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Early Activities of the Royal Society.

DURING the past twelve months NATURE has published, week by week, a column of selected extracts from Dr. Birch's "History of the Royal Society," under the title of "Early Science at the Royal Society." Its commencement was the subject of an explanatory note in the issue of February 9, 1924. The series has run the allotted period, and now some kind of retrospect of the discussions, experiments, and policy of the circle of men who were the promoters of the Royal Society, and of experimental inquiry in general, may be of advantage.

The series comprised the years 1660–87, an interval marking initial, yet fruitful, efforts to establish something that should be permanent in the English commonwealth of knowledge, something that should be shaped out and handed down to others as a reality. The accounts (in brief) of schemes propounded and experiments performed will, it is hoped, have been the means of bringing readers of NATURE into the atmosphere of patient endeavour which animated the founders of the "New Philosophy." We can, all the more readily, picture them forgathering at Gresham College in harmonious conclave and intent. True, as time proceeded, as mind encountered mind, weighty criticisms were offered, whilst dissensions, not quite of a milk-and-water type, arose; notwithstanding such intrusions, through all the same high resolve is maintained, the same sense of original responsibility is apparent. The grip of national conflict was over, perhaps forgotten, and things bespeaking mental awakening held indisputable sway. Harrington's contemptuous comment that they were, in early constitution, an assembly of men who had an excellent faculty of magnifying a louse and diminishing a commonwealth became empty and barren.

Inquiries in the departments of natural history, physiology (as understood), chemistry, medicine, mechanics, and astronomy were actively fostered, the last named especially. The vegetation of plants was frequently the subject of discourse. Evelyn's "Sylva" appeared in 1662. In 1673, Grew's microscopical observations of the texture of a piece of a walnut-tree section were discussed. The history of the silk-worm, in Latin, by Signor Malpighi, was sent in 1668, and ordered to be printed. The operator was directed to try again the feeding of spiders upon one another. In 1669, Robert Hooke (versatile and elusive, yet a veritable Master of the Ceremonies) produced a contrivance to see whether a mechanical muscle could be made by art, performing without labour the same office which a natural muscle did. Robert Boyle presented his "Sceptical Chymist" in 1679, which a committee were to peruse to see what could be learnt

from it. Moray presented the stones taken out of the Lord Balcarres' heart, in a silver box, together with a written account of the dissection of his body, attested by a physician. Only, in case the deceased lord's mother should claim it, it was not to be denied her.

Much time was taken up in discussing transfusion questions and arranging experiments. But what are we to think of Dr. Clarke's proposition that a man hanged might be begged of the King, to try to revive him, and that, in case he were revived, he might have his life granted him? In 1681 (Wren in the chair) it is recorded that Mr. Flamstead having cavilled against the method shown by Mr. Hooke of describing a parabola, the Society desired it again. Upon which the president declared it was true and certain. Honour to whom honour is due. Sir Robert Moray had presented from Prince Rupert an instrument of his Highness's invention for "casting any platform into perspective." It was ordered that the president (and others) wait upon the prince, return him the humble thanks of the Society, and show him an instrument of Dr. Wren's invention for casting any natural object into perspective. In 1666, Mr. Peter Lely was moved to communicate curiosities in the art of painting. Evelyn, Hooke (and others) were to meet and consider particulars. Report was made of willingness to serve the Society. We have, however, been unable to glean any issue.

His Majesty King Charles II. came upon the scene with a fanfare, thanks to the interest of Sir Robert Moray, the courtier, and the gentle scholarly Evelyn. It was long hoped and expected that his Majesty, as founder, would attend one of the meetings. However, he never came. "Early Science" speaks of the appointment of a committee to consider the manner of the King's reception and the conduct of chosen experiments, one being the contriving of optical pictures.

There must, however, have been considerable personal intercourse with his Majesty. Christopher Wren was charged by express command to make a great globe of the moon. On January 23, 1667/8, the operator was ordered to hasten the making of a thermometer for the use of the Queen. In the following year the president took notice that an experiment shown to the Society by Robert Boyle did not succeed at first at Whitehall, but at last it succeeded very well, and in his Majesty's presence. "Early Science" has omitted a pathetic story. In 1663, in a discussion of a new way of hatching pigeons, Sir Robert Moray was able to relate that the King, *when very young*, meeting with a blackbird's nest, and finding but one young one in it, carried it home in the nest, and put it to a thrush in a cage, who fed the blackbird as carefully as if it had been her own, but with this difference, that whereas other birds fed their young ones just before they feed themselves, the thrush fed herself before the blackbird.

The Society enjoyed the supreme advantage at its foundation, and for fourteen years, of the secretaryship of Henry Oldenburg. This accomplished man, a Latin scholar and able linguist, laboured indefatigably and exclusively in its interests with a true spirit of service. With extraordinary zeal he maintained a voluminous correspondence with philosophers abroad, and hence linked up and broadened the philosophical learning of his time. He would seem to have done his best to avoid the credulous and trivial.

Foreign visitors came ever and anon, providing a useful interchange of views. The Danish Ambassador was brought by Evelyn on February 13, 1660/1, and was given a sight of Mr. Boyle's air-pump. The Genoese Ambassador came on January 29, 1661/2. Leibnitz was present at the meeting of January 22, 1672/3 (Hooke, Boyle, and Oldenburg were there). The following year he was elected into the Society. Huygens was elected on June 22, 1663, at the same time as Sorbière (who afterwards narrowly escaped being struck off the roll). The Moroccan Ambassador was a visitor in 1682 and inscribed his name in the charter-book in Arabic. Later, he was responsible for an account of a person who was always dumb, except at noon! The Florentine envoy came in 1685 and was entertained by Papin.

The president and officers were at one period gravely concerned over the arrears of subscriptions, a very large total liability having arisen by degrees. Various fellows undertook to approach the forgetful ones. Not much advance was made in the case of Edmund Waller, the poet, though certainly his interest in the organisation was no more than dilettante. It was mentioned that he had put it off with an expression of merriment; that he thought it best to forget and forgive one another for what was past, and to begin on a new score. This was very disturbing to Oldenburg. In point of fact, Waller never did pay.

Pepys was elected February 15, 1664/5, and admitted the same day. On January 14, 1674/5, at a meeting at which Mr. Pepys and the Earl of Aylesbury were present, each took a day when they would provide a lecture for the Society. The latter excused himself, subsequently paying a fine of forty shillings. Although not recorded, it would appear that Pepys failed to keep his promise. We have found no reference to this lapse in the well-known Diary.

Limitations of space forbid further review; and so we take leave of these "early philosophers," grateful for efforts which shaped into actualities, and for their rich legacy of an essentially English foundation.

T. E. JAMES.

The Physiology of Colour-Change.

The Pigmentary Effector System: a Review of the Physiology of Colour Response. By Dr. Lancelot T. Hogben. (Biological Monographs and Manuals.) Pp. xi+152. (Edinburgh and London: Oliver and Boyd, 1924.) 10*s.* 6*d.* net.

AMONG the many unsolved problems of animal life, the significance of pigmentary colour and of rapid colour-change is one of the most elusive and attractive. Unlike the case of chlorophyll, the pigments of animals have no direct physiological value so far as really critical evidence goes at present. The colouring matters of birds' eggs, for example, the variable colouring of the egg of the guillemot, herring-gull, or cuckoo, has not yet been shown to possess the slightest relation to the welfare of the chick; nor has the (genuine) coloration or lack of colour in the skin or deeper tissues been proved conclusively to play a definite part in the welfare of the animal body. On the other hand, adaptational and survival value has been freely admitted, until recently, to account for the complex and exquisitely balanced correlation between coloration, habit, and environment in a large number of instances, of which insects and fishes offer the most notable examples. The difficulty that has made biologists sceptical of arguments that are used to prove protective, warning, and epigamic significance in animal colouring, lies in the absence of objective standards of excellence. How much does it benefit a flat-fish to fit so exactly into its niche and to stay there? How much does the note of warning avail? What was the value of the rough study in pigment before the painted animal canvas became amenable to the criticism of life? Are pigments or structural colours anything more than indices of chemical and physical structure, and is their biological value real or apparent only?

To these questions Dr. Hogben's book offers no direct answer, and much more analytical work has to be done before we can put really intelligent questions about animal coloration to the test of experiment and observation. What this excellent book does, is to analyse critically all that is accurately known about those quick changes of colour for which the chameleon has gained a wholly undeserved notoriety and in which it is excelled both in rapidity and range of repertoire by many fish, frogs, prawns, and cuttle-fish. Dr. Hogben's book is a critical review of the factors governing colour-change in vertebrates and Crustacea, and his special qualifications for this work lie not only in his own original contributions to experimental chromatology, but also in the judicial way in which he deals with the evidence and shows in each case what the problems are that now await solution. Such a survey will only require to be known to be at once appreciated by zoologists and physiologists as an indication of the new *rapprochement* that is taking place between these two bodies of workers, and that constitutes a reversion to that earlier practice when, as the editors of this series remark in their preface, "animal physiology was not yet divorced from morphology."

Colour-change is a response by the pigment cells of the skin to change in the external or internal environment. It takes the form of radiation of pigment, or of pigmented protoplasm, from the body of the cell into its spreading branches, an injection as it were of granules into a pre-existing dendritic pathway. When this occurs the general effect is darkening of tone. The frog, for example previously yellow, now becomes dark green or almost black. Again, the change may be one of pallor occasioned by the inflow of pigment from the branches into the central cell-body leaving, therefore, relatively large tracts of skin uncoloured or exposed so that the less mobile but lighter coloured groundwork—the body of the colour-scheme—becomes thereby visible. Such changes of coloration may be general or local. They may be slow or almost instantaneous. They may occasion a passing flush or a momentary pallor, or they may persist so long as the animal that exhibits them remains in a chosen habitat. They may come on at night and again at daybreak, and the rhythm of nocturnal and diurnal colour contrast may persist even when day is turned into night or night into day. As Lord Lister said in his classical paper on "The Pigmentary System of the Frog" (1858), the pigment cells "form a tissue with entirely new functions which, though apparently allied to the most recondite phenomena, yet produce very obvious effects."

Dr. Hogben's book is a commentary on these prophetic words. The pigmentary tissue gives evidence, accumulated now from the side of endocrinology as well as from those of neurology, of ecology, and of toxicology, of being "allied to the most recondite phenomena." Lister advocated the colour-changes and pigment-cells in the frog for use as "indicators" of the effects of poisonous substances on the animal organism. It has taken exactly sixty years for his suggestion to be carried into effect. The chromatophores of the frog and of the fish are now the most delicate tests of reaction to physiological and pharmacological stimulation; and as there exists a close if not an exact correlation between the action of drugs on a given tissue and those of the sympathetic and parasympathetic (or in the modern sense the "autonomic") nervous systems, change of colour—the radiation and

retraction of pigment in the cell—acquires merit not only in itself as a biological factor, but also as a signpost in the maze of hormonic and autonomic changes that take place in the body.

As an example of this modern development of chromatology we may take the case of an American fish Fundulus. Spaeth has shown that the tissue overlying a few detached scales and containing the mobile chromatophores can be studied in a living state under the microscope and the reactions of these pigment cells to various agencies can be recorded. Normal saline promotes expansion of the pigment into a dendritic form, whilst potassium and alkaline salts generally cause immediate retraction. These opposing effects can be balanced by using three reagents in suitable combination (NaCl 6 vol. + KCl 1 vol. + $CaCl_2$ 0·35 vol., N/10 in each case). Equilibrium having thus been attained, it is now possible to determine the effect of any given pharmacological reagent quantitatively by measuring the time taken by, and the extent of, pigmentary response. In this way, Spaeth has accomplished a pharmacological assay, and in the course of it he has discovered the remarkable effect of barium chloride (N/10). When this is applied to the pigmented tissue, the granules at once flow centrally and remain retracted for half an hour. Then the chromatophores at the edge of the scales suddenly radiate their pigment but almost immediately retract it again. There then follows a "Piccadilly effect." The pulsations begun by the cells at the edge of the scale, spread centripetally from cell to cell, increasing in amplitude of vibration as time goes on. Eventually the whole group of pigment-cells associated with each scale pulsates for several hours between the extremes of contraction and expansion.

The importance of these observations and of others on the effect of ergotoxine and adrenalin lies in the fact that the pigment-cell of the fish has one sympathetic nerve-ending and probably one only. Moreover, the pigment-cell, if not a modified smooth muscle-fibre, is a member of a closely allied "effector system," and the evidence it supplies as to the action of drugs and of hormones (such as ergotoxine and adrenalin respectively) throws light upon the action of these substances in the roots of the mammalian uterus. It is indeed an unexpected development of biological research to find the study of pigment a help to the gynæcologist.

The general conclusions that Dr. Hogben draws from his study of the factors governing colour-response in the lower vertebrates and Crustacea are based on a critical examination of the evidence. In the Amphibia, he concludes that the pituitary (posterior lobe) is the source of the effective stimulating substance that, in correlation with the action of natural stimuli, regulates colour-response; and that nervous control of the chromatophores, even if it exists, plays a very subordinate part. In fishes the weight of regulation lies, on the contrary, with the nervous system and owes little to hormonic influence. In reptiles, pallor is the result of adrenalin affecting the chromatophores, but the flushing of the skin with colour is not clearly understood. Finally, the factors for colour-change in Crustacea are ably dissociated and set out on the basis of Gamble and Keeble's work on Hippolyte, and the work ends with a short appendix on the chromatophores of cephalopods.

The volume, from its style, critical treatment, and breadth of view, should enhance the author's reputation and give encouragement to the editors and publishers to pursue the excellent object they have in view—the production of monographs on experimental biology by those who have something to say and are able to say it. F. W. GAMBLE.

The Recognition of Minerals by their Optical Characters.

(1) (*a*) *Les méthodes de Fédorof et leurs applications à la détermination des plagioclases.* Bull. Suisse de Minéralogie et Pétrographie, tome iii. fasc. 1-2, par L. Duparc et M. Reinhard, 1923. (*b*) *La détermination des plagioclases dans les coupes minces,* Mémoires de la Société de Physique et d'Histoire naturelle de Genève, vol. 40, fasc. 1, par L. Duparc et M. Reinhard, 1924.

(2) *Mikroskopische Physiographie der petrographisch-wichtigen Mineralien.* Begründet von H. Rosenbusch. Band 1. Erste Hälfte: Untersuchungsmethoden. Fünfte, völlig umgestaltete Auflage, von Prof. Dr. E. A. Wülfing. Zweite Lieferung. Pp. iv + 253-532. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung G.m.b.H., 1924.) n.p.

THE employment of crystal optics in the determination of minerals is a very special branch of applied physics which has been industriously pursued in recent years, but it is the task of distinguishing between the different plagioclases that has called for the greatest refinements. These important constituents of igneous rocks present the closest resemblance to one another, but vary greatly in composition, forming a continuous series from albite, soda plagioclase rich in silica, $Na_2OAl_2O6SiO_2$, to anorthite, lime plagioclase, $CaOAl_2O_32SiO_2$, which contains much less. They differ, however, in the orientation of their axes and planes of optical symmetry relatively to their crystal structures, and in other optical characters. The foundations of these investigations were laid by Schuster,

in Germany, and Michel Lévy in France, but it is to the great Russian crystallographer Fedorov and his pupil Nikitin that we owe the latest and most far-reaching developments, and they have now been rendered generally available by Duparc and Reinhard in Switzerland, and by Wülfing in Germany, in the works before us.

For this purpose a microscope with a theodolite stage is employed, that is to say, one in which a thin rock slice, containing a section of plagioclase, can be rotated successively on at least three different axes at right angles to one another, so that, with the help of glass hemispheres to prevent refraction, it may be examined from any direction. As the amounts of these rotations are recorded on graduated circles or arcs, the resulting position is exactly determined.

It is well known that plagioclase almost invariably occurs in twin crystals consisting of at least two differently orientated component parts, which are related by the fact that a rotation of one of them through an angle of 180° about a definite direction, the twin-axis, will bring it into parallelism with the other. There are a number of different kinds of twins of plagioclase, each with its characteristic twin-axis, but it is by no means always easy to say which is present.

By a series of manipulations of the theodolite stage the three axes of optical symmetry, the so-called "axes of elasticity," with the refractive indices α, β, γ, of one of the components of the twin crystal are brought in turn into a position parallel to the external horizontal axis of rotation of the theodolite stage, and their positions relatively to the normal to the thin rock section are read off on the graduated circles or arcs. These axes of optical symmetry are represented by three points on a stereographic projection in which the normal to the rock slice is the centre of projection.

The same procedure is followed with regard to the other component of the twin, and the three corresponding points are inserted in like manner on the same projection. If now great circles are drawn through each of the pairs of points representing corresponding axes of optical symmetry, the three great circles will meet in two opposite points, only one of which will as a rule be represented on the projection. Such a point (or points) will represent the twin axis, and its angular distance from the axes of optical symmetry is then measured, but so that if it exceeds a right angle the supplement is taken.

Recourse is now had to another stereographic projection. This is on tracing paper, and in it the point representing the intermediate axis of optical symmetry with refractive index β occupies the centre, and the other two with refractive indices γ and α are on the circumference at a distance of 90° from one another. The position of the twin axis can now be indicated, because its angular distances from the three axes of optical symmetry are known. They are of course the same for both components of the twin. The new projection is next compared with a standard projection on the same principle, which will be found in the works referred to above. It shows the positions relatively to the axes of optical symmetry of the crystal directions of the plagioclase, especially the twin axes. Instead of the crystal directions being considered as fixed, and the optical directions as varying with the composition of the plagioclase, exactly the opposite convention is adopted, the axes of optical symmetry being regarded as fixed and the crystal directions as varying with the composition. The position of the point representing the twin axis of a twin according to any particular twinning law will therefore vary with the composition of the plagioclase, and the points representing such a twin axis in all the different plagioclases will form a curved line, one end of which will correspond to albite and the other to anorthite. The intermediate points corresponding to plagioclases with 10, 20, 30, etc. of anorthite are figured accordingly. The standard projection shows a number of such lines, each corresponding to a particular kind of twinning.

By placing the tracing paper with the projection of the twin axis under investigation over the standard projection so that the corresponding axes of optical symmetry coincide, and noticing (1) on what line in the standard projection the twin axis in question falls, and (2) on what part of that line, it is known at once (1) what is the nature of the twinning, and (2) what is the proportion of anorthite present in the plagioclase.

The optical axial angle is also obtained in the course of the investigation.

In the publications by Duparc and Reinhard this method is explained with a wealth of diagrams and examples, and the older methods are also fully described and illustrated in greater detail than by previous authors. A full and clearly illustrated account of the Fedorov method is also given in the Stuttgart publication. This forms, however, only a small section of the new edition by Wülfing of the great classical work by Rosenbusch on microscopical petrography. It contains in addition a thorough exposition of the general theory of the microscope, of which petrologists, as a whole, know far too little. Considerable space is devoted to the description of different types of petrological microscopes and their accessories and their use. The high standard of previous editions is maintained and even surpassed, for all the latest advances will be found in its pages.

JOHN W. EVANS.

The British Portland Cement Industry.

A Hundred Years of Portland Cement, 1824–1924. By A. C. Davis. Pp. xxii+282. (London: Concrete Publications, Ltd., 1924.) Cloth, 21*s*.; leather, 25*s*.

SOME books are of transient value and others increase in value as time progresses. This work undoubtedly belongs to the latter class. The author's intimate knowledge of the cement industry, its complex business ramifications, and changing methods of manufacture, has enabled him to produce a book which must be regarded as authoritative over the period of which it treats, so far as the British industry is concerned. No attempt is made to follow the development of the industry in other lands, beyond what is essential for understanding it in our own.

After a brief survey of the knowledge of the ancients regarding limes and cements, and a critical examination of John Smeaton's work in 1756, the tangle of men and names associated with the beginning of the industry in different parts of England is gone into in considerable detail, this section of the work being illustrated by excellent actual photographs of historical value. The cement industry is now so rapidly changing that all these old landmarks of progress may in the near future be swept away, and the men who took an active part in its development and remember the conditions which prevailed in the industry even a few decades ago are now fast disappearing. The work, therefore, is valuable in that it gives an accurate account of the industrial conditions and influences which prevailed in the industry, following the gradual change until we reach modern conditions, when great accumulations of capital, expensive machinery, and accurate scientific control by routine chemists and scientific engineers are essential for successful manufacture.

What must strike the reader of this book is the unattractive personality and lack of education of the pioneers of the industry. The work of Joseph Aspin, and especially of his son William, is gone into in some detail. Did any of the Aspins really know how to produce the substance known now as portland cement, a substance which is produced by increasing the heat in the kilns sufficiently to cause the intimate union of the components accompanied by semi-fusion or "sintering"? The author decides that they did not. The original patent of Joseph Aspin is obviously deficient, and it has been suggested that the inventor suppressed vital information in order to mislead competitors. Mr. Davis decides that the Aspins never made what was now known as portland cement, although Joseph Aspin introduced what has proved the extremely successful trade name of "Portland Cement," and in this showed considerable ability. The fact of the matter is that both the Aspins were ignorant but gifted men, deficient in education and devoid of all scientific knowledge.

Joseph Aspin, the father, was a bricklayer by trade, a Yorkshireman, who seems to have distrusted his fellow-manufacturers to a considerable extent, as he surrounded his factory with walls 20 ft. high and carried on the manufacture as a sort of mystery. His son William continued this tradition, mystifying his workmen by sprinkling various secret chemicals from a tray on to the contents of the kilns in front of his workmen, with the result that he not only repeatedly succeeded in raising capital after each failure, but also succeeded in baffling inquiries right to the end. After repeated failures he died in Germany as the result of a fall while in an intoxicated condition, his last partner having got rid of him by a cash payment of 2500 marks.

This origin is no doubt the cause of the suspicious attitude towards all people who claim superior knowledge, which even to-day prevails to some extent in the industry, chemists and scientific workers generally being regarded with marked disfavour.

A man of greater ability than either of the Aspins was I. C. Johnson, who spent some time in spying around Aspin's works with the view of discovering his "secrets." He apparently quite met his match in the Yorkshireman, because the sample of material that Aspin supplied him with turned out to consist largely of calcium phosphate, which led Johnson to collect all the bones in his neighbourhood and burn them so as to create a mighty stench. Needless to say, he did not make portland cement with this material, but promptly silenced any criticism by blaming the analyst for making an incorrect analysis.

Johnson himself seems to have possessed only elementary scientific knowledge, but his ability was undoubted, and by means of numerous experiments made on the "trial and error" principle, he undoubtedly succeeded in making portland cement as we know it to-day. He also introduced the chamber kiln into England, and the enormous British industry which developed was largely due to this invention.

The cement industry seems to have been carried on in the crudest way, without scientific control of any sort, and a graphic description of the way a cement works was run in 1886, on p. 211, brings this aspect home to the reader, especially when a chemist will remember that at this time the German chemical firms for years past had been not only employing routine chemists to control output, but also, so far back as 1883, the Badische Anilin und Soda Fabrik was actually employing a director of scientific research at a salary of 5000*l*. per annum.

It was the shock of foreign competition which led to

improved methods of manufacture. Routine chemists were engaged to control output and material, the rotary kiln was reintroduced from the United States (after its initial invention and failure in Great Britain), and, generally, the industry took on its modern form. The author claims, and the reviewer thinks correctly, that at the present time the British cement industry is conducted with practical skill and accurate scientific control which equals, if it does not exceed, that exercised by any other country, but that great improvements are still possible in manufacture.

