it was deferred till the next meeting: and the amanuensis was ordered to draw the said schemes in great upon a large paper that every member might look upon them with conveniency.—Mr. Powle to be written to by Mr. Oldenburg, that he would send the society an exact description of the whispering place in the cathedral of Gloucester.

1684. Mr. Henshaw having propounded to try, whether a thermoscope, exhausted of air, with the liquor in it, exhausted of air too, might be sensible of cold and heat, as ordinary thermoscopes are; the thing was tried, and found that the effect was not sensibly altered by the absence of the air.

August 21, 1661. Mr. Colwall read his "Relation concerning the making of Alum," for which he received the thanks of the society, and it was ordered to be registered.

August 22, 1678. Mr. Hooke delivered to the Society an antient urn of glass, taken up in Spittlefields upon digging cellars there, presented by Sir Christopher Wren. There was this remarkable in it, that it seemed to be made after quite another manner than that used by the present workman in that art, it having no place at the bottom thereof; nor any visible sign how it could be held, whilst the lip and handle thereof were joined to the body.

Societies and Academies.

PARIS.

Academy of Sciences, July 16.—M. Guillaume Bigourdan in the chair.—V. **Grignard** and R. **Jenkins**: Mixed organo-aluminium compounds. The iodides of monoethyl- and of di-ethylaluminium. Dry ethyl iodide reacts with aluminium powder in the absence of oxygen, giving a mixture of the compounds $((C_2H_5)_2 . Al I)_2$ and $(C_2H_5 \cdot Al I_2)_2$. Both compounds are spontaneously inflammable in air, and in contact with water give pure ethane.—Jacques **Chapelon**: The representations of an integral number by certain forms with six variables.—Enrico **Bompiani**: The second fundamental form of a surface.—G. **Maneff**: Gravitation and the principle of equality of action and reaction.— — **Lémeray**: General conditions which must be satisfied by a theory of the universe in agreement with general relativity.—E. **Tournier**: A new method of calculating the power of the reciprocating steam engine.—Louis **Roy**: Electromagnetic waves in continuous media in motion.—Maurice **Curie**: The photo-electric effect and temperature.—P. **Lebeau** and Ch. **Bedel**: The estimation of carbon monoxide. The reagent recently proposed by Damiens (cuprous oxide dissolved in concentrated sulphuric acid) for the absorption of carbon monoxide is modified by the addition of β-naphthol. This addition renders the Damiens reagent more stable, and less liable to absorb oxygen.—E. **Kayser** and H. **Delaval**: Radioactivity and nitrogen-fixing organisms.

CAPE TOWN.

Royal Society of South Africa, June 18.—Dr. A. Ogg, president, in the chair.—R. S. **Adamson**: Preliminary note on secondary growth in some Iridaceæ. Three closely allied genera, Nivenia, Witsenia and Klattia, possess woody stems with continued secondary growth. The secondary growth has the same general features as that described for the arborescent Liliaceæ, but these plants differ in two features:—(1) The secondary bundles, or the inner ones, are very close together, often in contact. The radial arrangement of cells is obscured to a large extent. The bundles arise from a number of cambium cells. (2) In old stems the secondary tissues are arranged in zones (annual rings), a feature not previously described for monocotyledons.—Sir Thomas **Muir**: Note on systems of determinants with sets of deleted elements.—J. **Moir**: Colour and chemical constitution, Part XIX., Organic fluorescence.—S. H. **Haughton**: On a skull and partial skeleton of *Mesosuchus browni*, Watson. This paper contains the description of the only known complete skull of *Mesosuchus browni* from the Cynognathus beds of Aliwal North, as well as of the front half of the skeleton. The relationships of the form with Youngina, the Sphenodontia, the Rhynchosauria, the Lizards, Howesia, and the Thallatosauria, are discussed, and it is concluded that Mesosuchus may be placed in a new family, which is called the Mesosuchidæ, and placed in a new sub-order of Diapsid reptiles, the Mesosuchia.—C. W. **Kops**: A South African life table based on the European male population census. (Communicated by Prof. J. P. Dalton.) The life table is based on the census returns of 1918 and 1921, and the deaths during the years 1919–1921. The function graduated is q_x. The graduation was performed by fitting three curves to the data—a quadratic, together with an exponential function for ages 0 to 15, a first degree function, together with an exponential for ages 24 to 108, and these curves are joined by a cubic function having first order contact with each of the other curves. A Makeham graduation was also applied from age 20 to the end of the table. Both graduations are then compared with standard tables from other countries. Graphical comparisons are also made in the case of each graduation.

