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## Scientific Method in Educational Administration.

THE council of the British Science Guild has recently been directing its attention to the machinery of public educational administration in England, and has been endeavouring to find the main causes of the dissatisfaction on the subject which undoubtedly exists throughout the country, with the view of suggesting some remedy on a reasoned basis of scientific method. The executive of the Guild had drawn up a series of resolutions which it proposed to discuss last year with Mr. Wood, then Minister of Education, at a deputation which he had fixed for the end of November last. All arrangements made were, however, upset by the decision of the Government to appeal to the country, and further action has been delayed by the result of the general election. The Guild, thereupon, with the object of broadening the basis of its appeal, has set out in the February issue of its Journal a general statement of the reasons leading up to the resolutions which it desired the Minister to consider, and on this statement we propose to comment.

It is common ground that the present working of educational administration is regarded with deepening disfavour by the educational and general public. The complexity of the regulations, and of the circulars issued so frequently, produces a sense of helplessness in those concerned; their details irritate and confuse, while their lack of co-ordinated principle provokes a feeling of apathy or of cynicism. The present relation of the Education Office to authorities and institutions is not unlike that of the War Office to military operations before Lord Haldane's reforms separated staff work from field work and distinguished the function of planning and organising from that of carrying plans into effect. The Board of Education is as yet less concerned with education, its principles and methods, than with scrutinising the expenditure of Parliamentary grants for education. Such scrutiny, necessitated by the provisions of the Education Act of 1918, may be so conducted as to obscure and even to eclipse the object for which the grants are made. In proportion as the Board's energies are absorbed by finance, so far it becomes, as has been said, a mere outpost of the Treasury, unable and even unwilling to inspire or to lead in its own sphere of education. This is the Guild's chief point: it maintains that the Board is losing sight of its proper objective. If this diagnosis be correct, an important organ of the body politic is not functioning properly.

There is historic reason for this. The Education Department, the duties of which the Board has absorbed, was in existence long before local authorities for

education were constituted. At their establishment, no real or satisfactory readjustment of the work proper to central as distinct from other authorities was made, and none has since been made. Overlapping is, therefore, a natural outcome. We agree with the Guild in thinking that the time is ripe for a full and complete consideration and readjustment of relations; also, that it would be advisable to refer this matter to an authoritative Committee before which would be placed the views of all the parties concerned: namely, the Treasury, which rightly insists on adequate oversight of public moneys; the Board of Education, which ought to insist on that kind of scrutiny alone being required as shall not hamper it in its proper work of promoting national education; the local authorities, which desire that their initiative within their own area shall not be unduly checked; and the teaching profession, which claims for its members stable and satisfactory conditions of service.

If such a Committee were appointed, the desirability of applying scientific method to the solution of its problems is evident. The right assignment and apportionment of educational and financial functions among the bodies concerned is of prime importance; for all must in some measure exercise each of these duties. It is of supreme importance that a more elastic system of financial supervision by the Board should be devised which would allow it to occupy itself (as now is not the case) chiefly with its proper work—in seeing that educational benefits are made available on equal terms to all; that the teaching given in the various institutions is of the right kind and reaches an adequate standard of quality; that the general conditions of teaching, whether status, emoluments, or tenure, are satisfactory; and that educational tests are of an even and recognised value. Local authorities should in like manner be freed to devote themselves to their prime duties of ensuring that good schools and institutions of appropriate kinds are established or made accessible in every part of the area; and of promoting and encouraging local interest and co-operation in their management.

These freedoms depend on a rehandling of educational scrutiny, particularly in the matter of what the Act calls "approved expenditure." The Board's scrutiny is applied with equal rigidity and minuteness to the largest and the smallest authority—a bureaucratic method which exalts finance at the expense of education and results in a duplication—by the Board to satisfy the Treasury and by the authority to satisfy the Board—to which convenience and common sense alike are opposed. It is at this point that the scientific method of differentiation as opposed to mere uniformity is commended by the Guild to the committee of investigation. It asks that public control should be exercised by means of grants made on large and not on small units, and that methods of scrutiny should not necessarily be uniform. An important precedent is quoted. The Treasury has adopted a thoroughly reasonable scrutiny in the case of grants made to universities, and the Guild pleads for an extension of this method, by applying it, *mutatis mutandis*, in the case of authorities administering wide areas and of large technical institutions. This, in the language of mathematics, is a call to distinguish between values of different orders of magnitude.

In still another aspect the Guild puts in a nutshell a distinction of the greatest importance. "Control" ought to be distinguished from "administration"; that is, a separation should be made between the right of a superior authority to exercise control by basing its grants on broad principles and the duty of the lesser authority, under due safeguards, to apply the principles and to supervise the details.

The Guild thus invokes the aid of scientific method in educational administration by advocating differentiation rather than unbending uniformity. It emphasises distinction of function as well as of method, claiming that the proper aim of authorities regarded in lessening circles of responsibility—from the Board to the school—should be recognised in administration, so that the real interests of education should not be sacrificed to the gods of the machine; it asks for separation in practice between principles of control and the details of finance; it urges the desirability of different methods of scrutiny being applied to authorities and institutions of different magnitudes.

These recommendations may involve some trouble in working out, and will be resisted by those who are wedded to the rigid exercise of bureaucratic uniformity, but they contain the root of the matter. Their objective is the promotion of education in all its diversities, not the protection of machinery. Education is our greatest national asset, and its circulation must not be impeded nor its development checked by regulations which, however well intentioned, are based on no scientific principles and are applied with a maximum of bureaucratic intervention. Above all, a Board of Education should be true to its title, and be concerned, therefore, chiefly with the promotion of education instead of the checking of petty details of expenditure on returns demanded from local authorities. At present, nearly all the work done at the Board is of this narrow clerical type; and we look to it in vain for the stimulus and leadership essential to progressive development, and which it should be the special function of a national educational department to provide.

## The Structure of the Atom.

*Atomic Structure and Spectral Lines.* By Prof. Arnold Sommerfeld. Translated from the third German edition by Henry L. Brose. Pp. xiii+626. (London: Methuen and Co., Ltd., 1923.) 32*s.* net.

*La Constitution de l'atome et les raies spectrales.* Par Prof. A. Sommerfeld. Traduit sur la troisième édition allemande par H. Bellenot. (Collection de Monographies Scientifiques Étrangères.) Premier fascicule. Pp. vii+384. 25 francs. Deuxième fascicule. Pp. 385-744. 30 francs. (Paris: Albert Blanchard, 1923.)

WHEN physicists and chemists awoke from the coma of the years of War and began once again to take an interest in the realms of knowledge in which they had formerly lived and worked, they found that certain developments of fundamental importance had taken place during the period in which so many men had been occupied in "going to and fro in the earth and walking up and down in it." These developments, as was perhaps inevitable, were more noteworthy in the region of new ideas than of new experimental results, since during the period of "going to and fro" there was but little opportunity for experimental research, although there was occasionally a superabundance of time for thinking. Thus it was during the years of War that Aston conceived the brilliant idea of applying to positive rays the principle of the direct-vision spectroscope; but it was only on his release from war-service that the mass-spectrograph took on a material shape, and led to a new form of chemistry in which isotopes have taken the place of elements, and fractional atomic weights have been superseded by integral atomic numbers.

On the physical side of the borderland between physics and chemistry, no event was perhaps of greater importance than the appearance in September 1919 of the first German edition of Prof. Sommerfeld's "Atombau." The almost simultaneous appearance of English and French translations of the third edition of this work is a fitting tribute to its unique value. The work itself has now been in continuous use for nearly five years, and has long been familiar to those who are most closely concerned with the problems with which it deals. In the present review, therefore, it is only necessary to consider the translations, and their influence in widening still further the circle of readers to whom Sommerfeld's masterly exposition of sub-atomic phenomena is now available.

The translator of such a work is certainly faced with a difficult problem, not only in transposing correctly a highly complex argument from one language to another, but also in eliminating those indications of the "language of the country of origin" which are so specially persistent when the language in question is German. In the former respect both translators have been successful; and if, in reading the English translation, phrases have occasionally been found the meaning of which was rendered clearer by turning to the French edition, it is not unlikely that the converse observation might have been made if the French translation has been read to the same extent as the English. Only occasionally, however, has the meaning of a phrase been reversed in these various renderings of the same passage, as, for example, when the French translator considers "qu'il est juste" to compare Bode's law of the distribution of the planets with Bohr's stationary orbits, whilst the English translator (p. 67), concurring more closely with the German author, "declines to regard this as a result of the quantum theory."