The author furnishes an interesting chapter on the progress of scientific research in the industry. To sum up, the work is a valuable one, and gives an exact and very accurate picture of the cement industry as it exists to-day, and illustrates clearly the successive changes introduced into the industry in the successive decades. The work will enhance the author's reputation as one of our leading authorities on cement.

GEOFFREY MARTIN.

Prehistoric Man.

Fossil Man in Spain. By Prof. Hugo Obermaier. (Published for the Hispanic Society of America.) Pp. xxviii+495+23 plates. (New Haven: Yale University Press; London: Oxford University Press, 1924.) 23*s.* net.

DR. HUGO OBERMAIER was born in Bavaria; worked under Hoernes at Vienna; studied glacial geology throughout the Alps with Penck; excavated for the Prince of Monaco the largest and most important prehistoric dig at present known at Castillo (Cantabria); was professor, until the War broke out, at the Institute of Human Palæontology founded by the same Prince at Paris; and now is professor of prehistoric archæology at the University of Madrid. With such a record we may well expect a fine work and Dr. Obermaier has not disappointed us. To the German thoroughness and power of taking pains in details born in him, there has been added, from long association with the French, the Latin clarity of thought and power of intuition. Madrid has done well to envisage all this and come forward with a professorial chair when war difficulties approached. It is not too much to say that Dr. Obermaier is one of the two most learned prehistorians now alive.

It was in 1912 that his book "Der Mensch der Vorzeit" appeared, and this was followed in 1916 by "El Hombre Fosil," with a translation of which from the Spanish into English, accomplished thanks to the enterprise of the Hispanic Society of America, we are now concerned. It is a monumental work that will long retain a foremost place in the prehistorian's library, though no specialist has heretofore been able to do without the original Spanish edition. A few changes have been introduced in the new version and the book has to a large extent been brought up-to-date. This has been facilitated by the fact that, owing to innumerable delays in the United States, the production of the English edition is coinciding in time with the preparation of a second revised edition in Spanish, and it has been found possible to incorporate some of the new matter in the present volume. There are also alterations and additions in the plates, which are many and excellent. In the reviewer's opinion the English title is somewhat misleading, as the work is really of a general character, though stress is laid in the illustrations and text on the Iberian peninsula—"Fossil Man, with special reference to Spain" would really be a more accurate description.

The book opens with an account of Tertiary times and the problems of Tertiary man, followed by an exceedingly able summary of the existing knowledge of the Glacial epoch with lists of the plants and animals found.[1] Next comes a description of the various Palæolithic industries, a special chapter being devoted to the Iberian peninsula during these times. It is pleasant to see here the introduction of a new plate figuring a general view of the cave of Castillo, where the reviewer had the privilege of assisting at the digging of this really wonderful site under Dr. Obermaier's direction. Palæolithic art and the problems of chronology are then discussed, and the volume concludes with two chapters on fossil man and the transition from Palæolithic to Neolithic times successively. Not the least valuable part of the work is the group of appendices, notes and bibliography, which, in the English edition, are separated from their respective chapters and placed together at the end. Some minor changes in arrangement have been introduced which seem to be on the whole an improvement. Thus the order of the table on page 64, giving the archæological sequence of the various industries in the Somme valley, has been reversed from that of the Spanish edition, the latest deposits being placed at the top instead of at the bottom of the list. There are also one or two minor misprints of little importance, for example in the initials of at least one author quoted.

Of course, in any work of this nature there must be, besides basal and incontrovertible facts, theories which are not necessarily accepted by every one. For example, Dr. Obermaier's suggestion as to the significance of the Azilian painted pebbles, that the markings really represent conventionalised human figures, has always seemed to the reviewer difficult of credence; and his

[1] A translation of the whole of this chapter from the Spanish edition is given in the appendix—the main text contains a rewritten version not quite so overloaded with technicalities and mere lists.

comparison of them with the undoubted conventionalised figures of the Spanish Third Group paintings seems open to the objection that there is by no means an exact similarity, and, moreover, that the latter are very possibly of a much later date. However, these are points that further finds will no doubt elucidate.

It only remains once more to congratulate Dr. Obermaier on his book, and the Hispanic Society of America on having been the instrument of introducing it more fully to English readers. M. C. B.

Fluid Velocity and Pressure.

The Measurement of Fluid Velocity and Pressure. By J. R. Pannell. Edited by R. A. Frazer. Pp. vii+135. (London: E. Arnold and Co., 1924.) 10*s.* 6*d.* net.

TO a large extent this book is a product of the advent of aeronautics, and its preparation would not have been possible fifteen years ago. The author passed through the period during which no accurate means existed of measuring the velocity of fluids, and was intimately associated with the history of the needs of such methods as he describes. At the present moment, the calibration of anemometers depends on a solitary series of absolute measurements at the National Physical Laboratory, part of which was conducted by the author himself. The work of Stanton on wind pressure in 1903 was the first contribution to the production of the tube anemometer illustrated on p. 13; its establishment as a satisfactory standard followed the formation of an Aeronautics Department, and the development then reached the stage at which a skilled workman can reproduce the instrument so accurately as to give speed within one per cent. without special test.

Many other anemometers, including those established in aeronautical practice, are described together with manometers and balances for the measurement of fluid pressures. In the description of one of the manometers —p. 92—the short statement occurs that "the horizontal tubes are filled with a solution of distilled water and common salt of density 1·07 . . ." and no reference is made to the lengthy inquiry made by the author before this solution was decided on. In the early days of the use of tilting manometers of the Chattock type, distilled water was tried, with the result that renewal was necessary after each fortnight or three weeks. The glass work had then to be thoroughly cleaned. As a result of Pannell's efforts the period between cleansings was raised to a year or more and the operation of cleaning greatly facilitated. In this and in much of the material in the book under review there is just that precision of detail which is helpful to newcomers and will enable them to get to work quickly and safely.

Pannell lost his life when the airship R38 failed, whilst applying his knowledge of instruments to research, and together with his colleagues the author has left a record of which one is proud and of which this book is one item. The volume can be confidently recommended as an excellent statement of available methods of measurements in the motions of fluids, whether the application be in aeronautics, hydraulics, ventilation, or any other of the branches of engineering.

L. BAIRSTOW.

Our Bookshelf.

Soil Management. By Prof. Firman E. Bear. (Wiley Agricultural Series.) Pp. vi+268. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1924.) 10*s.* net.

THE work under notice is a text-book dealing with the application of scientific facts and principles to the practical management of the soil, and is written for the use of students in agricultural colleges who have already taken courses in chemistry, botany, geology, and physics. The requirements of crops and the properties of soils are discussed in the first ten chapters, which are followed by four chapters on the utilisation of the resources of the soil by cultivation operations, crop rotations, etc. The remainder of the book is concerned chiefly with the economic use of fertilisers and of lime. The nitrogen problem is treated with the thoroughness that would be expected from Prof. Bear, who has devoted much time to this question. It is a very common practice in the United States to purchase only phosphatic fertilisers and to depend on the air for nitrogen; on soils which have been cultivated for many years, such a system necessitates the well-managed introduction into the rotation of frequent leguminous crops for green-manuring, and the author is rightly insistent that every effort should be made to utilise such natural nitrogen-fixing agencies to the fullest possible extent for the maintenance of soil fertility.

The illustrative data are taken mainly from American sources, but the application is by no means confined to American conditions. It may, however, be questioned whether the book is not on the whole too advanced for students who "have little or no need for the course except as it may be useful to them in practice or in understanding practice." Certainly the average British student of this type will find it rather stiff reading; but his American cousin is perhaps different. C. T. G.

The Bombyliidæ of the Ethiopian Region: Based on Material in the British Museum (Natural History). By Mario Bezzi. Pp. viii+390: 46 text-figs. (London: British Museum (Natural History), 1924.) 32*s.* 6*d.*

THE Bombyliidæ are a large and highly interesting family of Diptera, and the present monograph forms an important contribution to our knowledge of these insects. In placing the preparation of the volume in the hands of Prof. Bezzi, a wise choice has been exercised,

since that author is well known as one of the leading dipterists of to-day. The book is based upon material submitted to him by the British Museum and the Imperial Bureau of Entomology as well as from the Museums in Cape Town, Buda-Pest, and Genoa, and also from Messrs. Alluaud and Jeannel in Paris. This wealth of specimens, together with those in the author's own collection, has made it possible to produce a monograph of great value. In addition to diagnostic keys and descriptions, all available biological data, however scanty, is included under each species together with notes on the known life-histories. It is hoped that, with the aid to identification thus provided, African entomologists will be stimulated to study the remarkable metamorphoses of these insects. Their larvæ are all parasites and have a wide range of hosts. The unexpected discovery of *Thridanthrax abruptus* parasitising the puparia of tsetse-flies is but a bare indication of what awaits investigation in the Ethiopian region. The book is admirably printed and illustrated, while the revision of the English manuscript by Major Austen has ensured this arduous task being carried out capably.

Distillation du bois. Par Prof. G. Dupont. (Encyclopédie Léauté, 2e série.) Pp. xv+284. (Paris: Gauthier-Villars et Cie; Masson et Cie, 1924.) 25 francs.

THE general treatment in this work is on somewhat similar lines to that followed in recent British and American text-books on the subject. Special attention is given to the distillation of resinous woods, and an interesting account of wood distillation plants is included, the text being made clear with numerous diagrams. There is a certain lack of proportion in the presentation of facts. Nearly one-third of the book is given over to an account, such as is available in numerous organic text-books, of the elementary chemistry of acetic acid and methyl alcohol, and of simple derivatives of these, yet the study of the gaseous products from the thermal decomposition of wood is intentionally neglected. Again, the analytical section is considerably restricted. The space occupied by this important subject is only half that given to the preparation and properties of formaldehyde, and it is doubtful if the meagre information therein contained will be of much real value to the analyst.

The monograph cannot be regarded as a handbook for the specialist. It is rather a general account of certain aspects of wood distillation presented in a form which will be attractive to the general reader and science student. J. REILLY.

Aristotelian Society. Supplementary Vol. 4. *Concepts of Continuity: the Papers and Symposia for discussion at the XIVth Joint Session of the Aristotelian Society and the Mind Association, at University College, Reading, July 11-14, 1924.* Pp. vi+240. (London: Williams and Norgate, 1924.) 15*s.* net.

THE papers read at the summer meeting of the Aristotelian Society and the Mind Association, though inspired with a distinctively philosophical motive, are of more than usual scientific interest. All in some form deal with the subject which gives the title to the volume, the concept of continuity.

Prof. Chevalier's article "Le Continu et le Discontinu" is designed to prove that though the problem of continuity is fundamental in mathematics and physics, it can be resolved only by philosophical arguments.

Three of the five symposia deal with scientific problems. One on the quantum theory discusses how far it modifies or can be made to accord with the definitions of continuity accepted in mathematics, physics, and psychology. The papers are by Dr. Nicholson, Mrs. Wrinch-Nicholson, Prof. Lindemann, and Prof. Wildon Carr. A second deals with the biological problem of the transmission of mental characters. This is discussed by Profs. Johnstone, Dendy, MacBride, and Lloyd Morgan. A third deals with the implications of the term "law" in psychology. The papers are by Mr. Wolters, Dr. M'Intyre, and Dr. Levine.

Chemical Thermodynamics: an Introduction to General Thermodynamics and its Applications to Chemistry. By Prof. J. R. Partington. Pp. vii+275. (London: Constable and Co., Ltd., 1924.) 10*s.* 6*d.* net.

A NEW edition of Prof. Partington's "Text-book of Thermodynamics with special reference to Chemistry" (1913) has been desired for some time, and those who are familiar with that work will welcome it in its new form under the title "Chemical Thermodynamics." The treatment has been simplified as well as brought up-to-date. Any one who is familiar with the large number of relevant papers published during the past decade will marvel at the skill with which the material has been incorporated. The author has made a special feature of the inclusion of much recent work published in American journals. "The accurate experiments, and the ingenious and original treatment, of the American workers on this subject will make all admit gratefully the debt which students in other countries owe to them." A point which teachers will appreciate is that the equations have been stated, so far as possible, in a form capable of direct numerical application, and many examples, with answers, have been provided. It is a convenience to have the numbers of the paragraphs printed on the inside edges at the tops of the pages. The book will prove indispensable to students of chemistry and physics alike.

Spectroscopy. By Prof. E. C. C. Baly. (Text-books of Physical Chemistry.) In 2 vols. Third edition. Vol. 1. Pp. xi+298. (London: Longmans, Green and Co., 1924.) 14*s.* net.

THE new edition of Prof. Baly's "Spectroscopy" is modelled closely on the original plan. It has, however, been reset in a new *format* with a larger page, so that the number of pages in the first volume of the new edition is about 10 per cent. less than in the corresponding half of the preceding edition. Since the earlier portions of the book are concerned mainly with prism and grating spectroscopes, they have not needed any drastic emendation as a result of the recent developments in the theory of spectroscopy; but attention may be directed to a useful table of standard wave-lengths, covering three pages of the new edition, and to the account that is given of recent work by McLennan and by Millikan on the extreme ultra-violet region of the spectrum.

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.*]

Limbs and Pigment-Cells.

I NOTICE in a review of Franz's "Geschichte der Organismen" which appeared in NATURE of December 20 a reference to the interesting evolutionary problem of the origin of the limbs of vertebrates. I have no intention of essaying the futile task of endeavouring to influence those whose minds are already made up regarding this problem, but I should like to direct the attention of others to the point that new facts having important bearings upon the problem have come to light in the investigation of the development of these relatively archaic types of vertebrate, Lepidosiren, Protopterus, and Polypterus. A short summary of these facts, and of the conclusions they suggest, will be found in my volume on vertebrate embryology, and the perusal of this summary will, I think, suffice to indicate the grounds for my belief that the older hypotheses referred to by the reviewer will, as knowledge of the relevant facts becomes diffused, be replaced as working hypotheses by the newer view that the limb of the vertebrate has evolved out of a projection from the body-wall which was primitively respiratory in function.

I take this opportunity of directing attention to another statement in recent literature which is liable to cause misunderstanding. It occurs in a book by Dr. L. T. Hogben entitled "The Pigmentary Effector System," where he refers (p. 93) to "Kolliker's work on the South American mud-fish, Lepidosiren." The creature upon which Kölliker worked was of course not the creature known to us to-day as Lepidosiren, not the South American "mud-fish," but the African Protopterus which for a brief period after its discovery was called Lepidosiren. As Dr. Hogben does not refer in his summary of our knowledge regarding the pigment-cells of fishes either to what I have published on the subject, or to what I made known to him by word of mouth, I will state very shortly the attitude that my work upon Lepidosiren caused me to take up, and which I have consistently adopted in teaching for many years. I adhere to the view that the colour change, so beautifully exemplified by the young Lepidosiren—of a deep rich black during the day and practically colourless during the hours of darkness (see Phil. Trans. Roy. Soc. B, 192, 1900, and *Quart. Journ. Micr. Sci.* 46, 1902), is due to actual change in the form of the black pigment-cells which, under the influence of light, push out their finely branched pigment-laden pseudopodia in a direction parallel to the surface of the body so as to provide a light-proof coat, and, when night falls, draw in their pseudopodia and shrink up to spheres so relatively small as to be without effect upon the general colouring. The considerations which induced this opinion were (1) the appearances presented under the microscope, (2) the fact that the pigment-cells changed their position in the body and therefore necessarily had the power of moving their pseudopodia, and (3) the fact that it was possible by teasing up the night skin to isolate individual chromatophores without their going to pieces as they would be liable to do were peripheral extensions of their body torn through in the operation.

As regards the active functioning of the pigment-cells, there is, I think, a tendency towards over-emphasis of one or other of the factors involved. There is, first of all, the fact that the healthy activity of the chromatophores, as of all other cells in the body, is dependent upon the internal medium of the body being of approximately "normal" composition, and recent work by various investigators, including Hogben, has served to emphasise the special importance of particular components of the internal medium provided by the adrenal or the pituitary organ, slight fluctuations in the proportion of this particular component evoking specific functional responses. There is, secondly, the nervous factor, and there is, thirdly, the direct influence of light.

As regards the latter, I may quote an observation made by me in South America. I happened to be watching a green tree-frog in the sunlight and admiring the extraordinarily perfect agreement between its colour and that of the surrounding leaves. Across its back fell a dark narrow bar of shadow caused by a blade of grass close by. When I caused the tree-frog to change its position it appeared, to my astonishment, to carry the shadow with it, the position where it had been remaining for some little time clearly indicated by a dark band across the green surface. That observation served to impress upon my mind very vividly the fact of response by the skin chromatophores to localised light stimulus, and while such responses may turn out to be complicated reflexes involving the central nervous system, it seems to me simpler, until convincing evidence to the contrary is produced, to regard them as direct cellular reactions to changes in the incidence of light rays.

J. GRAHAM KERR.

The University, Glasgow,
December 22.

Muscular Action.

DURING the last few years a considerable number of papers have appeared bearing on this subject. They may be divided roughly into two classes, the first dealing with the fatigue caused by muscular action, together with the nature of the accompanying waste products; the second, with the behaviour of isolated muscles under the action of artificial stimulus.

From a mechanical point of view, a muscle is a single-acting engine which can exert a pull but not a thrust: and with regard to any class of engines, some of the most important questions which can be asked are: What is (1) their efficiency; (2) their weight for unit of power; (3) how does the efficiency vary with the rapidity of the stroke (*i.e.* piston speed); (4) how do these quantities vary with absolute size? The physiologist may further inquire: (5) What is the nature of the nervous stimulus and how does it effect the required longitudinal contraction and lateral dilation of the muscular fibres? Electricity will act as a stimulus, but (6) is it certain that nervous stimulus is of the same nature? (7) Does an excised muscle behave in the same way as the muscle in a living animal?

Striped muscle wherever met with—from mammal to insect—varies very little in appearance or in the cross-section of the individual fibres. (8) Is the contractile force which can be exerted by each fibre the same or nearly the same in all orders?

These questions are not answered by any of the papers to which allusion has been made.

In a letter which appeared in NATURE of April 15, 1920, I said: "When muscular force is exerted, power is expended and fatigue is produced, even when the muscle remains stationary. Again, when no external force opposes the contraction of the muscle, physiological causes set a limit to the speed at which contraction can take place. In both cases the whole power

expended is lost in so far as the production of useful work is concerned."[1] For the maximum nervous stimulus the acceleration is limited by the mass of the muscle itself and of those parts or limbs to which it is attached and which must move with it; and the greatest contractive force will act when the muscle is stationary, the whole of the power again being lost by muscular leakage. Between these limits there must be a "most economical speed," *i.e.* a speed which will develop the greatest useful power.

If it is assumed that the leakage is proportional to the tension of the muscle, and is the same for the same tension whether the muscle is stationary or in motion, and also that all the work done in internal acceleration is lost (assumptions which should be the subject of experiment), the most economical speed is that which makes the losses by leakage and acceleration equal. If the operation of the muscles is periodic and is associated, as for example in walking, with a natural gravitational period, part of the acceleration is done by gravity, and the muscles only supply as much as is required to convert the natural period to the period of the step—that is, to convert a free period T_1 into a forced period T_2.

A simple experiment which will show the difference between the power required to maintain the forced and free motions may be made as follows. Crossing the arms so that the wrists are in the same vertical plane, make each hand describe a circle about the line joining the elbows and note the rate of revolutions which can be sustained. Here there is no external work to be done, and, since the average position of the forearms is horizontal, the natural period is infinite. Various muscles, however, must act periodically to balance the centrifugal force. Next place both wrists in a looped strap which will form a wrapping connexion between the arms. This will not interfere with the orbital motion, but the centrifugal force will be taken wholly by the strap, and the forced period may in consequence be any imposed period.

With this arrangement it will be found on trial that for the same sense of fatigue the rate of revolution is more than double that which could be reached when the hands were free. The only work done when the strap is in use depends on the small tangential force required to overcome the viscous and leakage losses.

If there were any direct method of measuring fatigue, experiment on these lines would afford a quantitative measure of the relation between the power spent in leakage and in acceleration.

As regards the behaviour of isolated muscle, H. S. Gasser and A. V. Hill give an account (Proc. R.S., B, vol. 96, p. 398) of experiments on an excised muscle fixed at one end and at the other attached by a thread to a balanced beam the moment of inertia of which was adjustable. The muscle was stimulated by a brief current from an induction coil, and the movements of the beam were observed and recorded.

It is not stated whether the same muscle was used in all the experiments, but it may be gathered that each specimen, if there were more than one, was used many times.

It can scarcely be imagined that a muscle deprived of blood supply can continue to perform work, unless that work is supplied by the stimulating current, but the amount of the electrical work is not given. If, however, the work done by the muscle is merely the equivalent of that supplied by the coil, it would indicate that nervous and electrical stimulation differed in kind, for nervous stimulation seems to act much as an igniter does on a charge of powder, that is, to call up power inherent in the muscle.

It would be interesting to have these experiments repeated in a somewhat modified form. Instead of acting on a massive beam, let the muscle turn a wheel by a ratchet and pawl against a resistance controlled by a brake (these need not weigh more than two or three grams) and let the stimulus be applied periodically. Let an automatic record be provided for the stroke, the brake force, and the electric energy consumed in stimulation, and let the experiments be continued for considerable periods (minutes or hours if necessary). In this way a comparison could be made between the work supplied and the work performed.

A. MALLOCK.

9 Baring Crescent, Exeter,
December 22.

[1] In this letter an analogy was suggested between muscular action and the working of an engine with a leaky cylinder. The supposed action would also be indicated if a cord, loaded with a certain mass, the motion of which was opposed by a viscous force, had one end attached to a wheel and brake, while the other was fitted with a hand-grip, which, when tension was applied, would slip at a speed proportional to the pull. Here the turning of the wheel would be a measure of the useful work done, and the slip, of the muscular leakage. If the applied tension was less than the brake resistance the cord would not move, but work would be done by the slip, and if the tension is greater, the mass will be accelerated until its viscous resistance plus the brake resistance is equal to the pull applied.

Constant Differential Growth-ratios and their Significance.

ON Mr. Julian Huxley's very interesting results as to the fiddler-crab (NATURE, December 20, p. 895), I suggested at Cambridge that in his equation $y = bx^{1\cdot61-1\cdot64}$, if we are to rationalise the index, $y = bx^{\frac{5}{3}}$ comes nearer to his results than does $y = bx^{\frac{3}{2}}$, and allows of the conceivable physiological explanation that the ratio of claw-weight to body-weight is the isogonous ratio multiplied by a ratio proportional to a growing area in the body. Thus the weight of the claw might be the isogonous weight multiplied by the ratio of an isogonous surface secreting a male hormone to a surface secreting a female hormone and remaining of constant area. I also pointed out that in the roe of the plaice we have a sexual appendage, shed every year, and every successive year showing an increasing rate between its weight and the weight of the body. The parallel proves so astonishingly close that I ask space to communicate the following two facts:

(*a*) Representing the weight of the ripe roe of a plaice as y and the weight of the gutted body as x, then, in plaice of different weights

$$y = bx^k,$$

as Mr. Huxley discovered for the claw of the fiddler-crab. The ration of ovary-weight to body-weight has no relation to age, but only to body-weight; in this, as in some other respects, the age of a plaice is not measured by years but by the quantity of food which it has succeeded in assimilating.