ROME.

Royal Academy of the Lincei, May 18.—B. **Grassi**: The transmission of malaria. In some years marked discordance exists between the number of Anopheles and the intensity of the malarial epidemic, the number of malarial individuals at the outbreak of the epidemic being insufficient to justify such discordance. The amount of semilunar gametes in some localities appears inadequate to explain the epidemiology of this form of malaria, except on the supposition of a mutation of the tertian parasites or a hybridisation of the latter with the estivo-autumnal parasites. A general incongruity is observed between the abundance of the gametes and the new infections, the gametes abounding particularly in winter and spring, during which seasons the Anopheles has no opportunity of undergoing infection.—A. **Russo**: Mixed individuals formed from the ex-conjugants, after true conjugation in *Criptochilum echini* Maupas, and the origin of the gametogens. These mixed individuals are shown to be differently constituted, not only from the diverse origin of the nuclei composing their nuclear apparatus, but also as regards the quantity of nuclear substance present. Of the four nuclei which go to make up this nuclear apparatus, one only assumes the sexual function for the formation of gametes.—G. **Vranceanu**: Stability of rolling of a disc.—M. **Maggini**: Distribution of the radiating power on planetary discs, determined with the interferometer. Investigation of the distribution of luminous intensity on the apparent discs of the planets Uranus and Vesta shows that, as is the case with Jupiter and Saturn, the peripheral regions are less luminous than the central ones.—F. **Signore**: Temperature measurements made in Lake Lucrino and in the neighbourhood of Maricello during 1922–1923.—G. **Piccardi**: Further observations on a thermal method for the study of gaseous systems. Experiments on a number of the more permanent gases by means of the apparatus now described give results in satisfactory agreement with the theory previously advanced.—G. R. **Levi** and A. **Ferrari**: Crystalline lattices of magnesium hydroxide and carbonate. The fundamental element of magnesium hydroxide is a parallelopiped having a rhombic base of side 3·114 Å and an acute angle of 60°, the height being 4·735 Å. The corresponding density would be 2·40, which agrees perfectly with the actual values for the natural and artificial products.—O. **Munerati**: Artificial nocturnal illumination as a means of accelerating the phases of the vegetable cycle.—R. **Perotti** and F. **Aureli**: Ammonifying power of arable soil. The method of measuring the ammonifying power of soils by means of nutrient solutions reveals marked differences corresponding with those found in the condition of the vegetation of the soils. With "normal" soils, which exhibit an alkaline reaction, the aptitude to the micro-biochemical production of ammoniacal nitrogen usually suffices for the needs of vegetation.—R. **Perotti** and G. **Grandis**: Measurement of the nitrifying power of arable soil. The optimum conditions for the measurement of the nitrifying power of soil by the method of nutrient solutions are defined.—P. **Dorello**: Observations on the erectile body of the penis of the genus Helix.—A. **Busacca**: Structure of the living crystalline fibre. The protoplasm of the fibre of the crystalline lens exhibits formations of undoubted mitochondrial character. These formations being mobile, the fundamental substance of this protoplasm is not a solid hydrogel but one of some fluidity, the latter resulting from the high degree of

imbibition experienced during the development. Although it has undergone very marked differentiation, the protoplasm preserves unchanged all the attributes of true protoplasm and cannot be regarded as a metaplasmatic substance.—E. **Momigliano**: Behaviour of lipoids in nephropathy.

VIENNA.

Academy of Sciences, March 6.—F. **Reinitzer**: Researches on olive-resin.—R. **Weiss** and E. **Freund**: The action of organic magnesium compounds on phthalonitril, I.—G. **Weissenberger** and L. **Piatti**: The behaviour of creosole towards alcohol, ether, and acetone.—V. **Brehm**: Diagnoses of new Entomostraca, Part III. Report from the Handel-Mazetti Expedition to China, 1914–1918, supported by a grant from the Vienna Academy of Science. New species are, *Diaptomus bidens*, Yunnan, and *D. Walterianus*, Yunnan.—G. **Jager**: The lines of force in the special theory of relativity.

March 13.—F. **Feigl** and A. F. **Lederer**: On diphenylcarbazon and its salts, also on the supposed diphenylcarbodiazon.—J. **Krames**: Regular surfaces of the third order, the infinite curves of which doubly osculate the absolute conic section.

March 20.—K. **Mader**: On the use of the Eötvös balance with large masses at close distances.—E. **Müller**: A new method for combined measurements of the capillary constant and of the internal friction in viscous liquids.