The English translator is, however, obviously less completely familiar with chemical physics than with mathematical physics, since he replaces calcspar by felspar on p. 121 and by fluorspar on p. 125, and on p. 123 assigns to cuprite the formula $CuO_2$. He also gives an unusual rendering of familiar phrases when he describes kilogram-calories as "major calories" and Mendeléeff's "long periods" as "great periods," and refers to Mendeléeff's *dwi*-manganese as *eka-eka*-manganese. "Spotting" (p. 122) is also not a conventional rendering of the familiar process of dispersing or pulverising metals, which is expressed by the German word "Zerstäuben"; and the "activity of the prepared substance" (p. 49) would be rendered more correctly as the "activity of the preparation." "Gramm-atom" (p. 6) is also an unusual spelling of a familiar unit, and "isomorphic" (p. 125) is more familiar in the form of "isomorphous," when applied to crystals.

In the earlier sections, the English translator has been hampered, to a far greater extent than his French colleague, by the attempt to follow the German text a little too closely, with the result that some of his phrases would appear unnatural if used by an English author, as when the word "manifold" is persistently used as a noun, or the word "jumping" is used to express the quantum theory of light in contrast with the vibrations of the undulatory theory. The French translator wisely omits this awkward phrase as being incapable of effective rendering in a foreign text. The English translation becomes more fluent, however, after the first few pages are passed, and it is only rarely that the reader is conscious that the text has been translated.

It is not easy to say what the effect of the translation on the range of usefulness of the book may be. The post-War period has brought almost an avalanche of

more or less popular books on atomic and sub-atomic physics, ranging from Bertrand Russell's expositions of the quantum theory to the proletariat in the columns of the *New Leader*, reference to which was made in NATURE of April 7, 1923, p. 477 (now reproduced in book form), to more stately works, such as that of Prof. Andrade, which was recently reviewed in these columns (October 20, 1923, p. 577). Most of these volumes have been written by onlookers, and they lack the peculiar merits which may be sought and found in a volume written by a protagonist in the great struggle towards that "undiscordant" theory which represents the immediate goal of physical workers. The cleanliness of the third German edition of Prof. Sommerfeld's book, when compared with the well-worn condition of the more recently purchased English translation, in the reading-room of one important physical laboratory, proves that serious students of physics, who may be faced in their examinations by the problems which the author discusses, have already given a hearty welcome to the translation.

Is it possible, however, to commend the book also to the larger crowd of instrumental physicists, physical chemists, engineers and metallurgists, who are curious about the structure of the atom but are not compelled by professional requirements to answer difficult questions about it? In the opinion of the reviewer, it may be so commended to the keen student of these other sciences. Prof. Sommerfeld is not a "heavy" writer, and there are many charming touches in the picture that he paints. Moreover, by banishing the tougher mathematical problems to an appendix, he avoids the risk of frightening the amateur reader unnecessarily. It is, indeed, not until he passes on from the K to the L and M series of X-ray spectra that the reader is likely to find the gradient at all steep; and even in the later chapters of the book the reader may still find level stretches, which form a welcome relief amidst the steep slopes leading to the summit. The book is written by a master-hand, and its value is increased in no small degree by the possibility of reading it without the distracting assistance of a dictionary.

A list of errata has been forwarded to the publishers.

## Mechanical Aids for the Farmer.

*Farm Implements and Machinery.* By J. R. Bond. Pp. xvi+282. (London: Benn Bros., Ltd., 1923.) 35*s*. net.

AS Sir John Russell remarks in his foreword to this work, "this is the kind of book that has long been wanted." The modern farmer can employ machinery in practically every phase of his operations—cultivation, seed-sowing, harvesting, haulage, milking, and so on—and it is certain that he must turn more and more towards its use, now that the days of cheap and unlimited manual labour have passed. His requirements are of a special type; his instruments must be robust and fairly simple in construction, able to stand rough usage, and, it must be confessed, a certain amount of neglect. The designer of an implement has to face both agricultural and engineering problems, and the final form is the best compromise between the requirements of the farmer and the engineering limitations. A machine based on a compromise of this sort can only do its best work when it is intelligently handled. The great merit of the book under review is that these inter-relations are clearly set out and treated in their bearing on the performance of the implement. In this connexion the reader will find the introductory sections of each chapter of considerable help, since they consist of a discussion of the work of the implement, the description of which follows. This treatment facilitates considerably the triple task of describing the machine and discussing the reasons for and methods of adjustment during use.

Any one who has discussed problems of ploughing and cultivation, for example, with practical farmers, cannot fail to be impressed with the great differences in the final result—the soil tilth—attributable to comparatively small adjustments to the implement, and to slight alterations in the method of use. Mr. Bond gives a full discussion of this subject in its many ramifications, the importance of which can perhaps be illustrated by referring to one of his examples: the "wing" of the plough (*i.e.* the horizontal knife that severs the furrow slice from the subsoil) does not, normally, sever the slice completely, but leaves an uncut portion of about 2 in. width. The furrow-slice turned over by the mouldboard, pivots on this uncut portion, and is pushed over into its partly inverted position. During the Food Production campaign, a number of American ploughs and tractors were obtained. These ploughs were of the "digger" type, in which the wing cuts the full width of the slice, and the result was that the furrow was pushed bodily sideways, rather than inverted, an unsuitable operation in this particular instance, where it was necessary to turn in grassland for wheat. Incomplete burying of the herbage resulted in an unsatisfactory seed-bed.

The large variety of cultivation implements—ploughs, cultivators, harrows, rollers, etc.—are fully treated on the lines indicated above, and discussions of other implements—manure-distributers, seed-sowing, harvesting, threshing, and barn-machinery—are also included.

Some important sections of the book are devoted

to a comparison of horse, tractor, and steam-tackle ploughing, from different points of view. This comparison is done really well, especially that part of it which deals with the vexed question of relative costs, and its value lies not so much in the actual figures arrived at—for these alter with each change in economic conditions—as in their service as a guide for the farmer who wishes to make the comparison under his own conditions.

The treatment of the book as a whole is primarily designed for the progressive farmer, but the wealth of practical information it contains will be equally welcome to the agricultural scientific worker. Where so much is given in 300 pages, it may appear ungrateful to ask for more, but one would have liked Mr. Bond's opinion of rotary tillage, which receives only a passing mention. One other point: there are more than 270 illustrations, which may account for the rather high price. Some could be omitted without any loss, as they deal with either unimportant or obvious modifications in a given implement, already clearly described in the text, while others contain too much detail to be of any real use. This minor criticism does not apply to the author's own line diagrams, which are excellent.

B. A. KEEN.

## Scottish Red Deer.

*The Deer and Deer Forests of Scotland: Historical, Descriptive, Sporting.* By A. I. McConnochie. Pp. 336+14 plates. (London: H. F. and G. Witherby, 1923.) 25*s.* net.

IN this ably written, up-to-date treatise on the deer and deer-forests of Scotland, Mr. McConnochie has dealt with the subject from three points of view—historical, statistical, and personally reminiscent. The historical part explains what is not generally known, that, to quote Lachlan Shaw in 1760, "such parts of the Mountains and Glens as are appropriated to the pasturing of Deer and other game" from the eleventh century onwards formed part of the *privatum patrimonium* of the monarch, whose rights were jealously protected under penalties of increasing stringency, until these rights were allowed to lapse after the Union of the Crowns in 1603. The forest laws were not enacted of old exclusively in the interest of sport, although that undoubtedly received consideration. Red deer venison is now of small account in regard of food supply, but it was of considerable importance in old times, large quantities of it being salted in barrels for winter consumption, while the hides formed no insignificant part of Scottish exports.

The statistical part of the volume—pp. 50-212—consists of a detailed account of the 3,500,000 acres now under deer in the Highlands, and the present condition of the forests, which, be it understood, are mainly treeless. The information will be of much value to owners and lessees, and perhaps also to politicians, some of whom seem to believe that arable farming might be a successful enterprise on these wastes; while the naturalist will find most interest in the existing wild life of the region.