(*b*) In the above equation, from the small sample of data at my disposal, I make

$$k = 1\cdot58 \pm 0\cdot10$$
$$-\log_{10} b = 2\cdot610 + 3\cdot063(k - 1\cdot58).$$

This preliminary investigation has been on data which Dr. Wallace kindly gave me at Lowestoft in 1906 from his manuscript notes (9 fishes, gutted weight 429 to 1800 grams, age-groups IV. to XIV.) and some published by Fulton (vol. ix. p. 263; 5 fishes, weight 1280 to 2145 grams, age-groups VIII. to XVI.). They are insufficient to determine with certainty whether or not k varies with increasing weight; on the whole the most probable conclusion from the data is that k is constant. Since Dr. Wallace's figures include only two fish more than 1100 grams, and Fulton's smallest fish is 1190 grams, it is impossible to test directly the similarity of the two groups; but taking the centre of gravity of the logarithms for the ovary and body-weights of

the three fishes under 700 grams, the line joining this to the centre of the remaining 11 fishes gives $k = 1{\cdot}610$; while the line joining it to the centre of only the 6 larger Lowestoft fishes gives also $k = 1{\cdot}610$. The figure 1·58 has been adopted as giving for the fourteen fishes the lowest average error, 0·0512, in the resulting deduced log y; but the average error with $k = 1{\cdot}500$ is only 0·0553, and with $k = 1{\cdot}667$ is 0·0536, so that the $\pm 0{\cdot}10$ seems to indicate the probable extent of our knowledge. (With $k = 1{\cdot}75$ the average error is 0·0626, and with $k = 1{\cdot}25$ it is 0·0781. It must be remembered that logarithmic plotting imparts an illusory aspect of accuracy; errors of 0·051 and 0·078 in log y represent errors respectively of 11½ per cent. and 20 per cent. in the weight of the ovary.) Further investigation of the extensive data by now available from the North Sea Investigations seems best left in the hands of those expert in the history of the statistics and in the natural history of the material. It would be instructive to know whether the increase in ratio of ovary to body-weight means a disproportionately large number of ova, or an isogonous number of ova of increased size? If an "area" really determine the ratio, does it secrete, in plaice or in crab, a hormone promoting cell-division, or promoting cell-growth?

The most interesting question now is whether the fact that $k = 1{\cdot}6 \pm 0{\cdot}1$ in fiddler-crab's claw and plaice's ovary be a chance coincidence, or whether Mr. Huxley's index, as well as his law of growth, be found to hold good in yet other animals?

I would urge that the latter suggestion cannot be negatived except by investigation of organisms living in the water. The index of the stag's antler would not necessarily follow the same law, for as a terrestrial animal the stag is under the necessity of a waning annual coefficient of bodily growth, since its size must not exceed the size which its legs are adapted to carry. Plaice add approximately an equal weight every similar year; for though the size of an aquatic animal may be limited by the size of its food or of its enemy, it is not affected by conditions of mechanical support. An average man is 5½ feet high, but there is no average length for a plaice; the plaice which is ten times the age of sexual maturity will be a longer fish when she is eleven times that age.

It seems possible that this necessity for a waning coefficient of growth may be the explanation of our death. Our growth-rate wanes very slowly to the zero point at 27 years old, but it does not stop waning when zero is reached. Except for creatures whose life is ended by the winter or summer, and those that perish with the act of reproduction, I do not remember any evidence of a marine animal dying a natural death, as we use the word of ourselves. It is natural for every fish to have life ended by the fangs or jaws of his fellow-creatures; in the waters, is any other end natural? Did old age and death only become the necessary fate for plants and animals when they left the swamps, claimed the land, and attempted swiftness or tallness in a medium 1/800 of their specific gravity? If this be true, it was for proportionment of weight to transverse section that we were compelled to renounce the gift of eternal growth, and to accept death.

GEO. P. BIDDER.

Cambridge, January 5.

On the Efficiency of the Petersen Grab.

THE Petersen Grab is now being much used in various parts of the world for the purpose of picking up a portion of the sea-bottom—where this is soft enough—along with the animals of all kinds contained in the surface layer of that portion of the sea-bottom. When a sufficiently large number of samples can be taken on a homogeneous stretch of ground the grab-samples are made a means of determining quantitatively the average distribution of the sedentary population of that area.

In the earlier illustrations of the instrument, as used by Petersen, two types are shown. One of these types appears to be in general use to-day, and is regarded by the present writer as inefficient, while the other, which appears to have gone out of use, is more efficient in principle, and by a slight alteration can be made reliable in practice.

During a recent survey of the oyster beds in the Fal Estuary, the present writer employed the Petersen grab, but came to the conclusion that the current form of grab was inefficient for the determination of an oyster population; and further, that on grounds

FIG. 1.—Peterson Grab modified to cut into a rectangular surface of the sea-bottom and to ensure partial protection of the gap present during closure. (From a photo by Mr. A. J. Smith.)

in which the grab cannot dig, and probably also to some extent even on soft grounds in shallow water, the grab will not pick up with certainty the extent of surface of the sea-bottom which it is supposed to do. The grab consists essentially of two very nearly quarter-sectors of a cylinder hinged along the axis of the cylinder. When the instrument is closed it has the form of very nearly half a cylinder. The occluding edges of the sectors are very nearly radii of the cylinder end section, and their peripheral ends are separated by a chord of about 36 cm. in the open condition of the 1/10 sq. metre type, in which the diameter of the imaginary cylinder is about 45 cm. The occluding radii of the sectors of this type are only exposed in about 16 cm. at their peripheral end, as a central small metal cylinder of about 12 cm. in diameter is built into the instrument around the main axis. The instrument is closed by a vertical pull on a chain, which passes over a pulley on the inside of one sector and is attached to the inside of the other (Fig. 1). In use the instrument is allowed to run freely and arrive on the bottom with a bang; the check on arrival being utilised to release the chain used for closing and hauling.

It follows from the construction of the grab that, in the act of closing, the gap in the semicircular ends tends to become higher and reach a maximum height of about 15 cm. from the line joining the peripheral ends of the occluding sector radii. This gap in the instruments at present in use is unprotected, and since the portion of the sea-bottom taken in the instrument cannot slide freely into the cavities of the sectors due to internal obstructions and friction, the captured soil tends to pile up under the middle of the instrument and opposite the gaping ends. Consequently, there is grave danger of a portion of the surface with its contained animals becoming lost by being pushed out of the grab at the final closing strokes. The loss of soil from this cause is no doubt greater on muddy grounds than on sandy ones, but has nevertheless to be reckoned with on all types of grounds.

It follows, therefore, that quantitative estimates of animals in the sea-bottom made by using the type of grab described are in all probability too low. In using the grab for quantitative estimations of oysters, the loss of a single oyster from approximately one square foot of ground is a very serious error, and the instrument was quickly altered to the type shown in Fig. 1 by bolting thin steel plates to the sides of one sector, so that when the grab touched the bottom it actually cut into a rectangular piece of soil. This modification is, however, still open to objection where animals living *in* the soil are being sought for, and the type of grab which will pick up a definite portion of the bottom soil with certainty is one the end plates of which form a complete semicircle. In such an instrument the end plates would cut into the soil before the sector jaws reach it, and protect the gap during the whole of the closing operation.

J. H. ORTON.

Marine Biological Laboratory, Plymouth,
December 24.

The Nature of the Contractile Vacuole.

FOR some years we have been investigating the cytoplasmic bodies in the protozoa. In NATURE of March 10, 1923, we were able to give the first account of the stages undergone by the Golgi bodies in the sporozoon Adelea. A full account of this work has been published in the *Q.J.M.S.*, vol. 67, Part III., 1923. More recently M. Ph. Joyet-Lavergne (*Comp. rend.*, 1924) has described the Golgi bodies in *Aggregata Eberthi*, and *Adelina dimidiata*, confirming our account.

For some time our attention has been given to an examination of the Ciliophora and Rhizopoda, in which we have failed to discover anything which we can satisfactorily homologise with the Golgi apparatus of the metazoon.

Now, however, Dimitry Nassonov, in the *Archiv f. mikr. Anat. u. Entwick.*, Oct. 1924, publishes a large paper in which he seeks to homologise the contractile vacuole of the protozoon with the Golgi apparatus of the metazoon.

Nassonov, by means of osmic acid technique, has succeeded, as we have done in our material, in blackening the cortex of the contractile vacuole and the canals leading to it. He claims that this osmiophile membrane has the property of secreting an osmotically active substance into the lumen of the contractile vacuole, and also itself has the distinctive character of a semipermeable membrane.

Furthermore, Nassonov gives several reasons for homologising the Golgi apparatus of the metazoa with the contractile vacuole cortex of the protozoa :— first, both organellæ are not visible *in vivo*; second, their morphology is similar, both being bladders with an osmiophile wall; third, the sponge (the metazoon nearest to the colonial protist) has a Golgi apparatus which looks like a contractile vacuole; and finally, the Golgi apparatus of the metazoan cell also has the power of secreting various substances.

In the first place, Nassonov has shown that the cortex of the contractile vacuole has the power of reducing, and of becoming blackened by, osmium tetroxide. We agree fully, having succeeded ourselves in blackening this cortex in a number of ciliates. We are also not unprepared to accept some of his interpretations as to the function of this lipoid membrane.

When, however, we come to the homology of the metazoan Golgi apparatus and the protozoan contractile vacuole, we feel, at present, that there may be some grounds for doubt. The Golgi bodies in embryonic or undifferentiated metazoan cells are almost invariably associated with a centrosphere and centrosome. In the ciliates no relation between the contractile vacuole and any body similar to a centrosome can be demonstrated. The centrosphere in metazoan cells is never, to our knowledge, a bladder-like structure; the sponge Golgi apparatus lies around a centrosome, from which the flagellum arises, and there is no evidence that the centrosphere in sponge cells is more fluid than the rest of the cytoplasm—but quite the reverse.

The line of evidence that both the cortex of the contractile vacuole and of the Golgi apparatus are not visible *in vivo* need not detain us.

Similarly, the view that the cortex of the contractile vacuole and the Golgi apparatus have similar powers of secreting substances, is not one of much value. The whole discussion comes down to the fact that the metazoan Golgi body, and the cortex of the contractile vacuole, both have the power of reducing osmium tetroxide. There are a number of lipoid substances which share this power, and much attention should not be given to this faculty alone.

Coming down from pure hypothesis to facts, what we know at present is this : a perfectly normal Golgi apparatus has been shown to exist in certain Sporozoa —in Adelea, Coccidium, Aggregata, Adelina, and Haplosporidium. The methods used for this demonstration have not succeeded so far in revealing a similar structure in any ciliate, though the contractile vacuole cortex can be blackened by osmic acid. In this laboratory we have tried amœbæ, and many ciliates both free living and parasitic, and we have come to the conclusion that a Golgi apparatus probably does not exist in the Ciliophora and Rhizopoda examined by us.

Finally, we prefer to believe that the Golgi apparatus arose in some primitive flagellated organism in direct association with the blepharoplast.

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The Interaction between Silica and Electrolytes in its Relation to Theories of Soil Acidity.

IN a note to NATURE (Dec. 2, 1922) some experiments were described in support of a theoretical explanation advanced in an earlier paper (*Phil. Mag.*, vi. 44, 338-45) regarding the nature of soil acidity. Joseph and Hancock (T. 1923, 123, 2022), however, state that " pure silica produces no effect on a solution of an acid," and that the adsorption we reported " would not be observed if the silica were more highly purified." We have since repeated our experiments

with hydrated silica (obtained in three different ways), which was purified with the greatest care. We have been able to confirm our previous observations that hydrated silica adsorbs acids and that electro-osmotic experiments show that anions are preferentially adsorbed, but we have also found that the samples of silica we used before contained alkali, and gave a much higher value for the amount of acid adsorbed. The adsorption of oxalic acid can be very easily demonstrated in view of the simplicity with which it can be volumetrically estimated. 10 gm. of air-dried hydrated silica obtained from the hydrolysis of pure silicon tetrachloride can retain, even after repeated washings, oxalic acid equivalent to 10 c.c. of N/100 permanganate solution.

It has been suggested by the writer (Trans. Far. Soc., vol. 18, part 3, p. 316) that the increase in P_H of the drainage water from Dartmoor may be attributed to the adsorption of acids by the siliceous beds over which the water passes. It is quite easy to demonstrate in the laboratory that a solution of hydrochloric acid, after filtration through a Gooch crucible of fused silica containing air-dried hydrated silica (from silicon tetrachloride), immediately shows an increase in P_H, amounting to more than one unit, indicating a diminution in concentration of more than 90 per cent. (*e.g.* from 3·4 to 4·6).

It has also been stated by Joseph and Hancock that interaction between silica and salt solution is of a chemical nature, as the residue gives an alkaline reaction on removal of the salt. It appears to us that this is not the only possible way of accounting for the production of the alkali (cf. "Adsorption by Sugar Charcoal," Bartell and Miller, J. Amer. Chem. Soc., 44, 1922, 1866; 45, 1923, 1106; 46, 1923, 1130).

Attention may be directed to the fact that the concentration of the acid liberated by a potassium chloride solution of definite concentration depends on the relative amounts of silica and solution, as also on its previous history. It would appear from the observations of Joseph and Hancock (*loc. cit.* p. 2023) that whereas a sample which has been previously treated with hydrochloric acid gives an extract having a P_H value equal to 3·96, samples which have not been treated with acids give extracts having P_H value equal to 5·33 (or 5·55) under identical conditions. The variation in concentration of the hydrogen ions of more than twenty times is extremely difficult to explain in terms of a chemical reaction. We would also like to mention the observations of Jordis and Kanter (*Z. anorg. Chem.*, 35, 20, 1903), who, from the difficulty in removing the last traces of hydrochloric acid from silica, concluded that silica forms traces of a complex acid similar to hydrofluosilicic acid.

Further experiments with precipitates like barium sulphate show perfect analogy with the reactions we have observed with silicic acid. In these instances, possibility of a chemical interaction between an acid and a neutral salt is very remote. In this connexion an interesting observation may be recorded, which to the writer's knowledge has not been recorded before. If barium sulphate is precipitated from the interaction of solutions of potassium sulphate (P_H = 6·8) and barium chloride (P_H = 6·6), the liquid shows either an alkaline or an acid reaction according as potassium sulphate or barium chloride is in excess. The acidity or alkalinity may be as high as that indicated by P_H values of 2 and 11 respectively. This reaction appears to offer a clue to the elucidation of the nature of "hydrolytic" adsorption.

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Helium and Airships.

IN a recent article on the British dirigible programme (NATURE, December 6, p. 842) it is stated "The United States naturally hold for themselves the only supplies of helium. . . ." Of course, it must be admitted that the United States authorities, ever since 1918, have pressed with vigour the investigation of their resources of helium, its production and use. At the present time the two large dirigibles, the *Shenandoah* and the *Los Angeles*, are inflated with helium. Processes of repurifying the gas in them have been devised and applied. A more efficient and cheaper method of production than the present Linde process has been worked out by the U.S. Bureau of Mines, and much valuable scientific data have been accumulated.

It should not be forgotten, however, that Prof. J. C. McLennan's investigation in 1916–1918 (see NATURE, August 12, 1920, p. 747) showed that helium could also be produced in Canada, and an experimental extraction plant was successfully operated in Calgary, Alberta, for a few months until financial support was no longer forthcoming. Since that time, the Canadian Department of Mines, in the course of a general investigation of natural gas in Canada, has confirmed and brought up-to-date the facts concerning the helium resources of Canada. Although few gases have been found with so high a helium content as the richest American natural gases, it is believed that commercial sources are available. To prove this, the re-establishment of an experimental helium extraction plant in Canada is essential. In this plant the best process for treating the different types of Canadian natural gas could be determined, and the actual cost of commercial production could be found. The helium produced, until such time as it was required by the authorities, would be of great value to supply to the many university and industrial research laboratories throughout the Empire which are needing it for experimental purpose.

In connexion with a later paragraph of the same article, referring to the useful life of German airships and the interest with which the progress of the *Los Angeles* (ZR3) and the new British craft will be observed, no reference is made to the great success already obtained with the helium-filled *Shenandoah*, which has now been in commission since the summer of 1923. In this period it has made many long voyages, including one transcontinental trip of more than 9000 miles. Although torn from its mooring mast with the framework damaged and two gas bags ripped, during a severe storm in January 1924, it eventually returned to its hangar. A hydrogen-filled ship subjected to the same conditions would probably have been destroyed.

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Molecular Dimensions of Celluloid.

MAY I amplify and comment upon Mr. Garnett's letter in NATURE of January 10, page 51? I have often been impressed, more particularly during the last few months in collecting material for a small book on cellulose ester solutions, with the want of precision shown by physicists in defining the materials used in experiments on nitrocellulose and its technical derivatives. Two eminent examples will suffice. My friend Prof. Coker entitled a most important paper, which he published in collaboration with Mr. Chakko, "The Stress-Strain Properties of Nitrocellulose and the Law of its Optical Behaviour,

whereas the material on which his experiments were carried out was xylonite or celluloid containing at least a fifth of its weight of camphor and rather more than that proportion of camphor by volume (Phil. Trans., A, vol. 221, pp. 139-162). Another old friend and teacher, Prof. Filon, in a paper which he and Mr. Jessop published on the stress-optical effect in transparent solids strained beyond the elastic limit (Phil. Trans., A, vol. 223, pp. 89-125), after deducing the existence in xylonite of a mixture of two materials with different elastic and plastic properties (page 112), speaks in his summary (paragraph (2), page 123) of "nitrocellulose under simple tension." The distinction between xylonite and nitrocellulose in this relation is really important, as it is probable that the elastic and stress-optical properties of nitrocellulose alone would be markedly different from those of xylonite.

Mr. Garnett refers to celluloid as the basis of photographic film. This is true, but photographic film is quite different in its composition from celluloid in the more massive form, such, for example, as was used by Prof. Coker and Prof. Filon. Not only is the nitrocellulose in celluloid film more highly nitrated, but the proportion of camphor is smaller. Even celluloid film, however, does not contain nitrocellulose so highly nitrated as to correspond with what used to be called cellulose trinitrate. This would contain 14·1 per cent. of nitrogen, while the nitrocellulose in cinema film usually contains from 12·0 to 12·5 per cent. of nitrogen. Lastly, having supervised the manufacture of a certain amount of a substitute for celloidin during the War, I should naturally agree that it is a carefully purified product, but I should not like to say that it approaches to a single chemical substance.

The analysis of celluloid, provided the camphor used in its manufacture is optically active, is not exceedingly difficult and can be carried out with moderate accuracy, and it would add greatly to the ultimate value of physical measurements made with the material if its composition were always given. In the instance which forms the subject of Mr. Garnett's criticism, one would like to know not only the chemical characteristics of the nitrocellulose used, but also as many physical properties as possible, more especially perhaps the fluidity-concentration curve in two or more chosen solvents. It is greatly to be desired that all researches on colloid materials should seek to correlate at least two different properties.

FOSTER SPROXTON.
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Essex, January 13.

The Need for a Universal Language.

I READ President Coolidge's address and Prof. Gardner's letter on this subject in the *Times* of November 21, 1923, and, now, your report of Prof. R. G. Kent's article (NATURE, January 3, p. 23), with interest, but there are two points connected with the matter to which attention may usefully be directed. One of the principal causes of the neglect of Latin and Greek in schools is the world-wide recognition of the importance of a knowledge of the so-called "modern languages." This is a blind argument. It is as if a student, desiring to acquaint himself with the contents of the top shelves in a library, deliberately ignored and neglected the ladder by which they are reached, and tried to get at them by jumping. Those who are old enough to have been at school in the days of compulsory Latin and Greek amply realise the enormous value of even an almost forgotten grounding in the classics, in the acquisition of any foreign language—this point requires no labouring. I wish to point out the great value of having at some time been taught the phonation of an unfamiliar text, like Greek, when one comes in later life to study any Oriental language—or, for obvious reasons, Russian. The mind is no longer terrified by the aspect of unknown characters, and thus the first great, and often repellent, difficulty is recognised as being really of little account.

A still more important point arises in connexion with the periodically recurring agitation for a "Universal Language." The obvious fallacy of founding such "languages" as Volapuk, Esperanto, Ido, and the others upon the native language of their protagonists requires no argument. The result is that each country pleads for its own universal (?) language, and we are back again where we started from.

But Latin is, and always has been, *the* universal language. Its claims are fully set forth in the report of the Committee of the British Association (1921, p. 390). I cannot, however, agree with the "Conclusion" of the Committee. Down to, and even in, modern times, knowledge intended to be of world-wide distribution has been, and is, conveyed in Latin—and the worse the Latin is, the easier it is to understand. I am not one of those who plead the rarefied joy of reading the great Latin authors in the original tongue—we have not the time, and existing translations are amply satisfactory—but we do want a language of universal intercommunication, and the appalling Latin of the Roman Church (cf. the Bollandists' "Lives of the Saints") is entirely sufficient for the purpose. I have proved this in many obscure corners of the world, using a doctor, chemist, priest, or librarian—any one in a black coat, in fact—as an interpreter.

If this were once realised and recognised, I see no reason why within a short time one may not ask of any wayfarer in a Magyar town:

"Quae est via ad vapor-stationem?"

And receive the reply: "Primus ad dextram et tunc tertius ad sinistram."

Atque Felix semper ambulabat.

(O, Shade of Arnold!)

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Balfour Stewart's Advances in Radiation Theory.

THE extremely interesting notes by Sir Arthur Schuster in a recent number of NATURE (January 17, p. 87) may possibly leave with the ordinary reader an impression that Balfour Stewart's contributions to the establishment of the laws of natural radiation were slighter than was actually the case. The considered opinion of the late Lord Rayleigh, set out in *Phil. Mag.*, i. 1901, pp. 98-100, or "Scientific Papers," iv. pp. 404-5, can hardly be gainsaid. In Stewart's discussion of radiation in an isolated enclosure containing moving bodies, his expressed conviction, that the second law of thermodynamics is only satisfied through the action of mechanical forces necessary to maintain the motion, is only turning round the other way the considerations employed by Boltzmann and by Wien long after, who by means of these mechanical forces (namely, the reaction of radiation pressure) combined with the second law of thermodynamics, deduced the law of structure of natural radiation. Reference may also be made to footnotes appended to the reprint of Stokes's cognate papers in "Math. and Phys. Papers," iv. especially p. 136.

JOSEPH LARMOR.
Cambridge, January 16.

The Tsetse-Fly Menace in Tropical Africa.

By Major A. G. CHURCH, D.S.O., M.C.
(Member of the East African Parliamentary Commission).

THE inauguration of a campaign against the tsetse-fly in Tropical Africa is long overdue. Tropical Africa is becoming progressively important as a source of food-supply and raw materials for the Eurasian and American nations. The world at large, therefore, cannot contemplate with equanimity the domination by "fly" of a large proportion of the most fertile lands in the tropics. What is most disquieting, moreover, is the fact that the area under "fly" is increasing and not diminishing. Hitherto, no colonial government has either had the means or has considered it worth while to adopt methods for its extermination like those employed by Gorgas in the Panama Canal zone against the mosquito. Yet, in effect, the ravages due to glossinæ are, in some respects, more deadly than those due to anophelines. Malaria has been largely robbed of its former terrors. It can be prevented and cured. But up to the present no certain preventive remedy has been found for human sleeping-sickness and animal trypanosomiasis, although cases of sleeping-sickness have been cured by atoxyl, Bayer "205," or tryparsamide.

From reports supplied to the Parliamentary Commission by the scientific staffs of the five East African territories, Northern Rhodesia, Nyasaland, Tanganyika, Uganda, and Kenya, it appears that the fly-belts are continuous from the Egyptian Sudan to Southern Rhodesia. Two-thirds of Tanganyika are under "fly," and this area is increasing owing to the encroachments by fly over the contiguous cultivated areas. Fly areas which a few years ago were confined to the north-eastern district of Northern Rhodesia now extend as belts through Nyasaland to the lake and make the southern and northern movement by land of cattle from the important district of Mombera an impossibility. Most of the islands on Lake Victoria Nyanza are depopulated, some compulsorily as in the case of the Sese[1] islands, others voluntarily, owing to the ravages of sleeping-sickness.