April 3.—E. **Heinricher**: Sleeping reactions of the inflorescences of *Dimorphothera pluvialis* (L.). The principal factor in the sleeping reactions of *Dimorphothera pluvialis* is change of temperature.—D. **Pettersson**: On the maximum range of the particles discharged from radium C (Mitt. d. Ra-Inst's No. 163). The long-range particles assumed by Bates and Rogers to be discharged from radium C have been examined under conditions excluding the production of secondary particles. The number of particles of ranges exceeding that of the normal α-particles was found to be less than a few per cent. of the number found by these authors.—E. **Landau**: On the inapplicability of Pfeiffer's method in the analytic theory of numbers.—R. **Weiss** and J. **Korczyn**: (Trimethylene-triphenylmethane-triketon).—A. **Merz**: Investigations of elastic after-effects by an acoustic method.—M. **Eisler** and L. **Portheim**: On insulin-like substances and their action on the exchange of the carbo-hydrates (Preliminary communication). Production of an insulin like substance from seeds of *Phaseolus multiflorus*, and preliminary experiments on the influence of this substance on the exchange of carbo-hydrates in the plants.—I. **Robinsohn**: The colouring of the stigmata—Stigmatochromy. A morphologic-biological method for researches on flowers.—H. **Handel-Mazzetti**: Plantæ novæ Sinenses diagnosibus brevibus descriptæ.—Fuller abstracts for the Vienna Academy of Sciences in 1923 are given in *Die Naturwissenschaften* for May 9 and May 16, pp. 372 and 394. These contain earlier papers on Triton by Weiss, on meteorology by Exner, and on cave-bears by Abel and others.

May 8.—Alois **Zinke** and Franz **Hanselmeyer**: Researches on perylene and its derivatives (Communication VI).—Alfred **Wagenhofen**: Contributions to our knowledge of para-orsellinic-acids. The aim of the work was the verification of the influence of the methyl-group on the retention of the carboxyl-group in many-substituted benzoic acids, for which the para-orsellinic-acid was chosen as starting-point. The nitrification of the dimethyl-para-orsellinic-acid-methyl-ester led to a mono-nitro-substitution product.—Elisabeth **Kara-Michailova** and Hans **Pettersson**: Communication of the Radium Institute, No. 164. On the measurement of the relative brilliancy of scintillations. A method is described for the determination of the relative brilliancy of scintillations and of their application for a confirmation of the particles deviating from quartz under α-particle bombardment as H-particles.—Anton **Kailan** and Roman **Obogi**: On the question of purifying glycerine from volatile fatty-acids and their esters. The addition of alkali works prejudicially on the distillation of glycerine, since it does not diminish, or does not appreciably diminish, the acid figure in the chief fraction whilst the ester figure is very strongly increased.—Kasimir **Atynski**: The preparation of selenides from selenium hydride and metallic salt solutions. The selenides are appreciably less stable than the sulphides.

May 14.—P. **Flach**: Cytological researches on vessel formation in *Cucurbita Pepo*.—Frau Dr. Helene **Kurz**: *Pholidopus* (*Achtheinus*) *intermedius* and *Dissonus glaber*, two new species of the family Caligidæ.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 10, No. 6, June).—W. M. **Davis**: The formation of the Lesser Antilles. The banks on which the Lesser Antilles stand represent reef-enclosed lagoon floors, formed according to Darwin's theory of coral reefs and modified by the processes of the glacial-control theory. The scheme of development is as follows. First there is eruptive growth of a volcanic island on a subsiding foundation; subsidence continues after growth ceases and lagoon deposits increase within the up-growing barrier reef. Reef abrasion and headland cliffing occur whenever the Glacial period intervenes. The second cycle commences by upheaval or uptilting and may interrupt the first cycle at any stage. Some of the Lesser Antilles are first stage islands and some belong to the second period.—G. R. **Putnam**: Radio fog signals for the protection of navigation; recent progress. The radio compass is considered to be the most important instrument invented for use on shipboard since the introduction of the magnetic compass. It is used in conjunction with radio fog signals which, in the United States, consist of characteristic signals on a wave-length of 1000 metres. There are 11 such beacons in the United States waters and 12 outside. About 291 vessels now have radio-compasses or direction finding apparatus. The spark transmitters are to be replaced by tube transmitters. With the present apparatus and conditions of use, no serious error is caused by the "night" effect.—D. F. **Jones**: Selective fertilisation among the gametes from the same individuals. Pollen carrying a dominant factor is better able to accomplish fertilisation in a sporophyte carrying the same factor than pollen carrying the corresponding recessive factor.—W. E. **Castle**: The Japanese rabbit and gametic purity. The so-called "Japanese" rabbit is yellow, mottled or brindled with black. The brindling seems to depend on the formation of a mosaic type of gene, very rare in occurrence but very stable when once produced, which is due to imperfect segregation between black and yellow, themselves simple allelomorphs.—K. **Sax**: The nature of size inheritance. Experiments with beans show that differences in size and total yield are, to some extent, due to factors linked with qualitative factors which are subject to Mendelian inheritance. Analysing Castle's rabbit data by determining partial correlations with body weight held constant, it is concluded that Castle is correct in stating that the genetic agencies affecting size in rabbits are general in action. The data of other workers using different animals indicate that body proportions may not be entirely dependent on factors which affect body weight.—E. B. **Wilson** and W. J. **Luyten**: A statistical discussion of sets of precise astronomical measurements. II—