The red deer (*Cervus elephas*, Linn.) is by nature a woodland animal, only resorting to the heights for summer pasture and to mountain tops as a refuge from flies; but the disappearance of the primeval forest, followed by the development of agriculture and mineral industry, have confined the herds at all seasons during the last three hundred years to the barest and most inhospitable parts of our country. How greatly conditions have changed for these animals may be realised if one remembers that in June 1528, James V. took part in a deer hunt in Meggatland, a pastoral district of Peeblesshire and Dumfriesshire, when 360 red deer were killed! The red deer is still the largest of our native terrestrial fauna, but exposure and scanty grazing have told sorely upon the race, as is evident, not only from the massive antlers preserved in peat mosses and river alluvium, but also from the dimensions still attained by deer confined in sheltered parks. Deterioration is accelerated by keen competition among sportsmen for the finest trophies. The modern sportsman, wielding the latest masterpiece in arms of precision, is taken up to the deer by a skilled stalker, who instructs him which stag in the herd he is to take. This is sure to be the one with the best head; and whereas, making due allowance for age, the strength of the antlers is a sure index of vigour, the stag with the best head is the very one that should perpetuate strong stock. Most of the deer ground being in these days let to strangers who have not the same interest as the owner of a forest naturally feels in the future of the deer, the practice of destroying, instead of preserving, the fittest has become more general than ever.

"It was not always so," remarks Mr. McConnochie; "our ancestors do not seem to have taken much account of the head; at all events there is no suggestion that what is now considered a valuable trophy in Scotland found a permanent place till about the beginning of the nineteenth century in palace, castle, or hall. The oldest heads, preserved by sportsmen, do not go farther back than the concluding years of the eighteenth century. The larder of the upper classes . . . was a primary consideration; with the fruits of forest, moor, and river their tables literally [?] groaned with plenty."

Charles St. John, himself an Englishman, writing in 1849, deplored the deterioration in the quality of the

horn, attributing it to the "numerous English rifles whose echoes are heard in almost every corrie."

The book is illustrated by a number of excellent photographs; it is interesting to compare them with the drawings by Edwin and Charles Landseer in Scrope's "Art of Deerstalking" (1839), which has long held its own as a classic. It is a marvel how early Victorian sportsmen ever managed to take the hill and get up to their deer in the tight trousers, heavy-skirted coats, silk stocks, "Gladstone" collars, shoes and spats depicted in those fine lithographs, strangely in contrast with the easy knickerbocker suit shown in the photograph of the Duke of Portland at p. 90 of the volume under review. HERBERT MAXWELL.

## The Making and Ministry of Man.

*What is Man?* By Prof. J. Arthur Thomson. Pp. ix+244. (London: Methuen and Co., Ltd., 1923.) 6*s*. 6*d*. net.

IT is always refreshing to read Prof. J. Arthur Thomson, not only, or even primarily, because he writes so well, but also because he adds to a sound knowledge of biology a moral interest in all questions of life and a hopeful outlook so far as man is concerned. This little book illustrates admirably all these qualities. It consists of the third series of Thomson Lectures, given in Aberdeen in 1922 under the auspices of the United Free Church College, and attempts to answer in a simple way the question how biologists regard man. It summarises the results of recent research on the biological pedigree of man, on his primitive state, on questions of heredity and variation, and on the hindrances and the conditions of future progress. It adds no original matter to our knowledge on any of these topics, but it is far the best short introduction, and it treats all the debatable points with which it teems in a spirit of perfect fairness and with an open mind.

It must suffice to enumerate a few of the salient good points. Among these is the emphasis laid from the first and throughout on the social aspect of man's early achievements and the supreme importance of his growing sociability. Talking of language and its emergence from still earlier song, Prof. Thomson tells us that there must have been a "means of social integration in the primitive song." Man was from the first a more sociable and kindly being than other animals, as well as cleverer in adapting means to ends; it is, in fact, open to any one to maintain that it is as the most sociable being that he came to the top of animate things.

There is a very careful discussion of the various meanings of "instinct," in which the author differs from Dr. McDougall, and on which this reviewer is inclined in turn to differ from him. The matter, however, is too long to be discussed here. On this and on the questions of variations by in- and out-breeding the book is likely to be followed by further controversy.

On the questions of the general tendencies of human evolution, Prof. Thomson presents us with the main conclusions reached by the leading workers in the field. He quotes with approval Karl Pearson's proof that offspring tend to the average of the race. "A man is the product not only of his father and mother, but of all his past ancestry," and the mean of that ancestry is not far from that of the general population. Hence there is the danger of a sinking into mediocrity, but, on the other hand, a safeguard against inferiority or sinking back.

The last chapter has the inspiring title of "What is Man not?" and gives us a hopeful view of the general trend of human evolution. There are many strands in the chain—the strand of better adaptation between organism and environment, the strand of symbiosis, the linking of lives together by establishing interrelations, the strand of greater intimacy between parents and offspring, as well as sociality of all kinds from vegetative colonies to intelligent communities. Above all, there is the trend towards "an increasing dominance of the mental aspect of life, towards the emancipation of the Psyche."

The book ends on a religious note. The modern idea of God chimes in well with the reinterpretation of the ancient name of the God of Israel. Jehovah—so scholars now tell us—meant not "I am that I am," but "I will be what I will be." F. S. M.

## Psychobiology.

*Das Zweckgesetz in der Natur: Grundlinien einer Metamechanik des Lebens.* Von Prof. Adolf Wagner. Pp. 301. (Erlenbach-Zürich, München und Leipzig: Eugen Rentsch Verlag, 1923.) 5 gold marks.

THE present state of biological philosophy is unsatisfactory. The prevailing opinion appears to be that the living thing must for the purposes of investigation be considered as a machine, and we find the most active progress in biological research taking place in the domain of biochemistry and biophysics. Most biologists would admit, however, that the materialistic conception is merely a working hypothesis and does not necessarily hold good for all the aspects and manifestations of life. A good example of the moderate point of view which is taken by many workers is afforded by Sir Charles Sherrington's presidential address to the British Association in 1922. While holding fast to the application of physical and chemical methods to physiological problems as the only sound line of progress, he

yet admits that certain phenomena of life, in particular the processes of development, have so far quite eluded explanation in physical terms.

The alternative formulation which has attracted most attention is the vitalistic, especially in the elaborate and closely reasoned form given to it by Driesch. But while the destructive criticism which Driesch applied so successfully to the mechanistic conception must be acknowledged to carry much weight, his constructive theory of entelechy has not found much support among working biologists. This is not to be wondered at—for two reasons. The first is that the concept of an immaterial entity intervening with regulatory powers in a chain of physico-chemical events raises acute philosophical difficulties and is inacceptable to most thinkers, and the second is that the vitalistic doctrine in practice does not lead to any distinctively new method of attack upon biological problems—the methods of research remain the same, and entelechy is appealed to only when physico-chemical methods have landed one in a mess.

Is there any way out from the dilemma—materialism or vitalism? Prof. Wagner's book indicates such a way. Developing a point of view which he stated in 1911 in his book "Vorlesungen über Tier- und Pflanzenkunde," and utilising the work of Pauly and Francé, he has in this little volume sketched in an interesting and convincing way what is best described as a psycho-biological view of living things. It is difficult in a short notice to give an adequate account of this psycho-biological theory of Wagner's, and the interested reader must be referred to the book itself, which he will find to be, though difficult reading, by no means dull—the criticism of materialism which runs as a fundamental theme throughout the book might almost be described as sprightly. Also, it is a book which no one who takes a serious interest in biological philosophy can afford to miss.

Perhaps one might sum up the main argument thus. Living things are in some respects comparable to machines, in that they show a teleological construction. They differ from machines, however, by virtue of the fact that their purposiveness is internal or immanent, and also because their form and activities are regulable. Wagner's contention is that these characteristics of living things imply a psychical element, and that just as machines of human construction presuppose mind, so organic structures or organ-tools imply some degree—admittedly a very low degree—of psychical activity. Living things, then, are best regarded not as purely material constructions but as psycho-physical individualities, whose activities are not purely physical but include also a psychical element. Put in another way, the activities of a living thing are never purely determined by its present configuration—they are both retrospective and prospective, for the past enters into them in the form of transmitted experience, and the future under the form of tendency and regulability, all of which imply psychical functions. This essentially psychological conception is developed with much skill and is brought out with special clearness in the concluding section of the book, where all the obvious objections to a psychobiological view of life are considered and answered in detail. It does seem to us that this view contains the germ of a new biological method, which may in time give us a new system of biology, free from the philosophical preconceptions both of materialism and of vitalism. Let the future decide. E. S. R.

## Our Bookshelf.

(1) *The Physical Chemistry of the Photographic Process: a General Discussion held by the Faraday Society, May 1923.* Pp. 241-406. 12*s.* 6*d.* net.

(2) *The Electronic Theory of Valency: a General Discussion held by the Faraday Society, July 1923.* Pp. 450-543. 10*s.* 6*d.* net.