The members of the Parliamentary Commission, on their journey from Dar-es-Salaam along the central Tanganyika Railway, were struck by the desolation of a long stretch of country between Kazi-Kazi and Tabora, a country which was formerly thickly populated. Along the eighty miles of road from Tabora to Kahama men and women passed in procession carrying head-loads of ground nuts to Tabora market, primarily due, not to the conservatism of the native, but to the impossibility of using ox-wagons in a fly district. The following day they passed along thirty miles of road approaching Shinyanga without seeing a native or a head of cattle, although the route lay through a district of exceptional fertility. Half the journey from Shinyanga to Mwanza provided the same melancholy testimony of the disastrous effect of tsetse. In one sultanate in this district the population has gone down from thirty thousand to three thousand in the past few years, due entirely to the destruction of cattle by this insect pest. For the natives, who still measure their wealth by the number of cattle they possess, will not remain in a district where the cattle die. Mr. Swynnerton, Chief Game Ranger to Tanganyika Territory, states that the fly is known to have advanced in seven places in one district during the past year. The largest cattle area in Tanganyika Territory is threatened by the advance of *Glossina swynnertoni*.

It is, however, not merely the destruction of cattle, but the effects which such destruction has upon the natives themselves and the country, which are now causing the gravest concern to the authorities. Major G. St. J. Orde Brown, an administrative officer with years of experience, attributes to this agency the degeneracy and degradation of the north-eastern branch of the Yao tribe compared with the main tribe. The loss of their cattle has led to the breakdown of tribal customs and the decline in their morality. There is another serious factor which must be taken into account. The lines of communication for the greater part of East Africa must necessarily pass through fly areas. For some years at least the economic products must be carried over roads. At the present time most of the roads are unfit for motor transport. The use of ox-wagons becomes, therefore, a matter of first importance, but at present their use is circumscribed by the fly-belt. In the past two or three years there has been a remarkable increase in the productivity of the native in most parts of East Africa. If this is to be maintained, the districts through which the roads pass must be cleared of fly; for the present method of head porterage is totally inadequate, and traders are already complaining that their up-country stores are filled to overflowing.

It must not be imagined that this problem has not been viewed with the gravest concern by medical and veterinary officers on the spot, or that the home authorities are not aware of the menace of the tsetse-fly. The work of Sir David Bruce is well known. So long ago as 1902 the Royal Society sent out a commission to investigate trypanosomiasis. Much individual and team work of great importance has been done since then. In 1914, Dr. J. O. Shircore, in a contribution to the *Bulletin of Entomological Research*, formulated a plan for the extermination and control of fly. He showed that the primary fly centres were to be found where moisture and game persisted throughout the year. They were to be found, in other words, where light forest, short grass, open glades, and water existed. Furthermore, from these primary centres the fly extended to secondary centres, and bush cover was essential as a communicating link between primary and secondary centres. He suggested that the secondary centres must first be attacked by cutting off their bush connexions with the primary centres, and that when the primaries had been isolated, wholesale and extensive burning during the dry season should be undertaken on a heroic scale. Unfortunately, the War intervened, and it was not until recently that Mr. Swynnerton's energies were applied to the methods suggested by Dr. Shircore. But Mr. Swynnerton has gone further. There is no ques-

[1] The natives are now being encouraged to return to these islands.

tion about the dependence of the fly upon blood. The further assumption was made that the fly cannot exist without game. Mr. Swynnerton has shown this to be untrue. In the Dar-es-Salaam district there is no game, but there are three kinds of fly known to exist. The fly apparently feeds upon human beings and animals indiscriminately.

Mr. Swynnerton proposes to exterminate the fly by bush burning, and he has already achieved a considerable measure of success in the Shinyanga district. There he was fortunate in obtaining the collaboration of a native chief of character and understanding and energy. Makweia, the chief in question, once convinced of the importance of fly extermination, called his people together and informed them that they were to take part in a campaign against a more insidious enemy than man, that they must discipline themselves and respond to instructions as if they were engaged in tribal warfare. With the assistance of fifteen thousand natives, Mr. Swynnerton was able to undertake bush clearings by means of burning and cutting on a vast scale, with the result that a large area of country will this year be under cultivation and a hitherto desolated district be re-populated and re-stocked.

In the neighbouring province of Uganda, Drs. Carpenter and Duke, and Mr. Fiske, are carrying out research of the greatest importance. Only a few years ago, owing to the death of more than two hundred thousand natives of sleeping-sickness, Sir Hesketh Bell removed the remaining population from the lake islands and the lake shores, an extremely costly undertaking and one which has been responsible since for much unrest among the detribalised natives. Mr. Fiske is carrying out single-handed an entomological survey of Uganda. Dr. Duke is at the moment engaged upon the important task of classifying human and animal trypanosomes and the connexion between human and animal trypanosomiasis. Dr. Lamborn, who has been working in Nyasaland, has for some time been engaged in the task of breeding parasites which attack the tsetse-fly with the object of exterminating tsetse by this measure.

It is clear, however, that unless all these territories make a co-ordinated and combined effort to deal with the tsetse-fly menace, the achievements in one territory will be negatived by the indifference in others. It will be useless, for example, to exterminate the fly in Uganda and Tanganyika portions of the Lake territory, if Kenya undertakes no similar campaign in the Kavirondo district. Sir Robert Coryndon, Governor of Kenya, has stated that "the leading experts who deal with the problems of sleeping-sickness and tsetse-fly control are servants of Uganda, and there is little organised or encouraged co-ordination or exchange of views between them and their technical colleagues in Kenya and Tanganyika Territory." In Kenya colony, as a matter of fact, there is practically no staff available for work in connexion with sleeping-sickness or animal trypanosomiasis.

There is every indication, however, of a changed attitude. In every territory the Governors impressed upon the members of the Parliamentary Commission the necessity for a co-ordinated plan of campaign in the interests of their territories. At the present time the Imperial Bureau of Entomology is engaged in formulating a plan of campaign of research into tsetse-fly problems. It is quite obvious that the problems are so vast as to be beyond the capacity of less than ten men to deal with them. As Dr. Andrew Balfour said in an address at the Anderson College of Medicine on October 14, 1924: "We are not yet certain as to whether *Trypanosoma gambiense* and *T. rhodesiense* are the same parasite or different species. We still quarrel over the vexed question of the big game, or perhaps one should say the wild animals, as reservoirs of infection. We know precious little about immunity to the disease; we are not at all sure as to the habits of Glossinæ, and we are still trying to discover which is the best drug and how we can best prevent this mysterious complaint." The matter is one of such great importance that it is to be hoped that Major Ormsby-Gore's suggestion, that a large working commission of experts be appointed to undertake the necessary research work in consultation with the men on the spot, will be acted upon. Such collaboration must form the basis of any heroic measures for tsetse-fly extermination.

Biographical Byways.[1]

By Sir ARTHUR SCHUSTER, F.R.S.

5. LUDWIG BOLTZMANN (1844–1906).

I DID not know Boltzmann intimately, but can tell of some incidents in his life and quote from passages in little-known publications, which mark his impulsive and vigorous character, and illustrate some features of his personality that would be missed by any one acquainted only with his scientific writings. As a young man twenty-six years old, who had only published one or two minor papers, Boltzmann called on Königsberger, then professor of mathematics at Heidelberg, mentioning incidentally that he had discovered an error in one of Kirchhoff's mathematical papers. Königsberger told him that this was a good opportunity of becoming personally acquainted with one of the great men of the time. "Call on Kirchhoff," he advised. "Lead the conversation to the subject, and explain the nature of his error."

Boltzmann acted with characteristic impetuosity. Within an hour Kirchhoff, who always took a great pride in his accuracy, came rushing into Königsberger's room in a state of extreme agitation. "A most distressing thing has just happened to me," he exclaimed. "A young man, of whom I know nothing, enters my room, and before he has time to shut the door behind him, calls out: 'Herr Professor, Sie haben einen Fehler gemacht!'" I give the tale on Königsberger's authority.

Boltzmann made his reputation during sixteen quiet years at Gratz, but it was a grief to him that his lectures did not attract a more numerous audience, and he was always looking out for a university where

[1] Continued from p. 127.

budding mathematicians were as plentiful as chemists or lawyers. He went to Munich; next to Vienna, but still not being able to satisfy his ambition he was drawn again to Germany, the country towards which he had strong political leanings. He received an offer of a professorship at Berlin, and I was informed by one in a position to know, that the faculty of science at that University received a series of telegrams and letters, few of the latter being dated, some accepting, some refusing, and no one knew in what order they were dispatched. Ultimately, the negotiations were broken off, and Boltzmann went to Leipzig, but he soon longed to return to Vienna. That University would have welcomed his return, but the Emperor declined to call him back, on the ground that an Austrian subject who had accepted foreign service was disqualified from ever again finding employment in his dominion. Mr. von Hartel—who at the time was Austrian Minister of Public Instruction—told me how for a considerable time he stood helpless between two fires: on one side the insistence of the University which wanted Boltzmann, on the other the obstinacy of the Emperor who remained firm in his refusal. At last von Hartel decided to make a final effort, and asked the Emperor for permission to put a hypothetical question. This being granted, the question put was: "If your Majesty's favourite ballet dancer were to run away, and after a year's absence wanted to return, would you have her back?" The Emperor admitted that perhaps he might.

"I beg to submit," said the Minister, "Boltzmann is to the University what your favourite ballet dancer is to you."

Francis Joseph laughed and gave in.

I do not tell the story merely as an amusing episode, but because the image of Boltzmann's ungainly figure trying to practise ballet steps recalls to my mind the occasions—fortunately rare—when Boltzmann indulged in humorous writing. He had travelled much, visiting America, Constantinople, Athens, Smyrna, and Algiers, and in one of his writings tells us how he had always declined to publish an account of his experiences, but that after returning from a lecturing engagement at the Berkeley University in California, the temptation proved too strong, and an article appeared under the title of "Reise eines deutschen Professors in Eldorado." His jokes are driven into us with hammers. Eating and drinking, followed by drinking without eating, form a favourite subject, because to him—as he says—the most important consideration in travelling is to keep one's digestion right. But he might have spared us the gross and unrepeatable allusions to the poisonous effects of pure water and the boast that his otherwise good memory for figures fails when he tries to remember the number of glasses of beer he has imbibed! The astonishing part of his recital is, however, its want of accuracy. In an account of a dinner party given in his honour at the country seat of a wealthy lady near San Francisco, he tells us how it began with blackberries, which were followed by oatmeal: "an indescribable mixture of paste and oats, which might be used for fattening geese in Vienna were it not that the geese would refuse to eat it." The enumeration of subsequent dishes makes it clear that it was really dinner and not breakfast that was meant. On scientific matters also he falls into error, as when he tells the reader that the moons of Mars were discovered at the Lick Observatory.

In great contrast with this heavy and vulgar joking, the other matter contained in the volume of popular writings shows us Boltzmann as a highly cultivated man, enthusiastic about poetry, fond of music, not averse from expressing an opinion on art, and with a leaning towards metaphysical speculations. An article on flying written in 1894 is specially interesting, and the following passage shows considerable foresight:

> "It is scarcely doubtful that a dirigible air-ship would create an expansion of intercommunication compared with which that due to the introduction of railways and steamers is negligible. Our armies of to-day would be as helpless against the dynamite thrown down from flying machines as those of Rome would have been against breechloaders. The customs' regulations would either have to submit to unthought-of alterations or to be abolished altogether."

Astonishing, as coming from an Austrian, is the German chauvinism to which Boltzmann occasionally gives expression. It appears in his article on aviation, and in a passage in the description of his Californian journey. After criticising the Berlin Academy and expressing regret that, since the death of Helmholtz and other distinguished Germans, American students prefer to study in Cambridge and Paris rather than in Berlin, he adds that the United States, and with it the whole world, will suffer in consequence.

On scientific matters his judgment is nearly always fair and uninfluenced by national feeling; at any rate so far as Great Britain is concerned. Here is an example of his style of writing when he is carried away by his subject:

> "A mathematician will at once recognise the authorship of the writings of Cauchy, Gauss, Jacobi or Helmholtz, just as musicians will distinguish between Mozart, Beethoven and Schubert on listening to the first few notes of a composition. Perfect elegance of construction, though occasionally supported by weak foundations, belongs to the French; the greatest dramatic vigour to the English—and above all to Maxwell. Who does not know his dynamical theory of gases? First the variations of velocities are deployed in majestic array; next enter from one side the mathematical conditions and from the other the equations of central motion. Higher and higher rises the chaotic flood of formulæ until suddenly four words resound: 'Let n be 5,' and the malignant demon V vanishes, just as in an orchestra a wild overpowering bass may suddenly be reduced to silence. By a magic wand, an apparently hopeless confusion is reduced to order. There is no time to explain why one or the other substitution is made; let him who does not feel it in his bones put away the book. Maxwell is not a conventional musician who has got to explain his notes; obediently his formulæ deliver torrential showers of results, until we reach the final surprise effect. The problem of the thermal equilibrium of a heavy gas is solved, and the curtain falls. I recollect Kirchhoff's

remark to me: 'This is the way to deal with gas theories!'"

It is not perhaps fair to examine this passage too closely, as a certain amount of poetic license must be forgiven—but Maxwell did not write, "Let n be 5"; he wrote, "It will be shown that we have reasons from experiment to believe that $n=5$." Sixteen words instead of four; but scientific accuracy has no chance when rhetorical effect is in danger, as the late Lord Rayleigh remarked to me when I criticised a statement of a distinguished relative of his.

Shortly after his final return to Vienna, Boltzmann committed suicide. With him passed away a man of great intellectual power and a fascinating personality. His predilection for Schiller's poetry indicates a strain of morbid sentimentality, and if his humour was somewhat primitive and his technique crude, he paid dearly for his disappointments in life.

The Talking Film.

By Dr. E. E. FOURNIER D'ALBE.

THE demonstration of the De Forest phonofilm at the Royal Society of Arts on November 26, 1924, and its recent exhibition at the Royal College of Science during the Physical and Optical Societies' Exhibition, showed that the old problem of producing a motion picture endowed with its original sound effects has been brought within hail of a perfect solution.

As Mr. C. F. Elwell remarked in the course of the demonstrations, the De Forest phonofilm was preceded by many partial solutions of the same problem.

The first "talking picture" was known as the "cameraphone"—the method employed being to make the motion picture while a stock wax cylinder type of record was played. The actors sang, or pretended to sing, and the camera photographed the lip motion. The novelty of this method made it popular for a time.

The "kinetophone" of Thomas A. Edison was the next step in advance. Better results were obtained for the reason that the phonograph record was made simultaneously with the making of the motion picture negative. The synchronisation of the sounds with the lip motion was good, but the reproduction of this synchronisation was difficult, as so much depended upon the skill of the operator, who generally had another man to start the phonograph record. If mechanical or electrical means were supplied it was difficult to keep the phonograph record and the film exactly in step. If a portion of the film became mutilated the difficulties became greater. Notwithstanding these objections the "kinetophone" enjoyed quite a large measure of popularity. But this popularity waned, and finally no more was heard of this method.

It became evident that no solution would be practically workable until a perfect synchronism between sound and movement could be automatically established. It was, therefore, necessary to look for other methods of reproducing sound. Among these the most promising was Ernst Ruhmer's "photographophone" of 1907, in which a "speaking arc" projected light through a slit on to a moving photographic film. The audio-frequency fluctuations of the arc were thus recorded as a series of lines stretching across the film in a direction normal to its displacement, and Ruhmer succeeded in reproducing the original sound by transmitting a beam of light through this record to a selenium cell.

It was a modification of this method which Dr. Lee de Forest used for his talking motion picture. In common with Berglund and other experimenters, he confined the photographophone record to a narrow portion of the standard one-inch film as used in cinema theatres. But his method of producing the record has many original features. He uses a double-button ("push-pull") microphone with a duralumin diaphragm between the two buttons. Such a microphone is capable of carrying 20 milliamperes. It is placed about 5 feet from the speaker, and responds to all frequencies from 30 to 7000 per second.

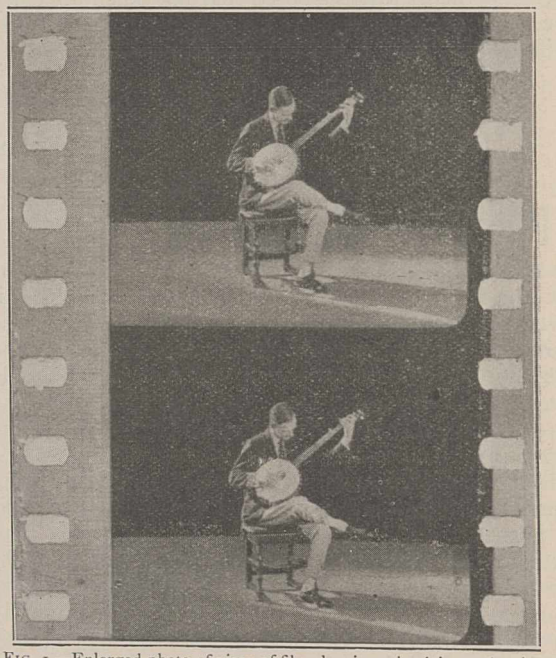

FIG. 1.—Enlarged photo of piece of film showing a banjoist performing. The cloudy strip at the left of the photograph is the music record.

An even better device is a condenser microphone with a capacity of 4 milli-microfarads, which is found capable of a range of 25 to 8000 vibrations per second.

The distortionless amplification of the electrical pulses yielded by the microphone is nowadays a comparatively easy matter, thanks largely to Dr. Lee de Forest's own previous inventions.

The next stage is the conversion of the electric pulses into fluctuations of actinic light. This conversion is neatly accomplished by means of a vacuum tube in which an electrode covered with barium dioxide discharges a current of some 5 milliamperes under a pressure of 150 volts through helium at 100 mm. pressure. This vacuum tube is called a "photion." It responds instantaneously to the variations of the

amplified microphone current, and as its glow is of a highly actinic wave-length it produces a well-marked effect upon the film, upon which it shines through a fine slit.

It remains to reconvert the photographic record into sound. For this purpose Dr. de Forest prefers to use photo-electric cells instead of selenium, mainly on account of their more constant zero, though it is difficult to see why that should be of any consequence in the case of intermittent light. Of the various forms of photo-electric cells he prefers T. W. Case's "thalofide" (thallium oxy-sulphide) cell, which has a resistance of from 5 to 500 megohms, and works best with some 140 volts on the electrodes.

The moving film passes a fine slit, 0·038 mm. wide and 2·3 mm. long, illuminated by a small incandescent lamp. The electric fluctuations produced in the circuit of the photo-electric cell are excessively minute on account of its high resistance, but four or five stages of amplification suffice to enable them to operate a loud-speaker, and the actual volume of sound heard at the demonstrations showed that not much difficulty need be anticipated on that score. The remaining difficulty appears to be the distortion introduced by the loud-speaker. Whether that can be entirely eliminated remains to be seen. The rapid progress made in the construction of loud-speaking telephone receivers in recent times gives room for optimism in this direction. In the banjo solo (see Fig. 1) no distortion was perceptible, but President Coolidge's speech was marked by an exaggerated American accent, most of which must have been due to the manner of reproduction. This fact may obtrude itself less upon an American audience than upon Britishers, but if it were to be perpetuated, the vogue of the American film in England would be seriously jeopardised.

It has often been objected that nobody wants the talking film; that silent film acting is an art in itself; that the film has an international appeal, which would be lost by introducing speech and local accent; and that the art and training of even the greatest film "stars" would become useless if the film were to throw off its mantle of silence. But the most probable issue is that the talking film will develop its own art and its own industry in its own way, and although it will no doubt evolve its own conventions and limitations, it is likely to win a permanent place among the amenities of civilisation.

Obituary.

Abbé Rousselot.

THE Abbé Rousselot passed away on December 16 last. Born in 1846 at St. Cloud (Charente), he was ordained in 1870 and became one of the teachers in the Petit Séminaire de Richemont. Leaving his pastoral work on account of his health, he devoted himself to language studies under Brachet, Bréal, and Bailly. He became convinced that "phonetics should take as its basis not dead texts but the living and speaking man." In his peregrinations from parish to parish he became keenly observant of the fact that "sounds change with perfect regularity from one region to another"; he came to believe that "phonetics could be something more and better than a descriptive science of spoken sounds, that it ought to be geographical." Noticing the differences in pronunciation among three generations of his own family living together, he got the idea of genealogical phonetics. This thought led to the foundation of the science of experimental phonetics.

Coming to Paris in 1880, Rousselot was initiated into questions of Romance linguistics by Gaston Paris and Michel Bréal, to the physical sciences by Branley and Becquerel, to physiology by Déjerine, and to fine instrument work by Koenig. Finding it impossible to detect the finer details of spoken sounds by the ear, he complained to Gaston Paris, who said, "Only mechanical registration will give you accurate knowledge. Attempts have been made in Marey's laboratory. Go and see!"

In 1886, Rousselot devised an electric speech recorder with which he made investigations of his native dialect. In 1889 the first course in experimental phonetics was given at the Institut Catholique de Paris. In 1891 he obtained his Doctorat ès Lettres before a committee hostile to experiments—the first doctorate in experimental phonetics. He was the inspirer of *La Parole* and later the founder and editor of the *Revue de Phonétique* (1911–1915). His great work, "Principes de phonétique expérimentale," was finished in 1908.

In 1897, G. Paris and Bréal succeeded in founding a laboratory of experimental phonetics at the Collège de France; it was annexed to the chair of comparative grammar (Bréal) and Rousselot was made its director. In opening the laboratory, Prof. Bréal did not hesitate to declare that "the moment has arrived when one could no longer think of phonetics as anything else than experimental"; he proclaimed that from now onward "it would be necessary to collect facts instead of announcing *a priori* principles."

In this heroic age, the Abbé and his pupils worked with insatiable ardour at inventing apparatus, developing methods, and collecting facts. They had to face the opposition of the whole world of linguists, grammarians, and philologists, but with ready pens they fired their bombs of explosive facts at the army of opinion and guesswork.

Rousselot had several admirers and friends of the older generation outside France. Foremost among them was the linguist and phonetician, Viëtor of Marburg, who invited Rousselot to lecture there and insisted on introducing experimental methods in a modest way. Under his auspices a phonetic cabinet was established with Calzia, a pupil of Rousselot, as chief. The speech pathologist Gutzmann developed an extensive laboratory on Rousselot's lines in Berlin in connexion with the speech clinic. Coming into phonetics from another side, I had the privilege of spending a few weeks in Rousselot's laboratory in the early days; his spirit and his methods have been the inspiration in all I have attempted since.

Few of Rousselot's pupils have succeeded in following him. The environment has usually not been favourable, and they have seldom had the inspiration that

leads to self-sacrifice for an ideal. The most successful pupil is probably Prof. Calzia in Hamburg, who, in a favourable environment created by Meinhoff, has built up the most completely equipped laboratory of the present day. A favourite pupil, Prof. Chlumski, has now a laboratory in the University of Prag. His latest pupil and assistant, the Abbé Millet, has been appointed to take charge of Rousselot's laboratory.