Proper motions. Allegheny and McCormick Observatories issue photographic proper motions in Right Ascension with reference to the mean of the comparison stars. The values are compared with meridian circle determinations (Boss), from which it appears probable that a factor of about 1·4 should be applied to the probable errors.—Raymond **Pearl**: The influence of alcohol on duration of life. Accurate information has been collected for a group of more than 6000 white persons of a working-class population. Exhaustive data were obtained and the material classified in eight groups according to alcohol consumption. Calculation of life-tables and so on shows that at every age from 30 to 100, moderate drinkers of both sexes have a slightly *higher* expectation of life than abstainers. Male heavy drinkers have a markedly lower expectation of life than moderate drinkers from 30 to 100 and than abstainers from 30 to 60; from 60 onwards the advantage is slightly to the heavy drinkers, possibly due to the selective effect of high mortality among heavy drinkers prior to 60. For females, expectation of life is markedly lower for heavy drinkers than for moderate drinkers or abstainers from 30 to 100.—W. M. **Wheeler**: Two extraordinary larval Myrmecophiles from Panama. Both were found in ant nests. One is broad, regularly elliptical, 5·7 mm. long, with flattened creeping-sole bordered with minute red papillæ; the integument is smooth, pale blue, and bears regular longitudinal white scales which on pupation were thrown violently off. No imaginal fly was obtained. It has been named *Microdon œolidiformis*. The other form has an anterior portion which can be withdrawn into the carapace-like abdominal region. The latter is covered with a mosaic of regular hexagonal chitinous plates, the dorsal surface bearing regularly arranged sense-organs; there is no creeping-sole. It has been named *Nothomicrodon aztecarum*.—W. B. **Cannon** and A. **Querido**: The rôle of adrenal secretion in the chemical control of body temperature. The rate of heart beat in animals with denervated hearts was increased 12 to 64 per cent. by cooling the body. The effect is not obtained if the adrenal glands are made inactive though shivering is still produced. It is argued that increased adrenal secretion can augment metabolism to counteract the effects of cold.—W. B. **Cannon** and J. R. **Pereira**: Increase of adrenal secretion in fever. Experiments similar to those of the previous paper show that fever is associated with increased adrenal secretion.—E. W. **Brown**: An explanation of the gaps in the distribution of the asteroids according to their periods of vibration. Instability of motion is suggested, on a mathematical basis, as the cause of the gaps.—J. H. **Oort** (1) Note on the difference in velocity between absolutely bright and faint stars. For stars with total velocities less than 65 km. or for stars moving in a direction opposite to the motions of high velocity stars, the average velocities for giants and dwarfs are nearly equal. There is no hint of increase of velocity with decreasing mass. (2) On a possible relation between globular clusters and stars of high velocity. Curves showing the galactic distribution of globular clusters and the antapices of the motions of high velocities alike show marked avoidance of the Milky Way.—W. J. **Luyten**: Note on some statistical consequences of the luminosity law.—W. C. **Rufus**: Atmospheric pulsation of the Cepheid variable, η Aquilæ. Line displacements from different elements and at different levels of the atmosphere of a star have been studied. Generally, compression of the atmosphere occurs after maximum compression of the star as a whole, thus accounting for the retardation of the light maximum. The humps of the velocity-difference curves of the various layers are synchronous with the *Stillstand* of the light curve; the latter appears to be due to a stage of comparative rest in the star's atmosphere.—B. de **Kerékjártó**: On parametric representations of continuous surfaces.—A. H. **Compton** and Y. H. **Woo**: The wave-length of molybdenum Kα rays when scattered by light elements. The secondary radiators used were lithium, boron, carbon, water, sodium, magnesium, and aluminium, and in every case, after scattering at about 125°, an addition to the usual Kα peak, there was another in the position predicted by Compton's quantum theory of scattering. With sodium and aluminium, there is perhaps some evidence of tertiary scattering in accordance with the theory of Clark, Stifler, and Duane.—E. C. **Kemble**: Quantisation in space and the relative intensities of the components of infra-red absorption bands. Bohr's correspondence principle applied to the evaluation of the intensities of lines in the infra-red absorption bands of diatomic gases gives values contrary to experiment in the case of the hydrogen chloride band at 3·5 μ. Better results are obtained by assuming a slight precession of the orbital plane about the lines of the earth's magnetic field.—L. **Thompson**: The ballistic (air resistance) function.—W. A. **Setchell**: Ruppia and its environmental factors. Two distinct forms of *Ruppia maritima* L. were found at Richardson Bay, California. At stations subject to tidal conditions, the plants were perennials with long, spirally curved peduncles, and most of the fruits were robust, rounded and only slightly curved without pronounced beak (var. *longipes*). Plants growing in shallow pools were annuals with practically opposite characteristics (var. *rostrata*). Laboratory experiments show that both varieties tolerate a wide range of salinity, P_H and daylight-darkness ratio; temperatures of 15-20° C. are necessary for germination, and 20-25° C. for growth and reproductive activity.