(London: The Faraday Society, 1923.)

THE general discussions of the Faraday Society, dealing usually with "borderland" subjects, have long since established an unique position for themselves amongst the activities of the scientific societies of Great Britain. Not once, but many times, the bringing together of contributions from a series of recognised authorities, and the organisation of gatherings at which these authorities can meet one another face to face and discuss their points of agreement and difference, has set up a milestone in the progress of a subject.

The two discussions of which the reports are now before us are certainly not below the average in their value as contributions to knowledge.

The former of the two discussions, on the "Physical Chemistry of the Photographic Process," held in London on April 23, 1923, was opened with an address by Prof. Bancroft, of Cornell University, on "The Theory of Photography," and was also attended by Dr. Luther and Prof. Goldberg of Dresden. The twenty-four papers contributed to the discussion include important contributions, not only by British workers, such as Dr. Slater Price and the staff of the British Photographic Research Association, but also a series of papers from the research laboratories of the Eastman Kodak Company at Rochester, and others from workers on the Continent.

The discussion on "The Electronic Theory of Valency" was held at Cambridge on July 13-14, 1923. The discussion was opened by Sir Joseph Thomson, and in addition to the large number of British chemists and physicists who attended, Prof. G. N. Lewis, Prof. W. A. Noyes, and Prof. Victor Henri were able to present papers in person, and to join in the discussions. The report now issued includes some twelve formal papers, a full report of the verbal discussions, and closes with a summary of these discussions, which has been drawn

up by Dr. E. K. Rideal. The electronic theory of atomic structure, and the possibility of applying it to the solution of chemical problems, are now attracting widespread attention, and this report will be read with interest as representing the present phase in the development of a very fascinating branch of study.

*Meteorological Office: Air Ministry. British Rainfall, 1922. The Sixty-second Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1922, as recorded by more than 5000 Observers in Great Britain and Ireland.* (M.O. 261.) Pp. xxi+266. (London: H.M. Stationery Office, 1923.) 15*s.*

IT must be gratifying to the British Rainfall Organization that the records continue year after year, especially when it is remembered that all the observations are voluntary, and in most cases the rainfall measurements are made daily. Part I. of the sixty-second annual volume deals with the arrangements for the discussion and utilisation of the collected observations. In 1861 there were 471 records from different parts of the British Isles, and ten years later the records exceeded 1000. There are now slightly fewer observations than in pre-War time, but a steady increase is again in progress. The transfer of the Organization from private management to Government control has entailed considerable change. A severe loss was sustained by the Organization in the early part of 1923 by the death of the Superintendent, Mr. M. de Carle Sowerby Salter, who was specially trained to the work. Part II. consists of more than 100 pages dealing with rainfall and meteorology of 1922. Droughts and heavy rains are discussed, and tabular statistics are given, including monthly and seasonal rains, while the totals for the year are compared with the average or normal. In 1922 England had a slight excess of rain, while Wales, Scotland, and Ireland had a slight deficit. The lowest rainfall for the year was 17·55 in. at Sutton (Co. Dublin), followed by 18·64 in. at Fortrose (Rossshire) and 18·66 in. at Shoeburyness (Essex). The highest totals were in the Lake District and in North Wales, the Stye (Cumberland) registering 172·80 in. and Snowdon (Carnarvon) 173·45 in. Part III. gives the total rainfall for the year, amount and frequency, at each observing station in the British Isles. Part IV. contains two special articles by Mr. J. Glasspoole, the senior Professional Assistant, one dealing with the "Fluctuations of Monthly Rainfall," and the second "A Comparison of the Fluctuations of Annual Rainfall over the British Isles."

Maps copiously illustrate the different rainfall features throughout the work. C. H.

*Oil Engines.* By A. L. Bird. Pp. vii+281. (London: Methuen and Co., Ltd., 1923.) 12*s.* 6*d.* net.

LECTURING recently on "Marine Propulsion during Fifty Years," Sir J. Fortescue Flannery told his audience that at the present time there are no less than one thousand oil-engined ships sailing under the British flag, and mentioned the interesting detail that the fuel consumption during a round voyage of nearly 27,000 miles of the good ship *Durenda*, having oil engines of 4600 i.h.p., was 11 to 12 tons of oil per day, or less than one-sixth of the weight of fuel which a coal ship would have needed. In view of such figures as these, it is small wonder that the proportion of oil-engined ships is rising rapidly.

The vigorous growth of this new industry explains the many books which are appearing on the subject of this prime mover. Of these productions, Mr. Bird's volume is easily the most readable and the most scientific. The author traces the history of the modern high economy oil engine from the pioneer work of Diesel, which, beginning as it did with an engine aiming at a somewhat fanciful ideal, moved towards the constant pressure cycle with high pressure air injection—the Diesel engine proper—and is now tending towards "airless," or "solid," injection of the fuel with a much more manageable compression pressure and a remarkable degree of fuel economy. The latter engines are sometimes also called Diesel engines, but it is not correct so to name them. Indeed, one of the needs of the moment is a revised nomenclature to cover the many varieties of engine which are being produced in response to present-day requirements. One of the great advantages of the Diesel, as of the solid injection engine, is the freedom from electric ignition troubles and from the complicated problems arising from detonation; on the other hand, the weight per h.p. tends to be high by reason of the relatively slow rotational speed, but the author gives reasons for anticipating a marked improvement in these speeds in the near future.

*The Chemistry of Rubber.* By B. D. W. Luff. Pp. 232+16 plates. (London: Ernest Benn, Ltd., 1923.) 25*s.* net.

WITHIN the limitations imposed by 214 pages of text, Mr. Luff has given an excellent account of the chemistry of rubber, including in this term both crude and vulcanised rubber and various synthetic products. He has done complete justice to the actual title of the book.

It is emphasised that the manufacture of rubber goods was for a long time conducted along empirical lines, and recent scientific researches are claimed as being responsible for improved methods of manufacture. As research chemist in a large rubber company, the author's opinions carry authority. It is therefore somewhat unfortunate that the description of manufacturing processes has been so meagre. It should be stated, however, that some of the splendid half-tone blocks refer to such operations. The majority of rubber articles are manufactured from vulcanised rubber, with the addition in many cases of fillings and pigments. The author has naturally given special attention to the chemistry of the vulcanising process and to the function of accelerators. Physical and mechanical properties of rubber at various stages of manufacture are also discussed.

Testing is considered from the physical and chemical aspects. Under tensile properties the Schopper machine rightly receives particular attention. A separate diagram of the apparatus might with advantage be included. In the accompanying illustration (incorrectly referred to as Plate 12) the view of the laboratory rather crowds out the apparatus under consideration. The methods of chemical analysis cover modern practice, but the descriptions are somewhat lacking in detail. The section is, however, well supplied with references to original papers. JOS. REILLY.

*Foundations of Biology.* By Prof. Lorande Loss Woodruff. Pp. xix + 476. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1922.) 16*s.* net.

IN many American universities a course on general biology forms part of the general educational scheme for their undergraduates, with the result that in any one year as many as five hundred students may be taking the course at the larger universities, such as Yale and Harvard. This does not mean that such students eventually specialise in one or the other branches of biology, but it does mean that a very large percentage of American graduates leave the university equipped with a knowledge of the fundamental principles underlying living phenomena. It is very desirable that something of the kind should be done at British universities, and a course of general biology could with profit be introduced, especially for those who are preparing for the teaching profession.

Prof. Woodruff's book, designed for such a course, is wholly excellent as an introduction to biology and indicates the lines on which it should be taught as a university subject. It is conceived on broad general lines, well planned and admirably balanced, and fundamental principles are clearly set forth without undue overloading by detail. There is a good bibliography, for each chapter or section of the book, of general works in English that can be used for reference or collateral reading and a useful glossary of technical terms. As a guide to the teaching of biology in schools it could be used with advantage in Great Britain, though it is rather too advanced for actual use as a text-book.

*Commercial Poultry Raising.* By H. Armstrong Roberts. Pp. xix + 588. (London: Chapman and Hall, Ltd., 1923.) 15*s.* net.

THE main part of this work is reprinted from the *Country Gentleman*, and *Public Ledger*, and possesses a chatty style appealing more to the general poultry keeper than the man of science. A slight American flavour is imparted by the use of words with special meanings: gift crate (non-returnable), dirt floor (earth), keep tabs on (have accurate records of). The statistics and list of American standard breeds are dated 1910, and the author's sentence—"Printing is so cheap these days . . . price lists . . . may be gotten out"—presumably belongs to the same year. The text includes some breeds which have been standardised since 1910, such as the Campine, which, alas, is given a *red* eye, a disqualification both in America and here, the Sicilian Buttercup, and the Faverolles, as well as the extinct Lakenvelder, but the author could find no place for the Sussex fowl. With regard to the Campine, the author fathers a veritable "traveller's tale": "It seems almost to be endowed with a kind of supernatural power, an obscure sense of being aware of the existence of an object before the object has actually appeared."