In establishing experimental or laboratory phonetics, Rousselot's scientific influence has been decisive. In France, laboratory work has been begun at Grenoble and Montpellier. Work with Rousselot's methods has also been introduced into the Sorbonne. In Germany, the large laboratory at Hamburg and the pathological speech laboratory at Berlin are based on his methods; smaller beginnings are found in other universities. In the United States I built up an extensive laboratory at Yale University, but the work was dropped after my departure. The demand for this work in that country is now pressing, but no men can be found who have learned the methods. In England I have for twelve years conducted researches on speech in nervous diseases, using Rousselot's graphic method, and I scarcely need say that in Vienna the work is based on Rousselot's ideas and methods.

In one way it might be said that Rousselot just lived to see the realisation of his ideal as expressed by Prof. Bréal. The adjective "experimental" need no longer be used; there is no other kind of phonetic science. This means that in investigating living speech, all judgments by the ear become quite subordinate to the study of registrations. But no one could for a moment think of any antagonism between the phonetics of present-day speech and the science of historical phonetics treating of sound change in the past. In fact, what experimental phoneticians have accomplished in their domain is a small matter in comparison with the magnificent work of past and present linguists. What Prof. Bréal meant to point out was probably that when the historical phoneticians wish for explanations of the past facts of sound change, they must seek the sources of similar processes in living speech; this information can be obtained only through experimental phonetics. It behoves experimenters, however, to recognise that in this direction they have been able to advance only a very small way.

Experimental work was begun by men in other sciences, such as Brücke, Donders, Hermann, Helmholtz and others—nearly all physiologists, but the unification of effort into a science was the work of Rousselot. He is fully entitled to be called the "Father of Experimental Phonetics."

E. W. SCRIPTURE.

SIR GUILFORD L. MOLESWORTH, K.C.I.E.

THE death on January 21 at the age of ninety-six of Sir Guilford Lindsey Molesworth removes one whose name has long been a household word among engineers. To few it is given to become a leader in his profession, but Sir Guilford Molesworth not only rose to distinction and became the president of the Institution of Civil Engineers, but he also compiled a standard work of reference which has been carried into the remotest corners of the earth. Published first in 1862, his "Pocket Book of Engineering Formulæ" passed through no fewer than twenty-four editions before 1900. A "Molesworth" was to be found in the pocket of practically every engineer, and its pages have been thumbed in many a difficult situation, knowing that its contents could safely be relied on.

Born in Southampton on May 3, 1828, nine years before Queen Victoria came to the throne, Sir Guilford was the son of the Rev. J. E. N. Molesworth, vicar of Rochdale, grandson of John Molesworth the mathematician, and was a descendant of the first Viscount Molesworth, created in 1716. He was educated at King's School, Canterbury, and at the College of Civil Engineering, Putney, and then was apprenticed to Fairbairn, the leading engineer of his day. He gained experience in railway engineering on the London and North-Western Railway, and London, Brighton, and South Coast Railway, and during the Crimean War was employed in Woolwich Arsenal. In 1859, at the age of thirty-one, he went out to the East in connexion with the first railway in Ceylon: that from Colombo to Kandy. Three years later he became chief resident engineer of the line, and in 1867 Director of Public Works. From Ceylon, in 1871, he passed into the service of the Indian Government as technical adviser on railways and held that position until 1889, receiving the honour of knighthood in 1888. He had seen active service in Afghan and Burma, and after his retirement was employed in various government missions, such as reporting on the Uganda Railway. He also became known as a writer on the decimal system, bimetallism, taxation, and other subjects. In 1904, at the age of seventy-six, he was chosen to succeed Sir William White, the great naval architect, as president of the Institution of Civil Engineers, and his address contains an admirable summary of the public works of India. Prefacing his remarks by a saying attributed to Macaulay to the effect that "a broken head in Coldbath Fields created greater excitement in England than three pitched battles in India," he reviewed the progress of the irrigation works and the railways of India, and referred to the Indian Government as "the purest administration in the world." Speaking of the resources of India, he said its coal fields covered an area of 35,000 square miles and contained some 20,000 million tons of coal.

A man of extraordinary physical energy, when in Uganda in 1899 Sir Guilford cycled 46 miles on the hottest day of the summer "without experiencing any fatigue," and in the early part of the War, when well over eighty years of age, he served as a skilled mechanic in one of the munition shops of Messrs. Vickers at Crayford.

WE much regret to announce the death on January 26, at the age of seventy-one years, of Sir James Mackenzie, F.R.S., honorary physician to his Majesty in Scotland. Sir James will be remembered as a pioneer investigator on cardiac disease, and only recently was awarded the Charles Mickle Prize offered by the University of Toronto for the best work to advance sound knowledge of a practical kind in medical art or science during the past ten years.

Current Topics and Events.

DURING the past week there have appeared articles upon a method of permanently moth-proofing wool, by the use of a substance of undisclosed composition, the product of a German dye firm. These were supplemented by a lecture given at Australia House on Friday, January 23, in which the merits of this process were elaborated. The tests made were on wool and furs, large quantities of eggs of the clothes moth being employed upon treated and untreated material under identical conditions. Two forms of treatment are used—one a water-soluble material for goods that can be treated with water; the second, soluble in benzene and suitable for the dry-cleaning process. It is claimed that after the water process, dry cleaning will not affect the goods; but dry-cleaning articles already treated by the dry-cleaning method will remove the protective substance. Prof. H. Maxwell Lefroy has been good enough to favour us with the following comments upon the process: "The nature of the water-soluble substance has been actually known in England for more than a year: tests have been carried out in London with this material for eighteen months, and two new classes of moth-proofing substance have been discovered, which have all the merits of this material and in addition are far less costly and far simpler to apply. As these are the result of inquiry instigated by commercial interests, it is not possible to disclose their composition; but it is unfortunate that the columns of reputable daily papers should be available for a description of a secret preparation under the guise of 'news,' made by a foreign firm. In this particular instance, scientific research in England appears to be ahead of that in Germany but, as usual, has not been backed by resources in any degree comparable to those employed by the firm in Germany now vigorously exploiting a method that has already been superseded. One may anticipate the adoption of the German substance in view of the vigorous publicity and the greater commercial enterprise in such chemical production."

A COMPREHENSIVE scheme for the publication of abstracts of biological research on an international scale has been developed in the United States and has received general support from scientific institutions in that country. The proposals were put before the British Association at Toronto last summer, and a committee of the Royal Society is also considering the matter. The subject was discussed at a representative meeting of British zoologists held in the rooms of the Zoological Society of London on January 10, when the following resolution was passed unanimously:—"This meeting of British zoologists is of opinion that it is in the highest degree desirable that an effort should be made to extend the system of publishing comprehensive abstracts of zoological literature, and we desire to place on record our great appreciation of the work that has been done to this end by the American Committee for *Biological Abstracts*. We are, however, also of opinion that the scheme that has recently been submitted for our approval is open to serious objection in various directions. Only some of these need here be mentioned, namely: (1) The magnitude of the work involved appears to have been under-estimated. (2) The financial arrangements so far made public are obviously quite inadequate for the purpose, which is a most serious point; it would be folly to assume that any publication of abstracts in pure science can be made self-supporting, and no scheme of this kind should be put into operation until satisfactory arrangements have been made for some permanent endowment. (3) The proposal to publish the abstracts of the whole of biological literature in a single journal is unsatisfactory; such a journal would be extremely cumbersome and highly inconvenient for all classes of workers. Bearing in mind the probable great increase of literature in the future, a much sounder plan would be to institute separate journals dealing with convenient sections of scientific work. (4) The abstracts will be very much shorter than those now being published in this country, and this brevity will seriously detract from their value to most workers. (5) The estimates for indexing are entirely inadequate. (6) No provision has been made for the utilisation or co-ordination of the various biological abstracting organisations that already exist in this country and deal adequately with several branches of science; apparently it is proposed to reduplicate their work, but in a less useful form. In the circumstances we consider that this scheme requires drastic revision."

THE application of science to problems connected with the cotton industry formed the subject of Dr. A. W. Crossley's discourse at the Royal Institution on Friday, January 23. Nearly every branch of science has its bearing on the cotton industry. Botanically, much work is being done on the structure of the cotton hair itself and its relation to the various processes, such as spinning, that it goes through during manufacture. From an engineering point of view, it is extraordinary that no great invention has been made in regard to cotton machinery for more than fifty years, and the British Cotton Industry Research Association has already under consideration important modifications in one machine. At the Shirley Institute laboratories, too, new light has been thrown on mercerisation, for which it has been found there is a definite limiting botanical factor. Much valuable work has just been carried out on problems connected with bleachings. Cotton well bleached should be white, but should not have suffered any deep-seated chemical changes such as would affect its physical properties or lower its strength; also bleaching is carried out by means of oxidising agents, and great care has to be taken as they attack the cellulose to form oxycelluloses. Unlevel dyeing may be a result. The chemical tests that are used for determining the extent of this attack have been investigated, and it has been discovered that the slightest change of acidity or alkalinity of the liquor plays an important part. The application of physics has produced a number

of important instruments for testing the regularity of yarns, their resistance to wear and to oscillating tensions, as well as their tension in the loom. In a special regularity tester, the irregularities in a yarn are magnified 18,000 times by a shoe riding over it and a system of indicators and mirrors which produce on a moving bromide strip a photographic record of every minute change of twist and so act as an index to the action of the spinning machinery on the yarn. The doubling twist can also be measured by the instrument. Here another important achievement has been attained, for in conjunction with a special photometer which compares degrees of brightness, the right doubling twist that should be given to a singles yarn to produce the most lustrous effect has been discovered.

AN interesting exhibition of photographs, paintings, and drawings from the third Everest Expedition is now being held at the Alpine Club Gallery, Mill Street, W. In addition to views of Everest, the photographs by Capt. J. B. L. Noel show something of the interesting country through which the expedition passed. Among them is a photograph of a gigantic figure of Buddha, more than forty feet high, from the Shekar Monastery. It is said that within this figure there are stored many thousands of precious stones and other treasures. The oil paintings and drawings by Mr. Francis Helps, apart from their artistic merit, which is considerable, are of scientific value as a record of racial types and costume. They depict Lepchas, Tibetans, and Sikkimese. A portrait of the Maharanee of Sikkim and of a lady in full Tibetan dress are both very effective. The latter wears the full Tibetan head-dress with false hair. A painting of a Lepcha woman has the old costume, now discarded, although the traditional dress of the men, also shown, is retained. There is a very fine representation of a Red Lama in ceremonial dress with striking and strongly marked features. A Bhutia girl with pronounced Mongolian characteristics, while not in itself unpleasing, in the heaviness of the type serves as a foil to the other female heads. The artist has shown great skill in catching the differences in type and expression of the various races.

A DISPATCH from the Cairo correspondent of the *Times* in the issue of January 20 records some noteworthy results obtained by the members of the Boston-Harvard Expedition this season in their excavations on the limestone plateau east of the pyramid of Cheops at Giza. In clearing the Royal Cemetery of the Fourth Dynasty, boat-shaped cuttings were found in the rock foundation of the chapel of Cheops which had served as receptacles for the funereal boats of the dead king and his queens. In one which has been uncovered, the bottom was made to fit the shape of the boat, and one of the slabs of the covering is still in position. The most important find consisted of two small tombs of the Sixth Dynasty belonging to two priests, Qa'ar and Iduw, his son. In the tomb of the former the entrance leads into a hall in which stand five figures each representing Qa'ar in one of his official capacities, with a little figure of his son Iduw. This tomb is of an entirely new type. The tomb of Iduw also contains six life-sized figures, five of Iduw himself and one of his son. On the walls are skilfully carved reliefs which include four scenes of men and women mourning, a subject rare at this period. What is described as the gem of the whole find is a stele of limestone, coloured to represent granite, on the right-hand wall. Starting high up on the wall, it reaches only half-way to the ground. The rock beneath the lower edges has been hollowed out to form a rectangular niche in which the upper part of Iduw's body is carved life-size, as if emerging from the rock, with outstretched arms, palms upward, as though in readiness to receive the offerings the priests placed on the offering stone which lies in front. It is an astonishing break from the formalism of Egyptian art, remarkable in the Old Empire.

IN a lecture given in the Royal Exchange on January 20 on the Evolution of the Steamship, to the members of Lloyds' Students' Society, Eng.-Capt. Edgar C. Smith, now the official guide lecturer at the Science Museum, South Kensington, suggested that if the members should be ever in need of technical information they could not do better than visit the Science Museum, where they would find models and diagrams in profusion and, moreover, the best technical library in Great Britain. In the course of his lecture, Capt. Smith said that the Science Museum deserves the support of every shipbuilder, shipowner and engineer in the country. It is much more than a museum; it is the nation's permanent Palace of Engineering. As compared with similar institutions, the Science Museum may be said to show how men have made their fortunes while the art galleries show how they have spent them. It was Sir Richard Tangye, whose first success came with the construction of the hydraulic jacks used to push the *Great Eastern* into the Thames, who gave Birmingham its beautiful picture gallery, while it was Samson Fox, the inventor of the corrugated flue used in marine boilers, who built the Royal College of Music at South Kensington. Bessemer, Hughes, Mond and many others had left large fortunes, but in the matter of legacies the Science Museum had been treated like a spendthrift and cut off without a shilling. Though the engineering exhibits at the Museum are in a fair way to be properly housed, the same remark does not apply to the naval collections, and what is wanted now at the Museum is a National Gallery of Ships and Shipping worthy of the greatest port in the world, of the nation itself, and of our glorious heritage of the sea.

THE presidential address to the Royal Meteorological Society was delivered on January 21 by Mr. C. J. P. Cave, who took as his subject, "The Present Position of Meteorology and Meteorological Knowledge." The Royal Meteorological Society celebrates its seventy-fifth anniversary this year. In looking back Mr. Cave stated that great progress has been made in the past 25 years, largely stimulated by upper air research. Meteorology is at a disadvantage compared with other sciences; the number of posts open to meteorologists is very limited; and support for the Society has to come largely from amateurs.

The Society ought to encourage education in meteorological science. But it is not only elementary meteorology that should be encouraged; there is a vast scope for research in the science; forecasting is only one of its branches, and except in the matter of forecasting, meteorology in Great Britain is the worst endowed of all the sciences. Is it too much to hope that some great company or some public-spirited individual may come forward to endow a chair of meteorology in one of our universities and to make provision for research. The Royal Meteorological Society is, so to speak, in a position of trust for meteorology, being the only independent body in the country especially devoted to that science. It is true that there is the Meteorological Office, but its position at the present time is an unfortunate one; its future is uncertain. In the past the Meteorological Office was directly under the Meteorological Committee, which administered a Government grant. Soon after the War, the Office was placed under the Air Ministry. It seems a grave anomaly that the Meteorological Office, which deals with problems of the greatest importance to many Government departments and to many public bodies, should be solely under the direction of the Air Ministry, more especially when there is in the Department of Scientific and Industrial Research a very suitable body under which it might have been placed.

SENATOR MARCONI has been elected an honorary member of the Institution of Civil Engineers.

DR. J. H. JEANS will deliver the sixteenth Kelvin Lecture of the Institution of Electrical Engineers on Thursday, February 5, at 6 o'clock. The title of the lecture will be "Electrical Forces and Quanta." At the beginning of the meeting a statuette of the late Sir Joseph Wilson Swan will be presented to the Institution by Mr. R. K. Morcom.

APPLICATIONS are invited by the Scottish Society for Research in Plant-breeding for the directorship of research, in succession to Mr. J. M. F. Drummond, who was recently appointed Regius professor of botany in the University of Glasgow. The applications, with statements of qualifications and experience (in each case seven copies), must reach the Secretary, 3 George IV. Bridge, Edinburgh, by March 14, at latest.

THE British Non-Ferrous Metals Research Association, 71 Temple Row, Birmingham, is inviting applications for three junior research posts, namely, a physical chemist or metallurgist (for work on atmospheric corrosion), a metallurgist or chemist (for the study of the wastage of copper locomotive fire-box stay rods), and a metallurgist with good physics training (for the study of zinc and high-zinc alloys and their workability). The latest date for the receipt of applications is February 9.

THE four-hundredth anniversary of the death of Vasco da Gama, who was the first to reach India by the Cape route, and died on Christmas Eve, 1524, is being celebrated at Lisbon. The *Times* correspondent reports that at a reception held at the Palace of Belem on January 24, representatives of twenty-six governments presented their credentials. On January 25 there was a service at Belem Cathedral, and the blessing of the sea at the place whence da Gama sailed.

SIR JOSEPH J. THOMSON has been awarded the Faraday Medal by the Council of the Institution of Electrical Engineers. This medal is awarded not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution. The present award is the fourth which has been made.

THE Buchan prize of the Royal Meteorological Society was awarded to Mr. W. H. Dines, at the annual general meeting held on January 21. The prize, now awarded for the first time, was recently founded to commemorate the late Dr. Alexander Buchan, who did much to advance the interest of meteorology in Scotland and was intimately associated with the work done on Ben Nevis. The award was made to Mr. W. H. Dines for his recent papers on radiation read before the Society. Mr. C. J. P. Cave, the president of the Society, in making the award, recalled the pioneer work which Mr. Dines had done in the investigation of the upper air before he turned his attention to the problems of radiation.

THE Gold Medal of the Royal Astronomical Society has been awarded by the Council to Sir Frank Dyson, Astronomer Royal, for his general contributions to astronomy, and in particular for his researches on the proper motions of stars. The medal will probably be presented at the ordinary meeting of the Society on June 12. At the annual meeting, to be held on February 13, Prof. Eddington, Dr. Jackson, Mrs. Maunder, and Prof. Milne will speak on the progress of astronomy during the past year; Prof. Fowler and Prof. Newall will speak on the forthcoming meeting of the International Astronomical Union at Cambridge; and Dr. Dreyer will give a short account of Tycho Brahe's observations, methods, and results.

THE National Institute of Agricultural Botany is now prepared to accept entries for its fourth series of yield and quality trials of new varieties of potatoes from breeders who are willing to entrust the Institute with the marketing of their productions on a profit-sharing basis. The trials are planned to last for five years, at first in Scotland only, but in the later years also in the English potato districts. Only those varieties which do sufficiently well in the trials will be placed on the market. Full particulars of the conditions of the trials can be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge. Applications should be made not later than February 28.

SCHOLARSHIPS, each of the annual value of 300*l.*, are being offered by the Grocers' Company for the encouragement of original research in sanitary science. There will also be an allowance to meet the cost of

apparatus and other expenses in connexion with the work. The tenure of the scholarships is one year, with possible renewal for a second or third year. Applications must be sent before April 1 to the Clerk of the Grocers' Company, Grocers' Hall, London, E.C.2, from whom a form of application and further information may be obtained.

CERTAIN of the members of the staff of the Rothamsted Experimental Station, Harpenden, Hertford, are available for a limited number of lectures to Chambers of Agriculture and Horticulture, Farmers' Clubs, Agricultural Societies, Farm Workers' Associations, and similar bodies, on the work being carried on at the Station. The subjects include various aspects of manuring and agricultural chemistry, physics and botany, the use of insecticides and fungicides, bee-keeping, and so on. All communications regarding lectures should be addressed to the Secretary of Rothamsted Experimental Station.

ACCORDING to the Report of the Council of the Zoological Society of London for December, the number of visitors to the Society's Gardens in Regent's Park during the year 1924 reached the total of 2,057,146—the largest number in the history of the Society, and an increase of 444,021 as compared with the previous year. The number of visitors to the Society's Aquarium since its opening in April reached the total of 567,936. The number of fellows elected and readmitted during the year 1924 was 876, an increase of 374 as compared with the previous year, and a record never before reached in the history of the Society.

THE collection of antique microscopes, about 400 in number, formed by the late Sir Frank Crisp, Bart., is to be offered for sale by auction at Stevens's Auction Rooms, Ltd., 38 King Street, Covent Garden, W.C.2, on Tuesday, February 17. Catalogues can be had from the auctioneers.

IT has been suggested recently that Messrs. Oertling, Ltd., are importing parts of German balances and merely assembling them in Great Britain. We understand that this is quite untrue. All Messrs. Oertling's balances are manufactured entirely at the firm's works in Turnmill Street, E.C.1.

Our Astronomical Column.

THE SOLAR ECLIPSE OF JANUARY 24.—Preparations were made at Greenwich for observing the first contact by the Innes method with several instruments, but thick clouds interfered. There were frequent glimpses of the partially eclipsed sun, but nothing could be done except to note the change of illumination and of the colour of daylight. The latter changed markedly near greatest phase, the cause, doubtless, being the absorption of light of short wave-length near the sun's limb. There were some beautiful spectral colours on clouds near the sun.

It is very welcome news that the conditions at the Yale Observatory, Newhaven, and elsewhere on the east coast of the United States, are described as perfect, and the photographs obtained there should be of great interest. The following time determinations of totality are given in the telegrams (the figures are the corrections to the times computed from the almanac data): Yale $+4^{sec}$, Buffalo -2^{sec}, Ithaca $+5^{sec}$, Poughkeepsie $+3^{sec}$, Newhaven $+5^{sec}$, Long Island $+3{\cdot}6^{sec}$. Mean $+3^{sec}$. The almanacs used a correction of $+8{\cdot}0''$ to Brown's longitude (corresponding with $+7{\cdot}0''$ to his mean longitude), but used no correction for the sun, which requires about $+1''$, or $+2^{sec}$ in the time of eclipse. Hence it would appear that the correction applied to the moon was within $1''$ of the truth, but perhaps slightly too great.

The country round New York was covered with snow, and the passage of the moon's shadow over this white surface, which was clearly seen, must have been a striking sight. On the whole, the weather in the United States seems to have beaten expectations, which were not high owing to the season.

OCCULTATION AND LUNAR ECLIPSE.—It is worth directing attention to the fact that the occultation of Aldebaran on February 2 is the last (at least for the neighbourhood of London) of the series that have been going on for some three years. It will be followed by a blank period of nearly sixteen years. Disappearance is at $23^h\ 54^m$, 4 hours west of the meridian, and reappearance 53 minutes later. In view of Prof. Brown's appeal, and the facilities for accurate time afforded by wireless, it is hoped that it will be extensively observed.

The lunar eclipse of February 8, lasting from $20^h\ 8^m$ to $23^h\ 15^m$, will be favourably visible in Great Britain, the moon being high up. Three-quarters of the moon's diameter will be obscured, and it may be possible to form some idea of the colour and illumination of the portion in the shadow. These are now believed to depend on the meteorological conditions prevailing at the regions where the moon is in the horizon, so that they give a sort of integrated effect of terrestrial weather.

THE NEW WOLF PERIODIC COMET.—Although this object was of mag. 17 on January 13, Prof. M. Wolf was able to make some interesting observations of its physical structure. "It was a small nebulous object of fan or sector shape, $\frac{3}{4}'$ in width, somewhat less in height, with nuclear condensation in the point of the sector which was towards S.E." This structure and the cometary nature of the orbit leave no doubt that it is correctly classed as a comet. The following orbit is by Dr. A. C. D. Crommelin from the photographic positions of December 22, January 13 (Heidelberg), and December 26 (Greenwich):

T	1925, January 23·9624 G.M.T. (new)	
ω	184° 8′ 27″	1924·0
Ω	260 36 36	
i	23 7 9	
ϕ	21 57 47	
μ	472·951″	
Period	7·5022 years.	

An ephemeris is of little use, for very few instruments can reach so faint an object.

There is a very near approach of the orbit at aphelion to that of Jupiter. There is no near approach at the next aphelion (nor has there been any in recent revolutions), but there will be a fairly close approach at the next aphelion but one. Similar elements were obtained by Herr Kahrstedt, who gave the period as 7·43 years.