Official Publications Received.

Department of Agriculture, Ceylon. Bulletin No. 69: Notes on the Habits and Life-History of the Indian Glow-worm (An Enemy of the African or Kalutara Snail). By Dr. J. C. Hutson and C. Douglas Austin. Pp. 60. (Peradeniya, Ceylon.) 40 cents.

Canada. Department of Mines: Geological Survey. Bulletin No. 38 (Geological Series No. 43): Contributions to Vertebrate Palæontology. By Charles W. Gilmore. Pp. ii+64+12 plates. Memoir 136 (No. 117 Geological Series): Arnprior-Quyon and Maniwaki Areas, Ontario and Quebec. By M. E. Wilson. Pp. iii+152+12 plates+4 maps. Memoir 137 (No. 118 Geological Series): Palæontology of the Silurian Rocks of Arisaig, Nova Scotia. By F. H. McLearn. Pp. ii+179+30 plates. (Ottawa: F. A. Acland.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 258: Effect of Variations in the assumed Figure of the Earth on the Mapping of a large Area. By Walter D. Lambert. (Special Publication. No. 100.) Pp. iii+35. (Washington: Government Printing Office.) 5 cents.

Department of the Interior: Bureau of Education. Bulletin, 1924. No. 21: Practices and Objectives in Training for Foreign Service; Report of the National Conference on Foreign Service Training, Washington, December 26, 1923. Prepared by Glen Levin Swiggett. Pp. iii+27. (Washington: Government Printing Office.) 5 cents.

Annuaire de l'Observatoire Royal de Belgique, 1925. Publié sous la direction de G. Lecointe. Pp. vi+294. (Bruxelles: Impr. Van Gompel.)

Department of Commerce: Bureau of Standards. Circular of the Bureau of Standards, No. 101: Physical Properties of Materials. 1: Strengths and related Properties of Metals and Wood. Second edition. Pp. 204. (Washington: Government Printing Office.) 40 cents.

Det Kgl. Danske Videnskabernes Selskab. Mathematisk-fysiske Meddelelser, V, 3: On the Effect of Magnetic and Electric Fields on the Mercury Spectrum. By H. M. Hansen, T. Takamine, and Sven Werner. Pp. 40+2 plates. (København: A. F. Høst and Son.) 2.25 kr.

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 487: A Quantitative Study of Regeneration by Inductive Feed Back. By C. B. Jolliffe and Miss J. A. Rodman. Pp. 419-428. 10 cents. Scientific Papers of the Bureau of Standards, No. 488: Thermal Expansion of Molybdenum. By Peter Hidnert and W. B. Gero. Pp. 429-444. 10 cents. Technologic Papers of the Bureau of Standards, No. 258: Strength of Steel Tubing under combined Column and Transverse Loading, including Tests of Columns and Beams. By Tom W. Greene. Pp. 243-276. 15 cents. (Washington: Government Printing Office.)

Liverpool Astronomical Society. Annual Report 1923-1924. Pp. 8. (Liverpool: H. Norman Edge, Hon. Sec., Central Technical School.)

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 1, Session 1923-24: The Deep-Sea Deposits of the Atlantic Ocean. Descriptions prepared under the Direction of the late Sir John Murray, and Discussion of the Results by James Chumley. Pp. ix+252. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 25s.