The novice must be warned that the well-drawn illustrations—there are 300 in all—are of American type birds, and that if he sends specimens to shows with private leg rings, as here advised, he would be disqualified. Yet, in spite of these blemishes, the book has real merit. The whole practice of poultry-raising is described with commendable clearness. Homely proverbs and shrewd business hints brighten the pages, and if on occasion the author roundly condemns a vicious practice, such as that of leaving dead chickens about to rot and poison the others, the warning is none too strong. The poultry-keeper in a large way will welcome the chapter on utilising the by-products, feathers and manure, and he will read with profit the notes on the avoidance of "leakages."

*Elementary Zoology.* By Oswald H. Latter. Pp. x + 333. (London: Methuen and Co., 1923.) 12*s.* net.

MR. LATTER has written a very useful and clear text-book on elementary zoology for the use of public and secondary schools, more especially those preparing for the matriculation examinations of the English universities. But we are inclined to think that the author has included too much material, and, moreover, the use of the book to the fullest advantage requires access to more comprehensive zoological collections than we suspect most schools to possess. The rabbit is chosen as the type for detailed anatomical study in the laboratory, and the author's treatment of the subject indicates that there may be considerable advantages in this selection, particularly in biological work in schools. By constant reference to and comparison with man, the fundamental, almost personal, importance of biological studies can be directly emphasised, and the interest of the boys is thereby more completely captured at the outset and more readily maintained, with good effects, when the later portions of the course come to be studied.

Throughout the book special attention has been paid to the correlation of structure and function, and the admirably clear accounts of the mechanism and physiology of various organs and structures are to be commended. The majority of the illustrations have been specially drawn for the book and are well and clearly reproduced.

*Vital Statistics: an Introduction to the Science of Demography.* By Prof. G. C. Whipple. Second edition. Pp. xiv + 579. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1923.) 20*s.* net.

THE first edition of this book was reviewed in these columns in April 1920 (Vol. 105, p. 131). Since then its usefulness as an elementary but careful treatment of the subject has led to its being translated into other languages, although it deals in the main with American problems. In Great Britain the new edition of Newsholme's work is now available, but the two books are, in some important respects, complementary. This edition includes later statistics, and also a new chapter on the prediction of future population.

*La Théorie de la physique chez les physiciens contemporains: Exposé des théories.* Par Prof. Abel Rey. (Bibliothèque de Philosophie Contemporaine.) Deuxième édition revue et augmentée d'un aperçu sur l'évolution actuelle de la physique. Pp. x + 346. (Paris: Félix Alcan, 1923.) 15 francs.

THE first edition of this book was issued in 1905. Since then the whole science of physics has assumed an altered aspect. Prof. Rey has brought his book to date by revision and additions, and it now includes an account of the relativity theories. We think he would have had an easier task if he had left his first book as it stood and given in another volume the new story.

## 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.*]

### Water-waves produced by Earthquakes.

In many accounts of earthquakes affecting coastal lands it is recorded that at first the level of the sea fell, and that later a wave or series of waves, arriving from seawards, broke on the shore; also that not infrequently there was a permanent alteration in the level of the land, but that exact measures of the change were difficult to obtain.

The following extracts from Darwin's "Voyage of the *Beagle*" contain some of his remarks on the earthquake on the coast of Chile in 1835.

"Shortly after the shock a great wave was seen, from the distance of three or four miles, approaching in the middle of the bay with a smooth outline; but along the shore it tore up cottages and trees as it swept onwards with irresistible force. At the head of the bay it broke in a fearful line of white breakers, which rushed to a height of 23 vertical feet above the highest spring tides. The first wave was followed by two others, which in their retreat carried away a vast wreck of floating objects. During most earthquakes, and especially those on the west coast of America, it is certain that the first great movement of the waters has been a retirement."

Such effects would follow if an area or strip of the sea-bottom not far from the coast were suddenly or quickly lowered, and this may be illustrated by a simple example in which the motion of the water is limited to two dimensions.

Suppose that in a uniform canal the length of which is great compared to its depth a "sink" or crevasse extending across its whole width is suddenly established at the point P (Fig. 1). The opening of the "sink" would (if the water was incompressible) instantaneously lower the level of the fluid in the whole length of the canal, though only by an insensible quantity, except in the neighbourhood of the "sink."

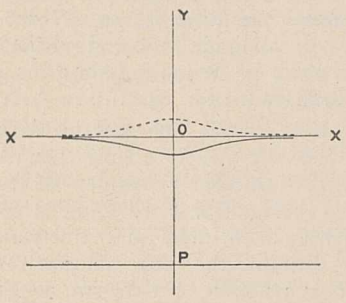


FIG. 1.—XX—Undisturbed surface of water in the canal. OP—Undisturbed depth of water in the canal. *Full Curve*—Depression of surface caused by a "sink" at P. *Dotted Curve*—Elevation of surface caused by a "source" at P. Not drawn to scale.

The first question is, what shape does the surface assume? Taking O, directly above P, as the origin, and the axis of X parallel to the length of the canal, H as the depth of the canal, and $y$ as the distance between the undisturbed and disturbed surfaces of the fluid, let $r_0$ be the half width of the sink and $r$ the distance of any point P′ in the surface from it.

The velocity $v_0$ of the fluid escaping at P is $\sqrt{2gH}$. The velocity at P′ will be $v_0(r_0/r)$.

In the absence of viscous forces, if any portion of a fluid starting from rest descends through a distance $y$ (no matter by what path), its velocity will be $\sqrt{2gy}$.

Hence $2gHr_0^2/r^2 = 2gy$, and since $r^2 = x^2 + (H - y)^2$, and if $r_0 = \theta H$, $x = pH$, and $y = qH$,

$$\theta = \{p^2 + (1 - q)^2\}/q,$$

and from this equation the form of the surface can be computed.

Such computed values, for various values of $\theta$ (*i.e.* ratios of the aperture of the "sink" to the undisturbed depth of the canal), are shown in Fig. 2.

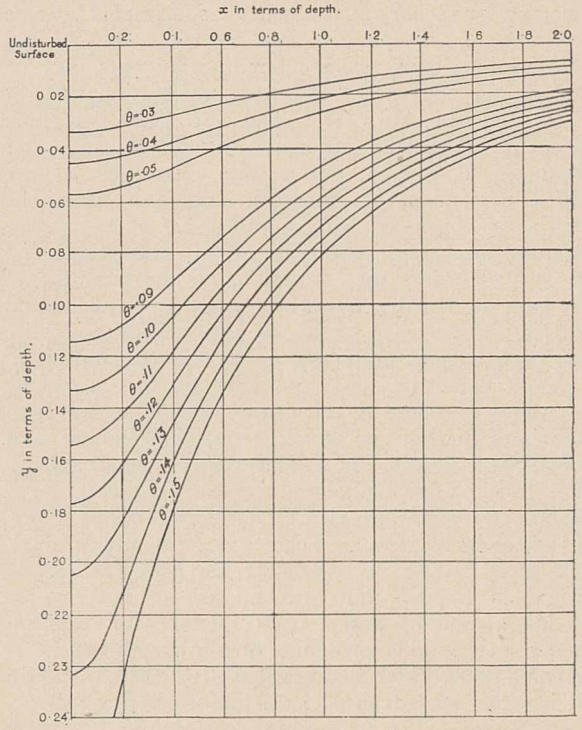


FIG. 2.—Curves showing the depression of the surface caused by the action of a "sink." The abscissæ and ordinates are given in terms of the depth of the canal. The various curves refer to the action of "sinks" the half widths of which are $\theta$ multiplied by the depth.

Suppose now that the "sink" is suddenly closed. After a short interval the surface will again come to rest, but with every point as much elevated above the undisturbed level as it was previously depressed below it. This elevation can then be treated as due to the meeting of waves travelling in opposite directions, and their subsequent motions determined.

When the elevation is only a small fraction of the depth of the canal these waves are very nearly of the same type as the solitary-wave investigated by the late Lord Rayleigh. The solitary-wave cannot be said to have a wave-length since the disturbance extends to infinity in both directions, but the crest has a definite velocity, namely, $\sqrt{2g} \times$ elevation at crest. It cannot be propagated to a distance without change of type, but when the profile is that given by Lord Rayleigh the change is slow.