Research Items.

THE CHRONOLOGY OF CENTRAL AMERICA.—Mr. R. C. E. Long in *Man* for January examines the bearings of the historical evidence upon the correlations of Mayan and Christian chronology put forward by Dr. Morley and Mr. Bowditch respectively. The argument turns upon whether it can be shown that Nahua influence existed in Chichen Itza before its overthrow by Hunnac Ceel, governor of Mayapan, or whether the Nahua buildings in the city—some of the greatest in Yucatan—were erected after that event, as Morley holds. A date deciphered by Morley on a ball-court—a typical Nahua structure—at Uxmal proves the existence of the Nahua in Yucatan before the date to which Bowditch assigned the fall of Chichen Itza. If, then, it can be shown that Nahua influence in Chichen Itza also precedes the fall, that in the light of the Uxmal date would afford strong support to the Bowditch dating; but if it can be shown to be later than that event, it supports the Morley correlation. It seems unlikely that the buildings at Chichen Itza which show Nahua influence would have been erected in a period of great wars, such as this is known to have been, when, as Morley thinks, the city had been handed over to Mexican mercenaries. A conclusive piece of evidence, however, is a passage in the Chilan Balam of Chumayel which states that Hunnac Ceel had himself once been thrown into the Cenote of Sacrifice at Chichen Itza, and that, as he had survived the requisite time, he had been taken out and worshipped. This custom of throwing victims into the Cenote was purely a Nahua practice and was introduced into Chichen Itza only after the establishment of Nahua rule. It follows, therefore, that as the custom must have been observed before the overthrow of Chichen Itza by Hunnac Ceel and not after, the date of the ball-court at Uxmal would fall into line with and support the date suggested by the Bowditch correlation.

MAGIC AND MEDICINE.—An illustrated guide to the collections dealing with medical history in the United States National Museum, Washington, has been compiled by Mr. Charles Whitehead, Assistant Curator of the Division of Medicine, and published as Article 15 of Vol. 65 of the Museum's Proceedings. These collections, which since 1916 have formed part of a larger section of the Department of Art and Industry covering the history of pharmacy, public hygiene and sanitation, are classified under magic medicine, psychic medicine, and pharmacological medicine, the last named including Egyptian, Greek, and Roman medicine, while the first covers the healing art of primitive, savage, and half-civilised man as well as the numerous survivals of primitive medicine among civilised peoples. It is naturally the most fully represented. Among the amulets or charms is a specimen illustrating the voodoo of the negroes of the United States and West Indies, which consists of a chicken feather, some human hair, a drop of blood on a rag, and a pine sliver. This is worn on the neck as a preventive of voodoo against the wearer. A number of "madstones," which, when applied to a dogbite, avert madness, have proved their efficacy in the hands of their former owners. For one, a highly polished seed of *Gymnocladus dioica*, the Kentucky coffee tree, 1000 dollars was asked, and a ball of matted hair, such as is occasionally found in the stomach of domesticated cattle and other ruminants, was said to have been used successfully in two cases. One exhibit is a section of a tree from Norfolk, Va., which had been tapped, human (negro) hair inserted, and the hole plugged and sealed with clay. Four inches of new growth formed over the plug, so that the hair must have been inserted fifty years before it was found. The operation was doubtless performed either to relieve headache, or to cause headache in the original possessor of the hair.

THE BRITISH RACES OF *ARICIA MEDON*, ESPER.—*Aricia medon* occurs in the British Isles in two distinct races, the type *medon* and the variety *artaxerxes*. The type occurs in England and Wales and the variety in Scotland and Ireland, but their areas of distribution overlap in the N.E. of England. Dr. J. W. H. Harrison and Mr. W. Carter (Trans. Nat. Hist. Soc. Northumberland, Durham, and Newcastle-upon-Tyne, N.S., vol. vi. pt. 1) have discussed the origin of these two races. They reject both the possibility of origin from an original mixed population in N.E. England, and an explanation based on orthogenetic mutations. They conclude that the variety originated in a contingent of the type isolated during the glacial period, under the long-continued influence of the refrigerating conditions that obtained at that time, and they cite the experimental results of refrigeration on other species of Lepidoptera in support of their theory. They find, moreover, that in the overlapping areas of their distribution the inheritance follows Mendelian lines.

MERISTEM GROWTH IN WOUNDED POTATOES.—G. A. C. Herklots has a paper in the *New Phytologist* (vol. 23, No. 5, December 1924) in which the cork meristem formed upon cut potato tubers under suitable conditions is used as a means of investigating certain views recently put forward (NATURE, August 16, 1924, p. 258, "Mechanism of Cell Growth") as to the influence of the external hydrion concentration upon the activity of meristematic protoplasm. Experimenting with the cut surface in contact with buffered solutions or jellies, he finds that an alkaline reaction at the cut surface favours rapid suberisation, but delays or (if beyond $P_H 8$) entirely prevents meristem formation, whilst an acid reaction at the cut surface, whilst delaying the process of suberisation, facilitates meristem formation.

A CINCHONA INSECT PEST.—In the report for 1923–24 of the Government cinchona plantations and factory in Bengal, attention is directed to the ravages of Helopeltis. On the plantations both at Mungpoo and Munsong, this pest is on the increase and the attacks have reached and maintained a severity that renders hand-picking ineffectual. The trouble is greater at lower than at higher elevations, and in certain parts of the plantations the growth of the plants is completely suspended for several months of the year. Coppicing as a preventative is beneficial in so far as the affected portions are removed entire, but the disease reappears when the fresh shoots sprout. There seems to be no satisfactory method of dealing with this insect pest. A season that is unfavourable to its development is more beneficial than all the counter measures that have been devised up to the present. In spite of these difficulties and somewhat adverse weather conditions, the plantations did well during the year under review.

ASIATIC SUCCINEIDÆ.—One of the most difficult of the families of the non-marine mollusca to deal with satisfactorily is the Succineidæ. The shells present so few salient characters, whilst far too little is known of their anatomy. All the more credit, therefore, to Mr. H. Srinivasa Rao, of the Zoological Survey of India, for the excellent little monograph he has just furnished of the Asiatic Succineidæ in the Indian Museum (Rec. Indian Mus. xxvi.). The author has

brought together all the facts he was able concerning the anatomy and habits of the members of the family as represented in the Indian Museum, and has principally utilised the jaw and radula for the purposes of distinguishing the various species. The Indian Succineidæ comprise four distinct genera: Succinea itself, which is amphibious, and three terrestrial genera — Indosuccinea, which is new, Lithotis, and Camptonyx. The type of the new genus is *Succinea semiserica* Gould, and the author has further created a few new species and varieties. There are good, clear text figures of the jaws and radula teeth and a very good photo-plate of the shells of the more important species.

RATOONED QUEENSLAND COTTON.—A short note by Mr. Frederick Summers in the Journal of the Textile Institute for December has considerable general interest. When growing wild, the cotton plant is always a perennial, but under cultivation, either because of drought or winter conditions in the resting season, or more usually because of the way in which the pests and diseases of the crop accumulate in the second and succeeding years, it is the rule in Egypt and the West Indies to remove the old stumps after the first year's crop of fruit has been gathered (NATURE, May 31, 1924, p. 800). In S. America, and also in Africa under native cultivation, the plants are often cut down hard at the end of the growing season, and then allowed to produce fresh shoots in the following season, in other words, treated as from time immemorial bush and woody fruits have been treated in Great Britain. In the case of cotton, this process is known as ratooning, and there has been much discussion, on inadequate data, as to whether the ratooned crop, whatever its quantity, is of similar quality with the first year's yield. Fruit growers would naturally tend to assume that quality would be maintained, and one can understand that when new areas come under cultivation for cotton, the pest problem being still little developed, the planters have a natural tendency to follow the practice of ratooning. Queensland growers have done this, although in 1923 for a short period the process was made illegal, as the result of inquiries by the Queensland Ministry of Agriculture as to the esteem in which ratoon cotton is held in Great Britain. This ban has again been removed, and Mr. Summers now reports a careful test of the quality of ratooned fibre as against the normal crop, and it is interesting to see that this examination tells heavily against the ratooned product. This conclusion is of great scientific interest and contrasts strongly with our experience of many perennial plants when brought into cultivation. Mr. Summers emphasises the fact that generalisation must not be based upon these Queensland samples alone, but they certainly raise the problem in a very definite form, and both its scientific interest and commercial importance should mean that further opportunities will be taken of comparing authentic samples of ratoon and normal cottons.

THE JAPANESE EARTHQUAKE OF 1923.—The investigation of the disastrous earthquake which devastated Tokyo in September 1923 is still proceeding, but some preliminary reports have already appeared. In the *Geographical Journal* for January, Dr. C. Davison has an article bringing together the information on the subject at present available, in which he discusses, among other aspects of the earthquake, its origin. The epicentral tract of the earthquake was of unusual size and may have covered so much as 2000 square miles, including the whole of Sagami Bay. Its area may even have been 4700 square miles. The cause, at least in part, is to be sought in the movements which produced remarkable changes in the floor of Sagami Bay. These changes were very considerable, and although no fault scarp has been discovered on the floor of the bay, a vast block or series of blocks seem to have subsided. A remarkable feature of this subsidence is that the movements on the floor of the bay have affected very slightly the surrounding coasts. The greatest elevation of the sea-bed was more than a hundred times that on land, and the greatest depression of the sea-bed was more than 1600 times that on land. Moreover, the centres of elevation and depression are very close to one another. There is also evidence that the movements on the sea floor were not confined to the time of the earthquake but continued in the same directions for so long as five months, and even now may not be at an end.

MAGNETIC SURVEY WORK IN THE UNITED STATES.—The results of magnetic observations made by the United States Coast and Geodetic Survey in 1923 are published as No. 268 of the survey publications. Five magnetic observatories continued in operation throughout the year, namely, Cheltenham, Md.; Sitka, Alaska; Honolulu, Hawaii; Vieques Island, P.R.; and Tucson, Arizona. Their records have furnished the data for reducing to monthly means the values of declination obtained from field observations. The magnetic survey of Florida was completed and a survey of North Carolina was made. Declination observations were made at a large number of stations along the southern and south-eastern shores of Alaska in connexion with the triangulation. Tables are given of the year's observations at various stations, and the report concludes with descriptions of the stations sufficiently detailed to enable them to be located even if the marking on the ground should be destroyed.

ROTATORY DISPERSION.—The thesis on "The Chemical Significance of Optical Dispersion," on which Dr. Harold Hunter was recently awarded the degree of D.Sc. (Lond.), has been printed and published (London: Battersea Polytechnic, Battersea Park Road, S.W.11; price 7*s*. 6*d*.). The thesis is a critical account of the recent position of a question which has formed the subject of considerable discussion both pre- and post-War. It presents in a convenient and accessible form the author's own personal contribution to that discussion and his comments on the views of other workers in the same field. There are very few points in the thesis which call for criticism, the principal one being perhaps the statement (p. 89) that "the rotatory dispersion equation of Drude" "suffers from the defect" that "it does not take into account the degradation of the light energy in the phenomenon of absorption," since this "defect" does not exist in Drude's original equation, but only in the simplified equation which alone is quoted by Dr. Hunter. On the other hand, a partial transposition into italic type is justified as a tribute of admiration for the neat statement (p. 49) that "One of the consequences of improvements in chemical technique is that *the dynamic isomerism of to-day becomes the static isomerism of to-morrow.*"

THE CONDENSATION AND RE-EVAPORATION OF ACTIVE HYDROGEN.—In an interesting paper (*Zeitschrift für Elektrochemie*, Nr. 21/22, pp. 504-508, 1924) Fritz Paneth discusses the properties of active hydrogen and describes experiments carried out in association with K. Peters. The monatomic form (H_1), produced at low pressures by glowing wires and electric discharges, is readily adsorbed and is condensed on the walls of glass vessels cooled by liquid air, the activity disappearing on re-evaporation. At high pressures another modification is produced,

usually regarded as tri-atomic hydrogen (H_3), in conformity with the observations of J. J. Thomson and Aston on positive rays. H_3 is less strongly adsorbed than H_1 and can pass through glass wool. It is generally recognised by the production of hydrogen sulphide, when it is passed at a very low temperature over powdered sulphur. Wendt and Landauer have described an investigation in which they appear to have been successful in producing not only condensation but also re-evaporation of H_3 without change of form, and, considering the substance analogous to ozone, they suggest for it the name "hyzone." Two new methods are now described in detail for the production and study of this active modification of hydrogen. In the first, hydrogen is passed over a glowing Nernst filament, and in the second, through a heated capillary tube of palladium. The results are believed to prove that active hydrogen so produced may be condensed and re-evaporated without loss of activity, and further, that its constitution must be H_3 and not H_1. Experiments are to be continued with the view of producing the active modification in greater quantities.

THE ISOTOPES OF MERCURY.—An interesting suggestion is made by Dr. F. Stumpf in the *Zeitschrift für Physik* of December 12. He directs attention to the facts that Aston has found the atomic weights 204, 202, 200, and 197 for the isotopes of mercury, and that the last number is almost identical with the atomic weight of gold. Although among the radioactive elements there are cases where different elements have the same atomic weight, this is not true for the other, non-radioactive, elements; and the author considers that it is possible that the 197 isotope was really gold and not mercury. Apparently the intensity of the 197 line was not very different from that of the others, so that it can scarcely have been due to gold existing originally as an impurity in the mercury. It is suggested that gold may have been produced from the mercury in the experiment in a similar manner to that in which Miethe claims to have caused this transformation. It might be possible to obtain evidence of this by receiving the positive rays on a plain sheet of glass or of quartz, instead of on a photographic plate; with a long exposure the glass might be coloured red with colloidal gold at the point in question. In Miethe's experiment parts of the discharge bulb were coloured red.

PROTECTIVE COLLOIDS.—A paper on colloidal protection, read by J. Alexander before the American Section of the Society of Chemical Industry last May, is published in *Chemistry and Industry* (Review) for December 19, 1924. The technical use of protective colloids has been known since antiquity. Thus the Chinese used glue in the manufacture of ink to deflocculate the lamp-black, and the ancient Egyptians used gum (probably acacia) for the same purpose. The protective action was recognised by Meyer and Lottermoser (1897). A protector may be defined as a substance which opposes the aggregation of molecules or particles into larger groups; according to Bechold, the protective action is consequent upon the adsorption of a layer of the protector at the interface between the dispersed and the dispersing phase. This layer is exceedingly thin, since it does not diminish the Brownian motion of the particles, and there is no ultramicroscopic evidence of its existence. Brief descriptions and applications are given of plural, auto- and cumulative protection.

PYROPHORIC ALLOYS.—The production and properties of pyrophoric alloys are described by Dr. N. F. Budgen in the *Chemical Trade Journal* for December 26, 1924. The "flint" of the popular type of gas-lighter was introduced by Auer von Welsbach in an interesting manner. The incandescent mantle which Welsbach introduced in 1886 contains 99 per cent. of thoria and 1 per cent. of ceria, and the large demand for thoria which it created led to the working up of the monazite sands found in different parts of the world. These sands contain about 5-10 per cent. thoria and 50-60 per cent. ceria and other rare earths, so that large quantities of rare earths, minus the thoria, accumulated at the mantle works. It was while trying to find a use for this "waste" that Welsbach discovered that alloys of iron and the cerium metals throw off sparks when rubbed with a file. The first step in the production of pyrophoric alloys is the preparation of "misch metal," which is an alloy of 40-50 per cent. cerium, 20-40 per cent. lanthanum, 1 per cent. yttrium, and small amounts of neodymium, samarium, gadolinium, etc. This alloy is then fused and mixed with an appropriate metal (*e.g.* iron, zinc, aluminium) in the molten state under a protective layer of salt or fluorspar. The best pyrophoric alloy is probably "auermetal," made by alloying up to 60 per cent. of iron with misch metal.

PHYSICAL ASPECTS OF CHEMICAL COMBINATION.—A paper on "Chemical Combination as a Dynamic Problem" by Prof. Born, of Göttingen, read at Innsbruck meeting of the German Scientific and Medical Association on September 26, 1924, is printed in *Die Naturwissenschaften* of December 26. The paper deals with the calculation of physical and chemical constants from data as to the electric charges and distances of the components of various aggregates. Thus the "lattice energies" of crystals of the rock-salt type can be calculated and give results which show a very close agreement with the observed values. In other cases, including the molecules of salt-vapours, the ions appear to be deformable, as indicated, for example, by the different refractive power of Cl′ in HCl and in NaCl. A table is, however, given of the energy of formation of salt-vapours, in comparison with the lattice energy minus the heat of sublimation. The calculation of the natural free-periods of ions such as CO_3, NO_3, ClO_3, SO_4, etc., which are constant in all compounds of these ions both in solution and in solid crystals, from the charges and distances of the atoms, is also referred to.

THE PROGRESS OF DEVELOPMENT OF A PHOTOGRAPHIC PLATE.—This matter has been investigated by Mr. L. F. Davidson, of the Imperial Dry Plate Company (Journal of the Royal Photographic Society, January 1925), by watching the actual process of development under the microscope, using a high-power objective, and by taking photomicrographs at various stages. The developer was coloured so that its movement was obvious. When the developer reaches a grain, there is a definite time interval before visible action begins, and this "induction period" varies according to the developer used and according to the nature of the grain, but appears to be unaffected by grain size. Development starts at points or "centres" which enlarge and join until the whole grain is blackened. Except in the case of certain slow emulsions, the shape of the grain is changed by its development. If by reason of this change of shape it comes into contact with another grain, this second grain appears to be rendered developable. The developed grain may present an area that is smaller or very much larger than the original silver haloid grain, this alteration in area varying from 0·8 to 104 per cent. in an extended series of experiments. It was sought, though apparently not very successfully, to find some relationship between the increase in size and the character of the plate.

Prize Awards of the Paris Academy of Sciences.

AT the annual public meeting of the Paris Academy of Sciences, held on December 22, M. Guillaume Bigourdan in the chair, the prizes awarded in 1924 were announced as follows :

Mathematics.—The Poncelet prize to Ernest Vessiot, for the whole of his mathematical work ; the Francœur prize to the late Ernest Malo, for his researches in algebra and arithmetic.

Mechanics.—The Montyon prize to Eugène Huguenard, Antoine Magnan, and André Planiol, for the important improvements which they have made in hot wire anemometry ; the Fourneyron prize to Marcel Crozet-Fourneyron, for his historical work and inventions connected with the hydraulic turbine ; the Boileau prize to Georges Routin, for his hydraulic researches ; the Henri de Parville prize to Paul Bloch, for his work in ballistics, with especial reference to the projection of missiles from aeroplanes.

Astronomy.—The Lalande prize to Jules Baillaud, for his work in celestial photography ; the Janssen medal to George Willis Ritchey, for his work on the construction of mirrors ; the La Caille prize to Dominique Saint-Blancat, for his work on the catalogue of stars. The Benjamin Valz prize was not awarded.

Geography.—The Delalande-Guérineau prize to Charles le Maître, for his cartographical work in Algeria ; the Gay prize to Émile Delcambre, for his work in topography and meteorology ; the Tchihatchef prize between Ernest Benoit (1500 francs), for his work on geodesy in Indo-China, and Laurent Friquegnon (1500 francs), for geographical work in Indo-China ; the Binoux prize between Jacques Bourcart (1000 francs), for his work on the physical geography of Albania, and Édouard de Martonne (1000 francs), for his topographical, geodesic, and cartographical work in French Western Africa.

Navigation.—The prize of 6000 francs between Yves Le Prieur (4000 francs), for inventions connected with naval artillery, and Émile Georges Barrillon (2000 francs), for his study of the gyration of ships ; the Plumey prize between Antoine Foillard, for his memoir on marine machines with electric transmission, and Paul Dumanois, for his volume on internal combustion motors.

Physics.—The La Caze prize to Paul Langevin, for the whole of his scientific work ; the Hébert prize to Edgar Haudié, for his " Cours d'électricité générale " ; the Hughes prize to Alexandre Dufour, for his cathodic oscillograph ; the Clément Félix prize between Jean Mercier, for his researches on the velocity of propagation of electric waves, and Pierre Fleury, for his researches on the measurement of the temperatures of electric furnaces.

Chemistry.—A Montyon prize (Unhealthy Trades) (2500 francs) to the late André Brochet, for his researches in organic chemistry and electro-chemistry ; an honourable mention (1500 francs) to Isidore Lazennec ; the Jecker prize to Louis Jacques Simon, for his work in organic chemistry ; the La Caze prize to Camille Matignon, for the whole of his chemical work ; the Cahours foundation to Suzanne Veil, for her physico-chemical researches on metallic oxides and hydroxides ; the Houzeau prize to Pierre Chevenard, for his inventions of apparatus used in metallurgical research.

Mineralogy and Geology.—The Fontannes prize to Frédéric Roman, for his work in palæontology ; the Victor Raulin prize to Jules Barthoux, for his memoir on the petrographical and geological study of the Arabian desert.

Botany.—The Desmazières prize to René Vandendries, for his memoirs on sexual determinism and sexuality of the Basidiomycetes ; the Montagne prize to Alphonse Labbé, for his volume on the biological cycles of the Dunaliella ; the de Coincy prize to François Pellegrin, for his memoir on the flora of Mayambe, from the collections of M. G. Le Testu.

Anatomy and Zoology.—The da Gama Machado prize to Christian Champy, for his researches on the spermatogenesis in *Discoglossus pictus* ; the Savigny prize to Clodomir Houard, for his work on galls in Northern Africa ; the Jean Thore prize to Adrien Perret-Maisonneuve, for his researches in apiculture.

Medicine and Surgery.—The Montyon prize between Victor Babès (2500 francs) for the whole of his work, Nöel Fiessinger (2500 francs), for his volume on the ferments of the leucocytes in physiology, pathology, and general therapeutics ; Jules Botreau-Roussel (2500 francs), for his memoir " Ostéites pianiques (Goundou) " ; honourable mentions (1500 francs) to Jean Baratoux, for his volume on the voice, the scientific study of its formation and emission, its diseases ; to Jean Rieux, for his book on clinical hæmatology ; and to Henri Glover, for his work entitled " L'auscultation électrique en physiologie et en clinique " ; the Barbier prize to Georges Mouriquand and Paul Michel, for their experimental work on accessory food substances ; the Bréant prize (arrears) between Alfred Boquet and Léopold Nègre (2500 francs), for their work on tuberculosis, and Léon Marchand and Raymond Moussu (2500 francs), for their work on enzootic encephalitis of the horse ; the Godard prize to Edmond Papin, for a memoir on endoscopy operations of the urinary passages ; the Mège prize to Mme. Angélique G. Panayotatou, for her volume on the hygiene of the ancient Greeks ; the Bellion prize between Paul Godin (700 francs), for his works on the evolution of growth, and Louis Bargeron (700 francs), for his researches on the lighting conditions of workshops ; the Larrey prize to François Bassères, for his memoir on the medical service of the Third Army in the War.

Physiology.—The Montyon prize to André Charles Guillaume, for his memoir on the normal and pathological morpho-physiology of the small superficial blood vessels ; the La Caze prize to Emmanuel Hédon, for his scientific work as a whole, and more especially for his researches on the physiology of the pancreas ; the Pourat prize to André Paillot, for his memoir on the bacterial diseases of insects and their utilisation in agriculture ; the Martin-Damourette prize to Henri Vignes, for his memoir on normal and pathological obstetrical physiology ; the Philipeaux prize to Antoine Léon Garrelon and Daniel Santenoise, for their researches on the oculo-cardiac reflex and vago-sympathetic toxin.

Statistics.—Montyon prizes to Michel Huber (1000 francs), for the whole of his statistical work, and Émile Lambert (1000 francs), for his work in statistics.

History and Philosophy of Science.—The Binoux prize to Mme. Hélène Metzger, for her volume on chemical doctrines in France from the beginning of the seventeenth to the end of the eighteenth century.

Medals.—The Berthelot Medal to André Brochet, Louis Jacques Simon, Camille Matignon, Suzanne Veil, and to Pierre Chevenard.

The Lavoisier Medal to Joseph Achille Le Bel, for his chemical work, as it is now fifty years since the discovery of the asymmetric carbon atom.

General Prizes.—The Grand Prize of Mathematical Sciences to Paul Montel, for his researches on suites of analytical functions ; the Bordin prize to Clément Vaney, for his work on the diseases of cattle ; the Lallemand prize to Henry Cardot and Henri Laugier,

for the discovery and study of the linguo-maxillary reflex; the Vaillant prize to Claude Guichard, for the whole of his work in higher geometry; the Le Conte prize to André Debierne, for his work in the field of radio-activity; the Houllevigue prize between Franz Lœwinson Lessing (3500) francs), for his work in petrography, and T. Husnot, for his work in botany; the Jean Jacques Berger prize to the Institut prophylactique; the Parkin prize to Ernest Fourneau, for his work in pharmacology; the Saintour prize equally between Paul Camboué, for his researches on silks of Madagascar, and Jean Jacques Kieffer, for his work on parasitic Diptera and Hymenoptera; the Henri de Parville prize to Maurice Vèzes and Georges Dupont, for their book on resins and turpentines and the industries connected with these; the Lonchampt prize between Émile Roubaud (2000 francs), for his work on the hibernation of flies, Ernest Lobstein (1000 francs), for his biochemical researches on the tubercle bacillus, and Paul Fleury (1000 francs), for his researches on laccase; the Henry Wilde prize to Charles Maurain, for the whole of his work and for the organisation of research at the Institut de Physique du Globe; the Caméré prize to M. Caquot, for his engineering work in connexion with bridge construction; the Gustave Roux prize to Eugène Séguy, for his work on Diptera; the Thorlet prize to Adolphe Richard.

Special Foundations.—The Lannelongue foundation between Mmes. Casco and Ruck.

Prix des Grands Écoles.—The Laplace prize to Philippe Charles André Coste; the L. E. Rivot prize between Philippe Charles André Coste, Lucien Félix Chadenson, Jean Charles Joseph Armanet, Vincent Louis François Pierre Bauzil.

Funds for Scientific Research.—The Gegner prize to Gustave Dollfus, for his geological work; the Jérome Ponti foundation to the late Hippolyte Coste, for his descriptive and illustrated flora of France; the Hirn foundation to Georges Giraud, for the whole of his work; the Henri Becquerel prize to René Garnier, for his works on differential equations.

The Loutreuil Foundation.—Thirty-two requests for grants from this fund were received; twenty-four grants were made as follows:

Establishments named by the founder:

National Museum of Natural History: 10,000 francs to P. Pierre Teilhard de Chardin, for palæontological researches in China; Collège de France, 15,000 francs to Henri Piéron, for the purchase of material for researches at the new physiological laboratory;

National Veterinary School at Alfort: 2000 francs to Albert Henry and Charles Leblois to pursue their researches on the etiology, pathogeny, and treatment of the parasitic skin affections of domestic animals; 3000 francs to Gabriel Petit, to pursue his researches on the radio-activation of the organism by intravenous injections of radium; 4000 francs to Gustave Moussu, for his researches on diseases of cattle and pigs; 2000 francs to François Maignon, for his work on insulin and on the mineral elements entering in the constitution of the tissue catalysts of animal and vegetable origin.

National Veterinary School of Lyons: 2000 francs to Gabriel Marotel to continue his researches on two parasitic diseases of the horse and dog; 4000 francs to Joseph Basset, to finish his researches on anthrax vaccination; 2000 francs to L. Jung, to pursue his researches on the rôle of the saliva of various domestic animals in its relations with their normal food regime.

National Veterinary School of Toulouse: 2000 francs to Jules Girard and Pierre Pons, for their researches on the modifying factors of growth (temperature, special feeding, castration); 3000 francs to Albert Dailleˆ, to finish his researches on the etiology and serotherapy of epizootic diarrhœa in newly-born calves; 2000 francs to Clément Bressou, to commence researches on the splanchnology of mammals, more particularly Carnivora, by the method of feeding and radio-opaque injections.

Grants acceded to establishments admitted for one year by the president:

Conservatoire national des arts et métiers: 4000 francs to Léon Guillet, for the purchase of a second Le Chatelier metallographic bench.

Independent requests: 1500 francs to Jean Bosler, for the *Journal des Observateurs*; 5000 francs to Jean Charcot, for the purchase of material required for the geological study of the sea floor; 3000 francs to Henri Colin, for the purchase of a combustion furnace and accessories, required in connexion with the study of new or little known carbohydrates; 1000 francs to Benjamin Jekhowsky, for assisting his work on new minor planets; 15,000 francs to Jean Mascart, for the publication of observations of variable stars; 3000 francs to the Office central de Chauffe rationnelle, for the study of the composition of a mixture of carbon monoxide and dioxide in equilibrium in the presence of carbon at various temperatures; 1500 francs to Paul Pallary, to pursue his explorations in the Middle Atlas; 5000 francs to Edmond Roy-Prémorant, for the construction of a tachylegometer invented by him; 6000 francs to the Société de Physique industrielle, for the study of the measurement of gas and steam in industry; 6000 francs to the Saint-Joseph University of Beirût, for the publication of the geological map of Syria, constructed by P. Godefroid Zumoffen.

The Bouchard foundation to Gabriel Bidon, to continue his researches on the neuro-physiology and treatment of the deformed; the Henry Le Chatelier foundation to Léon Jacqué, for researches on the fusibility of mixtures of lime, ferrous, and ferric oxides.

Medical Uses of Radium.

THE Medical Research Council has recently published, as No. 90 of its Special Report Series, a summary of reports for 1923 from research centres on the medical uses of radium. The nine clinical centres in Great Britain and Ireland which enjoy the use of radium lent to them by the Medical Research Council have been pursuing these investigations for several years, but this is the first occasion upon which the data have been arranged and used for public circulation. This is particularly welcome now, for results have been obtained which invite the careful consideration of radiologists, physicians, surgeons, and pathologists.

It may be said that the main object of the clinical investigations is to define the proper limitations of the uses of radium in the treatment of malignant disease, and to decide the best methods of treatment for any given type of this disease. Such an aim can be achieved only by very persistent work of a collaborate character continued over some years. The forms of malignant disease are so varied, the differences in reaction of the host are so large, and the factors in dosage are so numerous, that it may well be that more years will elapse before the main object of the Medical Research Council in these investigations is achieved. Yet a perusal of this report convinces the reader that a serious effort is in hand, not only to give these radiological investigations a quantitative

basis, but also to visualise the problem of radium therapy in cancer in all its complexity and yet not be baffled by it.

For some years it has been recognised that rodent ulcer is a disease very amenable to this form of therapy, and this is confirmed in the data before us. Of later years, the value of radium in cancer of the cervix uteri has been maintained, and there is a considerable mass of evidence in this report which substantiates the claim. In cancer of the breast, the data show an increasing use of radium combined with surgical operation, but the full value of this combination depends largely upon the nature of the surgical operation and the extent to which it is possible to insert the radium at places of likely extension of the disease. We gather from the report that the results obtained by the use of radium in malignant disease of the mouth, jaw, or throat, continue in most cases to be disappointing. This appears to be chiefly due to local anatomical and surgical difficulties rather than to any specific resistance of the tumours themselves.

Non-malignant conditions have also been investigated. It is satisfactory to find in the reports from three independent centres, a practical uniformity in the dose of radium employed in the treatment of uterine fibromata and of menorrhagia, and an equal measure of success in the results.

Recognising that progress in therapy is largely dependent upon collateral researches, the Medical Research Council, through its Radiology Committee, has, from the inception of this scheme, supported such researches which have so far been of physical or biological character. Sir Ernest Rutherford reports upon the disintegration of the elements by means of alpha rays.

Researches of a biological character are separately detailed as having been carried out by Mr. Timbrell Fisher in osteo-arthritis, by Dr. J. C. Mottram on changes in the intestinal tract resulting from radiation, and by Prof. S. Russ upon the determination of lethal doses of radiation for animal tumours.

The publication as a whole is worth serious study, for it is a finger-post along the road of treatment in malignant disease. While there are no extravagant claims made for it, it cannot be doubted that radium is a valuable instrument in the treatment of cancer and other diseases, and we look with confidence to the results which these investigations may provide in the near future.

Chemistry in India.

THE success which has attended the inauguration of the Indian Science Congress, and the great increase in the amount of new work in chemistry which has occurred in the Indian Empire during the past ten years, has led to the establishment of an Indian Chemical Society, under the presidency of Sir P. C. Rây, with offices at 92 Upper Circular Road, Calcutta; the first number of the Quarterly Journal of the Society has now appeared.

Hitherto, chemical papers emanating from India have been published either in the Journals of the Chemical Societies of London or America, or in one or other of the larger continental publications. The disadvantages attaching to this procedure became more and more obvious as the volume of new work increased, because the older Journals are becoming over-burdened, and the need for economy of space necessitated frequent correspondence between authors and editors, entailing grave loss of time in the cases of countries so far distant as India.

Apart, therefore, from the pleasure with which all British chemists will welcome this national effort on the part of India, there will be general agreement among them that the scheme of decentralisation of publications within the British Empire which it implies is the only one which can lead to the rapid and adequate publication of new knowledge and tend ultimately to the real advancement of chemistry. Optimists may dream of the time when there will be one Chemical Society and one Chemical Journal for all the English-speaking races, but until the transportation of matter can be accomplished with a velocity approaching that of light, distance must always act as an obstacle to any such plan, however desirable it may be.

The new Journal is a welcome illustration of the development which has taken place in Indian chemistry during recent years. There are thirteen papers, and only one of these is published under English names. The remaining papers are published by Indians and come from all parts of the Indian Empire. Four of them emanate from the College of Science, Calcutta, and this is as it should be, because, for many years past, this Institution has been the backbone of chemical research in India. The other communications come from Allahabad, Baroda, Dacca, Cuttack, Benares, and Madras, and constitute a series of which the organising committee and editor have every reason to be proud.

The Journal is well printed, and doubtless the structural formulæ, which seem, at times, to have given the printer some trouble, will improve with experience. Older chemists with impaired eyesight will probably quarrel with the colour of the cover, the printing on which is most difficult to read, but these are minor points and do not detract from the value of what is essentially a most creditable and important production.

J. F. T.

The Ross Barrier.

IN a paper to the Royal Geographical Society on January 19, Mr. C. S. Wright gave an account of the Ross Barrier and the mechanism of ice movement. There is now little doubt that the barrier is bounded by high land on all sides except the north, although the ranges between Edward Land and the Maud ranges have still to be discovered. The area of this ice sheet may be given as approximately 150,000 square miles. Ample proof is forthcoming that the seaward edge of the barrier is afloat, although it is probably aground at the site of Amundsen's winter quarters east of the Bay of Whales. Observations have proved that the slope of the barrier is very slight and this must be interpreted as evidence that the barrier is afloat even quite close to its southern edge.

The barrier movement is compounded of the result due to the thrust of glaciers from the plateau on the west, south and east, and movement due to the flattening and outward extension of a thick mass of ice under its own weight. Mr. Wright gave evidence in support of the view that these two causes are roughly of equal importance. If no movement were

contributed by glacier thrust, certainly the general level character of the barrier surface would be maintained, provided that the barrier rests on a warm frictionless plane—the sea. If it rested on land, the bottom friction would be high, the temperature low, and the movement slight. On the other hand, the fact that there is little or no local thickening in the region of the outflow of land glaciers to the barrier must indicate an efficient water circulation beneath it. In that case, local thickening would involve local depression and increased local melting from below; thus the general surface level would be maintained. It is not possible to suppose that floating glacier tongues played no part in the formation of the barrier. Such tongues are common in the Antarctic and many of them extend far out to sea.

The barrier had probably a twofold origin. Numerous floating ice tongues from the large glaciers at the back of the Ross Sea were no doubt cemented together by sheets of sea-ice formed in situ in the areas between them. The latter process would entail the formation of sea-ice and precipitation of snow thereon at a rate exceeding that at which it melts below.

These conditions were certainly possible during the period of maximum glaciation, even if they do not now occur. Observations have shown that the rate of increase in thickness of sea-ice does not decrease largely as the thickness increases. This points to the fact that conduction of heat from below is not the sole cause of growth. At present there are sheltered positions in which sea-ice can form and maintain itself for more than one year. Mr. Wright, in discussing the mechanism of movement of ice, shows how uncertain and incomplete are our data for the rate of advance of the barrier, its snowfall and contributions to its mass from land glaciers.

University and Educational Intelligence.

ABERDEEN.—The University Court has resolved to institute a lectureship in clinical chemistry.

Dr. Alexander Bowman has been appointed lecturer on the scientific study of fisheries.

CAMBRIDGE.—The Statutory Commissioners have been approached by a number of members of the Senate on the question of the retiring age for professors, which was fixed in the recommendations of the Royal Commission at 65 years. The Commissioners favour the proposal that the Board of Electors to a professorship may, when a professor reaches the age of sixty-five, invite him to hold office up to an age not exceeding seventy, if it is believed that the interests of the University will best be served thereby. The Board of Electors is to be precluded from making any fresh election of a professor who is already more than 65 years of age, but if a candidate is elected who is over sixty, he may be elected to hold office up to the age of seventy.

Mr. W. B. R. King, Magdalene College, has been reappointed assistant to the Woodwardian professor of geology. On the nomination of the Department of Scientific and Industrial Research, Sir Joseph Broodbank is being appointed to the committee of management of the Low Temperature Station for Research in Biochemistry and Biophysics.

The Special Board for Mathematics has reported to the Senate, asking the University to take steps to enable the Tyson Medal to be struck in bronze, instead of in gold as at present, and to be accompanied by a prize in money.

The Board for Engineering Studies has recommended certain changes in the regulations for the Mechanical Sciences Tripos, including the sub-division of certain of the advanced subjects necessary for a First Class. Thus electricity and magnetism is replaced by electric power and electric signalling, and theory of structures and strength of materials by theory of structures (civil) and theory of structures (mechanical). Mechanics of machines also figures for the first time as a separate subject. It is proposed also to establish jointly with the University of Birmingham a diploma in coal-mining engineering, for which the general course of engineering at Cambridge should count as part of the training, this course to be followed by four months' practical experience in a coal mine and a year's course in mining at the University of Birmingham.

EDINBURGH.—At the meeting of the University Court on Monday, January 19, the resignation of Sir Harold J. Stiles, Regius professor of clinical surgery in the University, to take effect on March 20, was announced. The Principal expressed the great regret which was felt by the Court, the high appreciation of the eminent services which Sir Harold Stiles had rendered to the University, and the sense of the deep loss which would be sustained upon his retirement, not by the Court alone but by the University as a whole.

The Library of the Geology Department of the University has been indebted for a number of years to the late Sir Archibald Geikie for donations of valuable geological literature. The last consignment has recently been received from his daughters. This Library was gradually built up and strengthened by the Geikie brothers who in turn filled the chair of geology.

LONDON.—A course of eight free public lectures on "The Chemistry of the Internal Secretions" will be given by Mr. E. C. Dodds, at the Middlesex Hospital Medical School, at 5 o'clock, on February 3, 5, 10, 12, 17, 19, 26, and March 3; one of four by Dr. J. Duncan Scott, on "The Medullary Centres," at the Physiology Department of St. Bartholomew's Hospital Medical College, 6 Giltspur Street, E.C., at 5 o'clock, on February 11, 18, 25, and March 4; and one of four by Sir William I. de Courcy Wheeler, at St. Bartholomew's Hospital Medical College, at 5 o'clock, on February 16, 17, 18, and 19, on "Some Practical Considerations and Experiences in the Conservative Treatment of Fractures of the Pelvis and the Lower Extremity." Two courses of free public lectures at Birkbeck College are announced, namely, four, by Dr. G. G. Coulton, on "Medieval Education" (February 2, 9, 16, and 23), and three by Prof. E. N. da C. Andrade, on "The Structure of the Atom" (February 5, 12, and 19). The lecture hour in each case will be 5.30, and no tickets will be required.

ST. ANDREWS.—The degree of Ph.D. has been conferred on Mr. G. R. Ross for a thesis entitled "The Serological and Immunological Characteristics of Tubercle Bacilli after Extraction with Fat Solvents."

APPLICATIONS are invited for two lectureships at University College, Leicester, viz. in physics and in chemistry. The applications must reach the secretary of the college by February 13 at latest.

DR. WALTER MAKOWER has been appointed professor of science at the Royal Military Academy, in succession to Prof. J. Young, retired. Dr. de Mouilpied, who was to have filled this post, resigned without taking up the appointment. Dr. Walter Makower, who was lately chief physicist to the Dunlop Rubber Company, was for many years lecturer in physics at the University of Manchester.

Societies and Academies.

LONDON.

Royal Society, January 22.—H. C. H. **Carpenter** and Miss C. F. **Elam**: Experiments on the distortion of single-crystal test-pieces of aluminium. Single crystal test-pieces of aluminium can be extended up to 7 per cent. without recrystallising on heating to 600° C. They will recrystallise to form either another single crystal of a different orientation or several crystals, according to the degree of strain. When a large crystal grows from a number of small ones, it has no particular orientation or relation to the direction of mechanical strain. Unless the metal recrystallises, the distortion of the crystal is not removed by heating, and unless the metal recrystallises, the heating does not remove the whole of the hardness acquired through mechanical strain. Hardening by mechanical deformation can take place independently of change of orientation. The proportional increase in hardening is greatest during the early stages of extension, but in the case of single crystals a stage is reached when the increase in hardness is approximately proportional to the amount of plastic deformation.—W. S. **Farren** and G. I. **Taylor**: The heat developed during plastic extension of metals. Hollow bars of certain metals were subjected to plastic stretching. The work done on a measured length in the middle of the specimen was measured, and at the same time the rise in temperature at the centre of the bar was recorded. The heat generated varied from 86·5 per cent. of the heat equivalent of the work done, in the case of annealed steel, to 95 per cent. in the case of single-crystal specimens of aluminium. This ratio remained constant for one material during the whole range of the extension, which in the case of aluminium amounted to more than 50 per cent. of the initial length.—J. V. **Howard** and S. L. **Smith**: Recent developments in tensile testing.—R. L. **Smith-Rose** and R. H. **Barfield**: On the determination of the directions of the forces in wireless waves at the earth's surface. The propagation of wireless waves over the earth's surface implies the reception of two or more distinct waves at an appreciable distance from the transmitting station. One of these is assumed to arrive at the earth's surface after reflection or refraction from the upper portions of the atmosphere, and an attempt is made to detect it by measuring the inclination of the wave-front of the arriving wave. Such a downcoming wave would give rise to a reflected wave which, at the earth's surface, will interfere with the incident wave in such a way as to tend to eliminate the horizontal component of the electric force and the vertical component of the magnetic force. The conductivity of the earth at wireless frequencies was determined experimentally by measuring the "forword tilt" of the waves arriving from neighbouring transmitters for a number of sites in South England. A moderately consistent value of about 10^8 (e.s.u.) was obtained, and calculations from this value show that the directions of the resultant forces at the surface will always be sensibly the same as those of a horizontally propagated wave.—D'Arcy **Thompson**: On the thirteen semi-regular solids of Archimedes, and on their development by the transformation of certain plane configurations. The thirteen isogonal non-isohedral solids attributed to Archimedes stand in close relation to the ten regular plane repeating patterns or "nets" first described by Kepler, which consist of regular and identical sets of congruent polygons. If, in the table of indices giving the number of triangles, squares, etc., found at each junction (or node), the *order* of an index be successively reduced, we pass accordingly from the plane polygonal assemblage to some one, and then to another, and so on, of the indices which characterise the several polyhedra. This transformation may be performed mechanically, by constructing a hinged net, removing (*i.e.* replacing by fenestræ) the polygons of a certain order, and allowing those which remain to slide over and so overlap one another.—F. G. **Mann** and Sir William **Pope**: 1 : 2 : 3-Triaminopropane and its complex metallic compounds.—D. L. **Chapman**, J. E. **Ramsbottom**, and C. G. **Trotman**: The union of hydrogen and oxygen in presence of silver and gold. The catalytic activity of silver is considerably reduced by heating to dull redness in oxygen, independently of the pressure of the oxygen in which it has been heated, provided that this pressure exceeds 0·005 mm. of mercury. As the pressure of the oxygen is diminished further, the activity of the treated metal falls rapidly, reaching a maximum when the oxygen pressure is 0·0013 mm. After silver has been heated to dull redness in oxygen at a pressure higher than 0·005 mm., it would seem to be covered with a thin film of silver oxide, which is a less powerful catalyst than the metal itself. Gold furnished similar but less pronounced results. In the presence of the film of silver which was formed on the surface of the glass during the experiments, hydrogen and oxygen will combine at the temperature of the laboratory.—U. R. **Evans**: The colours due to thin films on metals. Mallock has objected to the interference-theory of the colours on the grounds that he had failed to alter the colours of tempered iron by polishing the metal. It has now been shown that the colours can be changed when the thickness of the film is uniformly reduced by cathodic treatment in dilute hydrochloric acid. Raman has proposed that the colours are due to a granular structure; but the colours on molten lead can be obtained as easily when the oxide-film is molten as when it is solid, and thus the "granular theory" fails. The oxide-films have been lifted off molten lead, and examined, supported on glass; the colours by transmitted light are complementary to those by reflected light, as is to be expected on the interference view.—A. **Campbell**: On the determination of resistance in terms of mutual inductance. A new method of balancing mutual inductance against resistance is described, in which one of the conditions of balance is independent of frequency and can be set once for all, while the second condition gives a very simple relation between the frequency, two resistances and two mutual inductances.—S. **Butterworth**: On the alternating-current resistance of solenoidal coils. The general theory of eddy-current losses in cylindrical conductors is employed to establish formulæ for computing the alternating-current resistance of single-layer solenoidal coils. Two formulæ are obtained which are shown to be in reasonable agreement with observation, except when the frequency is extremely high. The formulæ should be applicable so long as the current may be regarded as having uniform distribution throughout the coil.—A. J. **Allmand** and V. S. **Puri**: The effect of superposed alternating current on the polarisable primary cell zinc—sulphuric acid—carbon. Part I.: Low-frequency current. Ten years ago Brown showed that, if an alternating current of either 100 or 12,000 periods and of suitable intensity were passed through the above primary cell, the polarisation of the latter was reduced and its current output increased. The experiments were repeated and extended, using alternating-current frequencies of 20 to 400 cycles per second, the potentials of the two electrodes being measured whilst the currents were running. The

results showed conclusively that, with such frequencies, the carbon electrode is chiefly responsible for the decreased polarisation and increased cell current. The lower the frequency, the greater the effect. At the same time there were certain indications that, with higher frequencies, an effect would be produced at the zinc electrode, as observed by Brown.—R. W. **Lunt**: The interaction of carbon dioxide and hydrogen in the corona due to alternating currents of high frequency. Alternating electric fields of frequency $1{\cdot}5 \times 10^7$ have been used. An equimolecular mixture interacts, giving a water-gas equilibrium, which is also attained by exposing mixtures of carbon monoxide and water vapour to the discharge. In no case has it been possible to detect the formation of formic acid or formaldehyde. T. **Royds**: The apparent tripling of certain lines in arc spectra. As many spectra as possible were searched through the visible region for instances of lines becoming complex when the amount of material in the arc was increased. Only seven cases were found, all of which apparently become triple with a sufficient quantity of material. The Tl line 5350 passes through five successive phases, namely, broad simple reversal, triplet, doublet, a second triplet form, and a final doublet, as the amount of material in the arc burns out. This line is essentially a doublet, and all the different phases can be explained as different stages in the self-reversal of the two lines of the doublet. A similar explanation was adopted for the six remaining instances of apparent tripling, as all except two were found to assume a doublet form as the final phase.—E. **Newbery**: Overvoltage and transfer resistance.