If (as when a stone is dropped into a pond) the waves spread in circles round the centre of disturbance, the profile necessarily changes rapidly because of the distribution of energy. In this case a solitary-wave will have but a short life, and the change of type will lead to a complex train of waves of varying length the group velocity of which is half that of the individual waves.

Should a disturbance be started by a "source" instead of a "sink" (*i.e.* should there be a sudden elevation of the sea-bottom), the first noticeable motion of the water on the shore would be an advance; or should the shore itself be elevated or depressed without affecting the distant sea-bottom, there would be an apparent retirement or advance of the water, but no subsequent large waves.

In real earthquakes any or all of these causes may be active, but probably a combination of them might be found to suit every particular case.

When a series of waves reaches the coast at an interval after the shock, the interval in question, together with the wave periods, would give a measure of the distance of the centre of disturbance from the coast.

The amplitude of the waves at the coast-line would depend chiefly on the under-water coastal gradient, for as the water shoals the unchanged quantity of energy in each wave is concentrated in a gradually diminishing mass of fluid. The same cause must have an influence in determining the large tides to be met with in certain channels and bays (*e.g.* the Bristol Channel and the Bay of Fundy).

All the wave-making and other features above mentioned can be recognised in the emptying of an ordinary bath by opening and closing the "waste" at suitable intervals and with the water at different levels.

On referring to Fig. 2 it may be gathered that when the width of the "sink" is somewhat less than a third of the depth, the cavity in the surface extends to the full depth of the water.

A. MALLOCK.

9 Baring Crescent, Exeter,
January 18.

**Solid Solutions and Inter-Atomic Relationships.**

DR. ROSENHAIN'S suggested explanation of the increased resistivity of solid solutions, etc. (NATURE, December 8, 1923, pp. 832-834), does not appear to be in accordance with some of the known facts. He states "where the atoms lie on perfectly straight lines on the space-lattice the movement of the electrons is entirely unhindered and the metal in that state should exhibit super-conductivity. This can only be fully realised very near the absolute zero, since at higher temperatures the thermal agitation of the atoms disturbs their perfect alignment even in a pure metal. . . . In a solid solution crystal, however, the atoms can never attain perfect alignment, owing to the lattice-distortion, and consequently the electrical conductivity of a solid solution will always be relatively very low."

In contradiction to the above it is known, first, that pure metals may be cold-drawn or cold-worked, so that the alignments of their atoms must—judging by the fact that the hardness may be increased some *three or four hundred per cent.*—be very considerably disarranged, and yet the electrical conductivity will only be increased some *two or three per cent.* It seems more probable, therefore, that the reason for metals being worse conductors with increasing temperature is due to the effect of heat on the *electrons* and not on the *atoms*.

The usual view is that heating a metal increases the kinetic energy of the electrons, and thus makes them less easily deflected in the direction in which the electric current is flowing.

In contradiction to Dr. Rosenhain's view there is also the fact that most "bad" conductors (*e.g.* silica and graphite) are better conductors at high temperatures than at low temperatures, the effect of heat in such cases being presumably to loosen the tightly held electrons. Furthermore, the metals bismuth and antimony (which share electrons in the solid state) increase in conductivity on melting.

With regard to the solid-solution part of the theory, experimental data show that there is no connexion between the sizes of the solute atoms and their effects in increasing the electrical resistivity of a metallic solvent. As an example, the relative effects of the atoms of silver and nickel when present in dilute solid solution in copper may be compared, and are as follows: (*a*) on the electrical resistivity the nickel atom has about *five times* the effect of the silver atom; (*b*) in so far as they differ in size from the copper atoms and increase the hardness by distorting the copper space-lattice, the effect of the nickel atom is about *one-twelfth* that of the silver atom. Here, again, the increased resistivity of solid solutions appears to be due to the effects of the solute atoms on the *electrons* and not on the *atomic structure* of the metal. It has been shown that in general the effect of a solute atom on the electrical resistivity of a solvent is small if it is near to the solvent in the Periodic Table, and larger according to its distance removed.

The above arguments are taken from the following papers, where they are more fully developed: "The Electrical Resistivity of Dilute Metallic Solid Solutions" (Trans. Faraday Soc., December 1919), "The Hardness of Certain Copper $\alpha$—Solid Solutions" (Journ. Inst. Metals, March 1923), "The Volumes occupied by the Solute Atoms in Certain Metallic Solid Solutions and their Consequent Hardening Effects" (Trans. Faraday Soc., November 1923).

A. L. NORBURY.

University College, Swansea,
January 8.

MR. NORBURY'S letter raises a number of points of considerable interest, although I think it can be shown that they do not adversely affect the theory which I have put forward.

In the first place, Mr. Norbury suggests that because the cold-drawing or cold-working of metals can increase the hardness by some 300 or 400 per cent., while the electrical conductivity is only decreased by 2 or 3 per cent., the disturbance of the linear arrangement of atoms cannot materially affect electrical conductivity. His view is based upon the assumption that in the cold-drawing process the bulk or at least a large proportion of the atoms in the metal are disarranged as regards their crystalline orientation. Experimental evidence shows that this is not the case. Even in cold-drawn wire, X-ray examination shows that the metal is essentially crystalline, and the hardness of cold-drawn metal generally cannot be ascribed to a widespread derangement of the atoms in regard to the space-lattices. The view which at present offers the only feasible explanation of the hardness of cold-worked metal is that put forward by Beilby, according to which, upon surfaces of slip, layers of amorphous material are formed.

It is the frequent intersection of such layers with possible planes of further gliding that gives rise to the very considerable increased resistance to further slip or gliding which is represented by mechanical hardness. From the electrical point of view, however, the fact that the bulk of the atoms are still definitely arranged on space-lattices in a crystalline manner leads to the inference, which is in accordance with fact, that the electrical properties of the material will be very much less affected than the mechanical properties. So long as there is an adequate number of straight paths left for the current to follow, the existence of disturbed layers (amorphous layers), which, from the atomic point of view, occur only here and there at long intervals, will produce only a slight effect.

Next, Mr. Norbury refers to the fact that most "bad" conductors are better conductors at high than at low temperatures. He quotes specifically silica and graphite. In regard to the former it is, I

think, universally admitted that conduction is of an electrolytic character, and therefore totally different from metallic conduction. In the case of graphite we have a material of very peculiar constitution both in regard to the atomic arrangement of the crystals and in regard to the aggregation of the crystals into solid masses. The behaviour of such a material can perhaps hardly be used as a fundamental argument for or against any general theory of conductivity.

Finally, Mr. Norbury refers to the fact that experimental data show no connexion between the sizes of the solute atoms and their effects in increasing the electrical resistivity of a metallic solvent. If Mr. Norbury will read my published papers on this subject he will find that the question of size of atom has not been emphasised in my views. It is, I think, perfectly clear that the mere size of an atom, whatever specific meaning we may attach to that term, is not by any means the only factor governing its effect when introduced into a space-lattice of other atoms. The strength and character of the field of force which an atom exerts is of at least as much importance as its own so-called size. An atom which is habitually closely spaced on its own lattice, and therefore might be called a "small" atom, may exert a very powerful attractive force upon its neighbours, and when introduced into the lattice of atoms more widely spaced, may cause a contraction of the lattice, or, on the contrary, if the field of force which it exerts is weaker than that of the atoms of the lattice into which it is introduced, the latter lattice may be expanded in spite of the fact that the solute atom is itself smaller. Consequently, the fact that the size of atom has no direct relation to its electrical effect is not by any means surprising from the view-point of my theory.

More interesting is the point raised by Mr. Norbury as to the relative effects of silver and nickel when present in dilute solid solution in copper. He points out that on the electrical resistivity the nickel atom has about five times the effect of the silver atom, while in regard to hardness its effect is only one-twelfth that of the silver atom. At first sight this might appear difficult to explain on the lattice-distortion theory which I have put forward, but a little further consideration will, I think, clear the matter up. The interesting point which should be considered here is that while the nickel atom causes a *contraction* of the copper lattice, the silver atom causes an *expansion*, the two effects corresponding respectively to a raising and lowering of the melting points. If we think of electrical conductivity in the terms of the passage of electrons through atomic interspaces or between the atoms or through their outer electron shells, it will be obvious at once that when a lattice is contracted, a slight degree of irregularity will offer greater hindrance to the passage of electrons through such spaces or corridors, than will be the case with an equal amount of actual atomic distortion if the lattice is first widened. It would seem therefore that, where the introduction of a stranger atom causes an expansion of the lattice, this would be an effect to a certain extent counterbalancing the distorting effect which it also produces; while, on the other hand, where the introduction of a stranger atom causes a reduction in the size of the lattice, this would be an influence additive to the distorting effect. Examination of the electrical behaviour of a number of solid solutions confirms this view, since in most cases where the atomic distortion is accompanied by lattice contraction a very much larger effect on electrical resistivity is produced than in the converse case.