Physical Society, December 12.—A. C. **Egerton**: Numerical values of chemical constants and frequencies of the elements. The experimental evidence for the general chemical constant C_0 possessing the theoretical value ($-1{\cdot}589$) is collected. A linear relation between logarithm of mass and characteristic temperature is indicated.—J. H. **Powell**: The sensibility of circular diaphragms for the reception of sounds in water. The diaphragms were mounted with one face immersed in water and to the other was attached a microphonic or electro-magnetic detector. They were all designed to have a frequency of 850~ under these conditions. The response of the diaphragms to sounds of a single definite frequency was measured, and resonance curves were obtained from which the magnitude of the damping due to the detector was determined. The corrected values for the resonance amplitude and for the persistence of vibration were consistent with those determined mathematically by Prof. H. Lamb for diaphragms under ideal conditions. The investigation was extended successfully to cover complex sounds or "noises" of no definite pitch.—A. **Campbell**: A direct-reading frequency meter of long range. A direct-reading frequency meter for audio frequencies is described. It is a null instrument, reading by single adjustment, the working system embodying a new method of balancing mutual inductance by resistance. The standard type has five ranges, covering from 180 to 4000~ per second, with accuracy of the order of 1 in 1000, and negligible temperature coefficient except at the lowest frequencies.

Linnean Society, January 8.—E. S. **Goodrich**: On the cranial roofing-bones in the Dipnoi. A general fundamental plan of the roofing-bones of the skull can be made out, to which conform the primitive Teleostomi and Tetrapoda. The earliest fossil dipnoan, Dipterus, appears to possess the usual paired frontals and parietals (still more distinct in Scaumenacia); but Messrs. Watson and Gill identify these as nasals and frontals, and believe the parietals to be represented by the median posterior occipital plate. The bones in early Dipnoi conform to the general plan; but in the course of specialisation the paired frontals and parietals tend to become reduced in size, separated in the middle line, and more and more superseded by a series of median elements, of which the median occipital is the largest and most constant.—C. C. **Lacaita**: (1) A note on *Colchicum montanum* Linn. The name *Colchicum montanum* must be abandoned altogether. It has generally been used for the Italian *C. Bertolonii*, but *C. montanum* of Linn. Sp. Pl. is a mixture of *Merendera Bulbocodium* with *Colchicum alpinuum*, while the specimen in herb. Linn. is really *C. Bulbocodium* from the eastern Mediterranean. It was not sent to Linnæus by Loefling, for it does not grow in Spain, and the sheet is marked on the back "Habitat in Morea." The spring-flowering *C. Bulbocodium*, with broader leaves and more nerves in the sepals, is a distinct species from *C. Bertolonii*. (2) Some critical species of Marrubium. The Linnean diagnoses were written for Hort. Cliff., and only repeated in Sp. Pl. Therefore H. Cliff. specimens and not those of herb. Linn. are decisive, except in the case of *M. hispanicum*. The Adriatic plant usually called *M. candidissimum* is not that of Linnæus, and must bear the name of *M. incanum* Desr. True *M. candidissimum* Linn. is a species from Asia Minor. J. C. **Waller**: On types of electric response in plants.

DUBLIN.

Royal Irish Academy, January 12.—H. **Ryan** and J. **Lennon**: The condensation of aldehydes with methylethylketone: γ-benzylidene-methylethylketone condenses with benzaldehyde to yield iso-methyldiphenylcyclopentenone, with anisaldehyde to yield 1-methyl-4-anisyl-5-phenyl-cyclo-penten(3)-one(2) and with piperonal to form 1-methyl-4-piperonyl-5-phenyl-cyclo-penten(3)-one(2). When isomethyldiphenylcyclopentenone is warmed with dilute alcoholic hydrochloric acid, it changes into methyldiphenylcyclopentenone. This compound condensed with benzaldehyde to yield benzylidene-methyl-diphenylcyclopentenone, which is identical with the tri-condensation product of benzaldehyde and methylethylketone obtained by Ryan and Devine. Anisaldehyde condensed with methylanisylphenylcyclopentenone to yield anisylidene-methylanisylphenylcyclopentenone, and the isomeric compound obtained by Ryan and Devine by the action of anisaldehyde on α-benzylidene-methylethylketone is anisylidene-methylphenylanisylcyclopentenone.

CALCUTTA.

Asiatic Society of Bengal, January 7.—Johan van **Manen**: A collection of Tibetan proverbs. More than 200 sayings have now been gathered.—Sunder Lal **Hora**: On the habits of a succineid mollusc from the Western Ghats. In August 1924 a new species of Succinea was discovered hibernating on the bark of mango trees at Lonavla. Several members of the family Succineidæ are known to aestivate over periods of draught by æstivating, but none have so far been recorded in a comatose condition during the rainy season. Other members of this family have been found on rocks, but this is the first occasion when a succineid mollusc has been found hibernating on barks of trees.

SYDNEY.

Linnean Society of New South Wales, November 26.—H. M. **Hale**: Two new Hemiptera from New South Wales. Description of a new genus, from Berowra

Creek and Epping, belonging to the Notonectinæ, and a new species of Salda from Wentworth Falls.—W. A. **Haswell**: Critical notes on the Temnocephaloidea. A description is given of the female part of the reproductive apparatus in various species of Temnocephala from Australia, New Zealand, and South America. The relations of the vesicles variously known as receptacula seminis, receptacula vitelli, and vesiculæ resorbientes are described and their functions and homologies discussed.—P. **Brough**, J. **McLuckie**, and A. H. K. **Petrie**: An ecological study of the flora of Mt. Wilson. Pt. I.: The vegetation of the basalt. The origin and distribution in Eastern Australia of the Malayan floristic elements are discussed, and an account is given of the structure, composition, inter-relationships, and distribution of the plant communities occupying the basalt caps at Mt. Wilson, the flora of which is largely composed of Malayan elements. A detailed study is made of the overlapping of the Malayan flora of the basalt, and the endemic flora of the adjacent sandstone.

WASHINGTON, D.C.

National Academy of Sciences (Proc., Vol. 10, No. 11, November).—H. **Fricke** and O. **Glasser**: The secondary electrons produced by hard X-rays in light elements. The ionisation current was measured in ionisation chambers (0·5-9 c.c. in volume) constructed entirely of the material under examination, which are small in comparison with the path of the photo-electrons in the chamber. In these circumstances, the current can be represented, according to Compton's theory of scattering of X-rays, as the sum of two quantities, one of which is independent of the effective atomic number of the scattering substance. The ratio of these quantities is determined and agrees with that calculated, using Compton's theory, from other data, for two nearly homogeneous radiations.—C. **Barus**: The diffusion of hydrogen into air, measured by the interferometer U-gauge. Essentially, the method is to measure the pressure at the closed top end of a vertical tube while hydrogen diffuses from the open bottom end. Using various tubes of different length and diameter, the diffusion constant is always considerably higher than the generally accepted value.—W. N. **Birchby**: White light interference fringes with a thick glass plate in one path. A glass plate is inserted in one of the paths of a Michelson interferometer. The fringes are alternately red and green, while the central fringes are indeterminate. For the central region the effect is due to interference in one narrow range of the spectrum superimposed on uniform illumination from the rest of the spectrum.—J. **Kendall** and J. F. **White**: The separation of isotopes by the ionic migration method. If isotopic ions have significant different mobilities, it should be possible to effect separation by electrolysis (NATURE, June 2, 1923, p. 763). Preliminary short runs were made in which it was found possible to effect separation of iodide and thiocyanate ions (16 per cent. mobility difference), barium and calcium ions (8 per cent. difference), barium and strontium ions (5 per cent. difference), and iodide and chloride (about 1 per cent.). A 5 cm. sodium chloride section (0·1 N) between sodium hydroxide and acetate was moved 1000-2000 cm. with inconclusive results. The tubes used, 1·5 in. wide, are not big enough to give segments suitable for ordinary analysis.—W. J. **Crozier**: On the possibility of identifying chemical processes in living matter. Chemical transformations proceed according to Arrhenius's equation, that the velocity of monomolecular change is proportional to the exponential of $-E/RT$, where R is the gas constant, T the absolute temperature, and E is the amount of heat required to convert 1 gm. molecule of the reactant from an inactive to a reactive form. E is thus characteristic of the reactant and, in simple chemical processes, of the catalyst. The velocities of many biological processes are influenced by temperature in a manner similar to ordinary chemical reactions, and the critical increments, or *temperature characteristics*, of the former fall into definite groups. Physiological transformations of a similar type give identical values for this constant suggesting the presence of similar catalytic agents (*not* enzymes). This points to the possibility of the identification of chemical transformations in undisturbed living matter.—R. L. **Moore**: Concerning sets of segments which cover a point set in the Vitali sense.—A. E. **Kennelly**: Time constants for engineering purposes in simple exponential transient phenomena.

Official Publications Received.

Publications of the Astronomical Institute of the University of Amsterdam. No. 1: Researches on the Structure of the Universe. 1: The Local Starsystem deduced from the Durchmusterung Catalogues. By A. Pannekoek. Pp. ii+122+6 charts. (Amsterdam: Stadsdrukkerij.)

Europe as an Emigrant-exporting Continent and the United States as an Immigrant-receiving Nation. Hearings before the Committee on Immigration and Naturalization, House of Representatives. Sixty-eighth Congress, First Session, March 8, 1924. Serial 5-A. Statement of Dr. Harry H. Laughlin. With Appendices printed by Authorization of the Committee, including (1) Text of Immigration Act of 1924 and the Proclamation of the President in connection therewith, (2) Report of the Rome Conference on Emigration and Immigration, and (3) Other important Studies and Official Reports on Migration Problems down to November 19, 1924. Pp. v+1231-1437. (Washington: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1924, No. 7: Statistics of Public High Schools, 1921-1922. Prepared under the Direction of Frank M. Phillips. Pp. 69. 10 cents. Bulletin, 1924, No. 11: Manual Arts in the Junior High School. By William E. Roberts. Pp. iv+89. 15 cents. Bulletin, 1924, No. 20: Statistics of Universities, Colleges and Professional Schools, 1921-22. Prepared under the Direction of Frank M. Phillips. Pp. 161. 20 cents. (Washington: Government Printing Office.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 273: Earth Movements in California. By William Bowie. (Special Publication No. 106.) Pp. 22. (Washington: Government Printing Office.) 5 cents.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 48 (Botanical Section): The Effects of Heat Treatment of Cotton Seed and its Germination and on the subsequent Growth and Development of the Plants. By James Templeton. Pp. 9+3 plates. (Cairo: Government Publications Office.) 5 P.T.

Air Ministry: Meteorological Office, London. Southport Auxiliary Observatory (The Fernley Observatory of the Corporation of Southport). Annual Report and Results of Meteorological Observations, for the Year 1923. By Joseph Baxendell. Pp. 28. (Southport: Fernley Observatory; London: Meteorological Office.)

Havsforskningsinstitutets Skrift. No. 17: Wasserstandsregistrierungen in Helingsfors 1904-1920. Von Henrik Renquist. Pp. 75+3 plates. 15 Fmk. No. 19: Dagliga vattenståndsuppgifter 1921. Referat: Tägliche Wasserstandsangaben 1921. Av Henrik Renquist. Pp. 30. 3 Fmk. No. 20: Regelbundna iakttagelser av havets temperatur och salthalt under år 1921. Referat: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1921. Av Gunnar Granquist. Pp. 54. 6 Fmk. No. 22: Isarna vintern 1920-21. Referat: Das Meereis im Winter 1920-21. Av Gunnar Granquist. Pp. 79+11 plates. 30 Fmk. No. 24: Ström- och vindobservationer vid fyrskeppen år 1922. Referat: Strom- und Windbeobachtungen an den Leuchtschiffen im Jahre 1922. Av Gunnar Granquist. Pp. 40. 4 Fmk. No. 25: Havsforskningsinstitutets värksamhet under år 1922. Av Rolf Witting. Pp. 25. 3 Fmk. No. 26: Regelbundna iakttagelser av havets temperatur och salthalt under år 1922. Referat: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1922. Av Gunnar Granquist. Pp. 53. 6 Fmk. No. 27: Talassologiska värexpeditionen 1923. Referat: Die thalassologische Terminfahrt im Jahre 1923. Av R'sto Jurwa. Pp. 28+1 plate. 4 Fmk. No. 29: Dagliga vattenståndsuppgifter 1922. Referat: Tägliche Wasserstandsangaben 1922. Av Henrik Renquist. Pp. 44. 7 Fmk. No. 31: Havsforskningsinstitutet värksamhet under år 1923. Av Rolf Witting. Pp. 25. 4 Fmk. (Helsingfors.)

A Short Account of the Growth of the University of Leeds. Pp. 31. (Leeds.)

Leeds University. General Prospectus. Jubilee edition. Pp. 47+6 plates. (Leeds.)

Diary of Societies.

MONDAY, FEBRUARY 2.

CAMBRIDGE PHILOSOPHICAL SOCIETY, at 4.30.

ROYAL INSTITUTION OF GREAT BRITAIN (General Meeting), at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. Z. Cope: Extravasation of Bile.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—A. S. Buckle: Presidential Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Plymouth), at 6.—H. Marryat: Electric Passenger Lifts.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.15.—G. Rogers: Automatic and Semi-Automatic Mercury-Vapour Rectifier Substations.

JUNIOR INSTITUTION OF ENGINEERS (North-Western Section) (at 16 St. Mary's Parsonage, Manchester), at 7.15.—G. B. Walker: The Design and Construction of a Piano Player.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street, W.C.), at 8.—Prof. G. H. Langley: Values and Temporal Experience.

ROYAL SOCIETY OF ARTS, at 8.—V. E. Pullen: Radiological Research—a History (III.) (Cantor Lectures).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—E. J. Lush: Kinetics of Hydrogenation.—C. O. Condrup and E. W. Smith: Tar Distillation by means of the T.I.C. (Lead Bath) Process.

INSTITUTE OF THE RUBBER INDUSTRY (London Section) (at Engineers' Club), at 8.—W. G. Martin: The Calender in the Rubber Industry.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—President's Address and Presentation of Prizes.

TUESDAY, FEBRUARY 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. H. R. Hall: The Connexion and Relations of the Prehistoric Greek and Ancient Egyptian Civilisations (II.).

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, at 5.30.—Prof. W. L. Bragg: (*a*) Model illustrating the Formation of Crystals; (*b*) Exhibit of Diffraction Gratings constructed to illustrate the Effect of Crystals on X-Rays.—R. W. James: The Structure of Barium Sulphate.—Dr. E. C. S. Dickson: The Flettner Rotor-Sail.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. H. I. Waterman and J. N. J. Perquin: Decomposition of Paraffin Wax at 450° C. in Presence and in Absence of Hydrogen under High Pressure.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the months of November and December 1924.—G. C. Robson: Exhibition of a Giant Squid (*Stenoteuthis caroli*) recently stranded on the Yorkshire Coast.—M. S. Mackinlay: The Language of the Emotions: Universal Methods of Expression.—Dr. N. S. Lucas: Ill-health in Captive Wild Animals and its Causes.—Prof. O. Fuhrmann and Dr. Jean G. Baer: Zoological Results of the Third Tanganyika Expedition conducted by Dr. W. A. Cunnington, F.Z.S., 1904–1905.—Report on the Cestoda.—Doris R. Crofts: The Comparative Morphology of the Cæcal Gland (Rectal Gland) of Selachian Fishes.—S. Hirst: Descriptions of New Acari, mainly parasitic on Rodents.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—W. B. Lewis and G. S. Irving: The Treatment of Boiler Feed Water.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—A. B. Mallinson and others: Discussion on Justifiable Small Power Plants.

INSTITUTE OF METALS (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7.—Discussion on Metal Melting.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Section) (at Broadgate Café, Coventry), at 7.15.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7.15.—Dr. T. Slater Price: The Action of Light on the Photographic Plate.—J. I. Graham and F. Lawrence: The Use of Iodine Pentoxide in the Estimation of Carbon Monoxide.

INSTITUTE OF METALS (North-East Coast Section) (at Armstrong College, Newcastle-on-Tyne), at 7.30.

RÖNTGEN SOCIETY (at British Institute of Radiology, 32 Welbeck Street, W.), at 8.15.—Major C. E. S. Phillips: Constant Voltage High Tension Generators.—C. H. Holbeach: (*a*) Some Further Aspects of the Theory and Operation of Potter-Bucky Diaphragms; (*b*) Demonstration of the New C.D.X. Dental X-Ray Equipment.

WEDNESDAY, FEBRUARY 4.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. H. P. W. White: The Pathology of Hydronephrosis.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. A. Heard: The Petrology of the District between Nevin and Clynnog-fawr (Carnarvonshire).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—L. B. Turner and F. P. Best: The Optimum Damping in the Auditive Reception of Wireless Telegraph Signals.

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7.30.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (Annual General Meeting) (at Chemical Society), at 8.—Presidential Address.—(Ordinary Meeting).—Dr. D. Hooper: Cinchonine as a Tannin Precipitant with Special Reference to the Analysis of Cutch and Gambier.—C. Ainsworth Mitchell: The Examination of Charred Documents.—H. R. Ambler: The Absorption of Carbon Monoxide in Gas Analysis.

ROYAL SOCIETY OF ARTS, at 8.—Sir Ernest Rutherford: The Stability of Atoms (Trueman Wood Lecture).

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL SOCIETY OF MEDICINE (Surgery, Medicine, Anæsthetics, Pathology, Obstetrics and Gynæcology Sections), at 8.—Sir Charles Gordon-Watson, E. C. Lindsay, and others: Special Discussion on The Prevention and Treatment of Post-Operative Pulmonary Affections.

THURSDAY, FEBRUARY 5.

ROYAL SOCIETY, at 4.30.—H. M. Carleton: Growth, Phagocytosis and other Phenomena in Tissue Cultures of Fœtal and Adult Lung.—F. W. Fox and J. A. Gardner: The Origin and Destiny of Cholesterol in the Animal Organism. Part XIV. The Cholesterol Metabolism in Normal Breast-fed Infants.—H. H. Thomas: The Caytoniales. A new Group of Angiospermous Plants from the Jurassic Rocks of Yorkshire.—Dr. Winifred Brenchley and H. G. Thornton: The Relation between the Development, Structure, and Functioning of the Nodules on *Vicia Faba* as influenced by the Presence or Absence of Boron in the Nutrient Medium.—*To be read in title only*:—A. S. Rau, F. W. R. Brambell, and Prof. J. B. Gatenby: Observations on the Golgi Bodies in the Living Cell.—V. Nath: Cell Inclusions in the Oogenesis of Scorpions.—L. J. Harris: The Combination of Proteins, Amino-Acids, etc. with Acids and Alkalis and their Combining Weights, as determined by Physico-Chemical Measurements.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. G. P. Bidder: Growth and Death: a Discussion.—Dr. J. Burtt-Davy: The Geographical Distribution of the Arborescent Vegetation of Subtropical South Africa.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: The Properties and Structure of Quartz (II.).

ROYAL AERONAUTICAL SOCIETY, at 5.30.—Air Commodore C. R. Samson: The Operation of Flying Boats in the Mediterranean.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Mrs. V. Plincke: The Waldorf School, Stuttgart.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. J. H. Jeans: Electrical Forces and Quanta (Kelvin Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.—P. G. J. Gueterbock: Tin.

CHEMICAL SOCIETY, at 8.

SOCIETY OF DYERS AND COLOURISTS (West Riding Section).—Prof. H. E. Armstrong: Colour Problems.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Meeting).—J. Biggam: Methods of Determining the Properties of Steam.

INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Meeting).

FRIDAY, FEBRUARY 6.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—J. T. Marten: The Indian Census.

ROYAL DUBLIN SOCIETY, at 4.30.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. H. Todd: Syphilitic Arthritis.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—J. B. Dahlerus: Anti-Friction Bearing Applications for Heavy Duty.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at 16 St. Mary's Parsonage, Manchester), at 7.—Dr. T. Callan: The Detection and Determination of Alpha-Naphthol in Beta-Naphthol.—W. J. S. Naunton: Some Organic Rubber Vulcanising Accelerators.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—E. G. Herbert: The Measurement of Hardness and Allied Properties of Metals.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—H. Smith: Constructional Work.

PHILOLOGICAL SOCIETY (at University College), at 8.—N. W. Thomas: The Sudanic Languages.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. R. W. Chambers: The Earliest Recorded Kings of the English.

SATURDAY, FEBRUARY 7.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.), at 3.—Dr. J. R. Leeson: The Evolution of Man.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. H. Fellowes: The Elizabethan Ayre.

PUBLIC LECTURES.

SATURDAY, JANUARY 31.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: The Empire of Egypt.

MONDAY, FEBRUARY 2.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—Dr. E. B. Behrens: International Labour Organisation.

BIRKBECK COLLEGE, at 5.30.—Dr. G. G. Coulton: Medieval Education (I.) The Monastic School.

TUESDAY, FEBRUARY 3.

MIDDLESEX HOSPITAL MEDICAL SCHOOL, at 5.—E. C. Dodds: Chemistry of the Internal Secretions. (Succeeding Lectures on February 5, 10, 12, 17, 19, 26, and March 3.)

UNIVERSITY COLLEGE, at 5.30.—W. J. Perry: The Beginnings of Civilisation.—W. H. Baynes: Some Aspects of Byzantine Civilisation (I.) Constantinople. (Succeeding Lectures on February 10, 17, 24.)

KING'S COLLEGE, at 5.30.—Miss Hilda D. Oakeley: The Religious Ideas of Plato.

GRESHAM COLLEGE, at 6.—A. R. Hinks: Our Place in the Universe. (Succeeding Lectures on February 4, 5, 6.)

UNIVERSITY OF LEEDS, at 8.—Dr. W. H. Pearsall: Woodlands and Moorlands in Yorkshire.

WEDNESDAY, FEBRUARY 4.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—H. P. Shapland: The Principles of Design as applied to Furniture.

KING'S COLLEGE, at 5.30.—Prof. A. Mawer: The Viking Age, A.D. 800-1000.

UNIVERSITY COLLEGE, at 5.30.—R. E. Flower: The Use of Libraries (II.) Collections and Manuscripts.

THURSDAY, FEBRUARY 5.

BIRKBECK COLLEGE, at 5.30.—Prof. E. N. da C. Andrade: The Structure of the Atom (I.). (Succeeding Lectures on February 12, 19.)

KING'S COLLEGE, at 5.30.—Lt.-Commdr. A. S. E. Sutton: The Civilisation of China: General View.

FRIDAY, FEBRUARY 6.

UNIVERSITY OF LEEDS AND LEEDS PHILOSOPHICAL AND LITERARY SOCIETY (at Philosophical Hall, Leeds), at 8.—Prof. J. Garstang: The Archæology of Palestine.

SATURDAY, FEBRUARY 7.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—R. P. G. Denman: The Development of Modern Radio Communication.