While I think that these considerations show that the points raised by Mr. Norbury are not really difficulties in the way of my theory, I would like to emphasise that I do not by any means contend that the lattice-distortion theory gives a clue to the whole of the electrical behaviour of metals as regards conductivity. There can be no doubt that the electrons themselves must be affected by such conditions as temperature and even by lattice distortion, and consequently effects are to be looked for, possibly of a secondary nature, which cannot be immediately explained by the simple theory of lattice distortion. At all events, the consideration of such points as those raised by Mr. Norbury is of considerable value in helping to clear up doubtful points in the theory, and in assisting us in arriving at a view as to its ultimate correctness.

WALTER ROSENHAIN.

The National Physical Laboratory,
Teddington, January 11.

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### Well-Worms and their Allies.

THE story of the well-worms does not appear as yet to have been told. Though it extends over exactly a century it is undoubtedly still incomplete. I have been led to review the subject on account of a new discovery now to be recorded; and although the following outline is far from being exhaustive, it may prove of service in stimulating research.

If we go back to 1821 we find our first reference to one of these worms (*Lumbricus gordioides*, Hartmann). Hoffmeister, one of the pioneers in helminthology, renamed it Phreoryctes in 1845, and this appears to be the first occasion on which a term derived from the Greek word for a well, water tank or reservoir (φρέαρ), was used in connexion with oligochæts. The worm so described is now known as Haplotaxis, and Michaelsen, who gives a very full, though not strictly accurate synonymy ("Oligochæta," 1900, p. 108) describes it as occurring "in Sümpfen, Gräben, Quellen und Brunnen." In 1876 Vejdovsky introduced the generic term Phreatothrix when diagnosing a new well-worm found in Prague. The species so described (*Phr. pragensis*, Vejd.) is by some authorities now referred to the genus Trichodrilus, but Beddard retained the name when, later, he described a new worm (*Phr. cantabrigensis*, Bedd.) found in Cambridge. Then for the first time well-worms were shown to occur in Great Britain. Vejdovsky in 1889 published an account of another annelid (*Pachydrilus subterraneus*, Vejd.), now referred to the genus Lumbricillus, found "in Brunnen und Wasserleitungen" at Lille and Prague. The same species was sent to me in 1892 by Dr. Plowright, who found it in the drinking water of King's Lynn. It has since been the subject of much investigation, both at home and abroad, and has often reached me from various parts of the country, with notes on its occurrence in the water from taps and elsewhere.

The year 1891 witnessed the founding of the genus Phreodrilus by Beddard, who based the term on the discovery of a new species of worm found in deep wells at Ashbourne, New Zealand. The name still stands, and Benham, who has added other Antarctic species, has made it the basis of a new family title, Phreodrilidæ. The distribution, so far as it was known in 1912, is given in Beddard's little volume, "Earthworms and their Allies," p. 37. In 1896 I received a new well-worm from a medical man in Chelmsford, which I described in the *Essex Naturalist* as *Dichæta curvisetosa*. Though placed by Michaelsen under *Haplotaxis gordioides*, it is really a distinct species, as I have proved by the discovery of the

typical *H. gordioides* in Alexandra Park, Hastings. We therefore have two species of this genus Haplotaxis in England. In 1907, while residing in East Anglia, I found a number of well-worms at Mildenhall in Suffolk. One species I believe to be identical with Beddard's Cambridge worm (*Phr. cantabrigensis*); and a second was described by me in 1921 (Ann. and Mag. Nat. Hist., vii. 139) as *Anagaster fontinalis*, along with a new species of Sparganophilus. In 1913 another worm (*Rhynchelmis limosella*, Hoffm.) was sent to me from Ringwood, Hants, by a chemist who had found it, or had it brought to him by one who had discovered it in drinking water. This seems to be the only duly authenticated record for this species, and the example is now with my earthworm types in the British Museum. See Beddard's "Monograph of the Oligochæta," 1895, pp. 215-16.

Curiously enough, it is from Ringwood also that the specimen comes which has given occasion for the penning of this brief communication. On January 29 I received a letter from a correspondent asking me to name "the accompanying worm. It is pumped up frequently from a well, apparently of pure water, in Ringwood, Hants. It clearly lives in the dark, with some small crustaceans. I wonder if they feed on each other!" We are well aware that certain aquatic worms do so subsist. There is an interesting account of "The Lurco, or Glutton, a Diaphanous Species of Nais," with a coloured plate, in Pritchard's "Notes on Natural History," 1854, showing this; and in more recent years Mr. C. S. Todd and I have found certain Naididæ (*Ophidonais reckei*, Fl.) and other worms so feeding. There can, I think, be no doubt that the new well-worm from Ringwood is *Helodrilus oculatus*, Hoffmeister, first described in 1845. It was placed by Beddard in 1895 among the uncertain species, but in 1890 was rediscovered and named anew (*Allolobophora hermanni*, Mich.). Some years later I found it in the gardens at Cambridge and followed Michaelsen's nomenclature. In 1912 I took a number of specimens possessing eye-spots from the bottom of a streamlet and elsewhere in the neighbourhood of Malvern, since which time it has been found to be one of our commonest indigenous worms. It delights in stiff clayey soil at the bottoms of ponds and streams. I have found two forms in the mud of the Thames at Kew, and reference to the diagnoses of this worm and Anagaster ("British Earthworms and how to Identify them," The Epworth Press, pp. 46, 54-5) will show that they have many features in common. This is the first occasion upon which Helodrilus has been taken from a well, and it therefore makes an interesting addition to our list. But further research in this subject is greatly to be desired.

HILDERIC FRIEND.

Solihull, Warwickshire.

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### The Continuous Spectrum of Hydrogen.

IN NATURE of January 26, Prof. Harvey B. Lemon has given an interesting account of the appearance of a continuous spectrum of hydrogen extending into the visible region and having its long wave-length limit in the yellow-green. Perhaps we may be permitted to invite attention to our own observations of the voltage conditions controlling the production of this spectrum, and to a suggested explanation of its origin, which we gave in the course of a paper on "Critical Electron Energies in Hydrogen," published in the *Philosophical Magazine* for November 1923.

The apparatus which we employed was similar to that which we have used in earlier investigations of the limiting conditions under which the various spectra of the gases helium, argon, and neon are produced. The source of electrons was a coated platinum filament (as in Prof. Lemon's experiments), and the tube was so constructed that it could be placed between the poles of an electromagnet whereby a concentration of the luminosity into a bright column, parallel to the slit of the spectroscope, could be effected. A system of plane gauzes at right angles to the axis of the tube enabled various arrangements of electric fields between the filament and anode to be employed.

The source of the continuous spectrum was a blue glow which appeared under certain conditions, and we found that this blue glow was produced for lower electron energies than those required to excite the Balmer series lines and the lines of the secondary spectrum. The limiting electron energy for the excitation of these two latter spectra was found to be the same, and was that corresponding to 15·9 volts (the voltage at which we found that the molecule is dissociated into atoms and one of each pair of atoms is ionised), whereas the blue glow was observed with an electron energy as low as that corresponding to 13·5 volts.

When the electron energy was gradually increased and the appearance of luminosity watched for, this blue glow was the first thing to be observed, and the continuous spectrum remained as a background to the Balmer series and the secondary spectrum when these were first excited at somewhat higher voltages. Conversely, with a gradually decreasing electron energy the continuous spectrum remained when all trace of the Balmer series and the secondary spectrum lines had vanished. That less electron energy is required for the production of the continuous spectrum than for the excitation of lines of the Balmer series or of the secondary spectrum was strikingly shown by arranging the electric fields between the gauzes in our tube so that the electrons were first given sufficient energy to stimulate the line spectra, and were then retarded by means of an opposing electric field nearer to the anode. When the voltages were properly adjusted, the glow in this latter part of the tube was in the form of a pink column with a bright blue end on the anode side, where the electron energy was least in consequence of the retarding field.

The lowest electron energy for which the blue glow was actually observed in our experiments was that corresponding to 13·5 volts, though the gradual manner of the disappearance of the glow, as the voltage was reduced, suggested that this was not necessarily the critical value for the production of the continuous spectrum. It was found that the appearance of the blue glow was not accompanied by any ionisation of the hydrogen, and it was therefore concluded that the agreement between the minimum electron energy for which the glow was actually observed, and the ionisation voltage for the hydrogen atom, was fortuitous. The writers concluded, from experiments described in the paper referred to, that 12·6 volts is the lowest electron energy at which dissociation of the hydrogen molecule into atoms occurs, and that at this voltage the dissociation is accompanied by the excitation of one of each resulting pair of atoms. They suggested that this voltage is the true limiting voltage for the production of the continuous spectrum, as radiation giving such a spectrum might be expected to arise from the formation of molecules by the combination of neutral atoms. The production in this way of diatomic molecules only would fix the long wave-length limit of the resulting continuous spectrum at that corresponding to the energy of dissociation of these molecules, which we found to be 2·4 volts.

Although an exact determination of the long wave-length limit of the continuous radiation obtained in

the authors' experiments was not possible, it was clear that the radiation extended on the red side well beyond the wave-length corresponding to 2·4 volts, and the authors therefore suggested that part of this radiation might be attributable to the formation of the system $H_3$.

In the experiments which Prof. Lemon describes, he obtained the change from the Balmer series lines to the secondary spectrum, and from the latter to the continuous spectrum, by gradually increasing the temperature of his cathode and thereby increasing the current across the tube. As we have already indicated, our experiments have shown that it is the energy of the bombarding electrons, and not the intensity of the stream, which is the controlling factor in effecting the change from the blue glow, which gives the continuous spectrum, to the pink glow, which shows Balmer series and secondary spectrum lines. It is therefore probable that the change from a line spectrum to the continuous spectrum which Prof. Lemon found to occur on increasing the electron emission from his filament was due to an accompanying decrease in the electric intensity between the filament and the part of the luminous discharge under observation.

F. HORTON.
A. C. DAVIES.

Royal Holloway College,
Englefield Green, Surrey, February 6.

### Sand and Rock Specimens from Reg-i-Ruwan.

THE Marquis of Curzon having kindly sent me some specimens of rock and sand from the above for examination, the following notes may be of interest.

The sand is composed chiefly of quartz grains, crystalline and opaque (milky vein-quartz). There are also grains of a green schistose rock (probably chlorite), showing, sometimes, a metallic lustre due to the presence of mica, iron, amethyst, carnelian, and some dark brown and green grains, the nature of which I have not determined. Some of the grains are composite, showing quartz associated with other minerals. Many of the latter, and some of the dark grains, are feebly magnetic.

The sand is clean, being practically free of fine fragments or dust. There is no calcareous or argillaceous matter present.

The grains vary considerably in size, uniformity not being a special feature. They are chiefly subangular, but there is a small proportion of rough and angular grains, and only a small percentage of rounded grains. Grains with the highly polished surfaces characteristic of the higher types of musical sands are rare. The quartz grains have, generally speaking, smoother and more rounded surfaces than those of the other mineral grains present, but these surfaces are gelic rather than glacious in appearance—a feature which is conspicuous in the wind-abraded sands of deserts. I noticed a few cylindrical grains with freshly broken surfaces.

The sand was not musical under any of the usual tests, though when plunged in a glazed vessel it gave hopeful indications. As only about a quarter of a pint of the sand was available, there was insufficient to enable me to adopt measures which might improve its condition musically.

It is possible that, in places where the more highly rounded grains may have been separated from the others, either by wind, water, or gravity-motion on a slope, they might, under conditions of motion and compression, produce vibrations which would, when reinforced by the echoes, produce the wonderful acoustic effects observed at Reg-i-Ruwan. But without being actually on the spot to study the phenomenon from every aspect, it would be rash to do more than speculate as to the cause.

The rock specimens are as follows :

1. Crystalline limestone of a stalagmitic character with the surface much eroded by weathering. Probably a secondary deposit due to the dissolution of a pre-existing limestone.

2. Fine calcareous sandstone, having on one side a group of coarser grains which may indicate the source of the sand.

3. Green chlorite schist. Contains brown grains similar to those found in the sand. Small flakes of muscovite mica plentiful.

4. Bluish-grey fragments which appear to represent an indurated and metamorphosed limestone. Crystalline calcic carbonate occurs in cavities, but I found none of this mineral in the sand. The only rock from which the bulk of the sand could be derived is represented by Specimen 2, unless, as seems probable, this rock is a mass of sand recently consolidated by a secondary deposit of calcium carbonate.

CECIL CARUS-WILSON.

Altmore, Waldegrave Park,
Strawberry Hill,
January 30.

### A New Technique in Radium Therapy.

FROM the nature of the radiations emitted by the later disintegration products of radium, it was thought that preparations of these later products alone, and without any of the more active members of the series, might have a specific action on superficial lesions. It has been found possible to prepare quite suitable applicators, and initial clinical experiment has so confirmed the expectation, that we desire to make this preliminary notice of the work.

The diseases which have so far been treated with these preparations are : superficial nævus of the telangiectatic type, and lupus erythematosus. Within a short time, a very definite reaction has resulted in each disease. Part of an extensive superficial nævus showed marked improvement within ten days, with final pallor over the area of application. In a very intractable case of lupus erythematosus, the reaction was most pronounced, and an apparently healthy area of natural colour was produced.

The results so far obtained are very encouraging, and work is being continued both on the methods of extraction of the particular active material and on the therapeutic use of such preparations. It is hoped to publish at a later date full details of the processes involved, and of all the clinical results.

W. HERBERT BROWN
(Dermatologist to the Victoria Infirmary, Glasgow).
JOHN P. MCHUTCHISON
(Physical Chemist to the Glasgow and West of Scotland Radium Committee).

### Feldspar or Felspar.

Now that the interest aroused by letters in NATURE on the spelling of names derived from Greek has been referred to as a matter of "pure English," is it not time to take up the cause of the spelling "feldspar" as against "felspar"? The spread of literature across the Pacific, rather than by the Indian Ocean routes, has fully converted geologists in British colonies in Australasia to the use of the correct form "feldspar." The omission of the "d" was defended by Alexandre Brongniart ("Traite de Mineralogie"), but was generally recognised in France as an error. If, as I hope, the Irish Free State will follow the

example of the majority in the commonwealth of British nations, Great Britain will be left as the only country in the world where the spelling "felspar" still remains. Commercial men must be well acquainted with the correct form; they are, moreover, not going to be asked to use the German form "feldspat," any more than "kainit," which has become common without a final "e." The spelling "feldspar" of course carries with it "feldspathic" and "feldspathoid"; also "feldstone" for "felstone," a term that might well be abandoned. "Felsite" remains unaltered.

GRENVILLE A. J. COLE.

Carrickmines, Co. Dublin,
January 10.

### Standardisation of Scientific and Technical Publications.

IN reply to Mr. W. P. Widdowson's letter in NATURE of January 12, p. 51, I should describe as very unsafe his supposition that a standard page size would be rather futile unless nearly every publication adopted it. There are many possible uses of a standard size, and some of them have little connexion with the general body of scientific literature. In my communication to NATURE of December 1, p. 794, I did not perhaps sufficiently indicate that what I have in mind is a series of proposals to suit different sets of circumstances rather than any rigid scheme. I am now writing an account in which I am distinguishing between those proposals which I suggest are immediately practicable, and those which lie rather in the future. J. F. POWNALL.

20 Watery Lane, Merton Park,
London, S.W.20.

### The Hypothetical North Polar Land.

IT has often been suggested that land exists to the north of Alaska, and the extent of American confidence may be gauged by the proposal to send the airship *Shenandoah* to annex "the vast unexplored areas contiguous to Alaska" for the U.S.A. R. A. Harris deduced the existence of this land from tidal observations in the Arctic Ocean, and marked its approximate boundaries on a map of co-tidal lines for the Arctic regions (Arctic Tides, U.S. Coast and Geodetic Survey, 1911).

Further evidence is now to hand which throws doubt upon this hypothesis. The *Maud* has been drifting in the ice north of Siberia for some years, and regular tidal observations were carried out at her winter quarters at Maud Harbour (1918–19), Aion (1919–20), and Cape Serdze Kamen (1920–21). These observations have been sent to the Geophysical Institute at Bergen, and J. E. Fjeldstad has published a preliminary note on the result of his examination of the material (*Naturen*, 1923, p. 161).

Fjeldstad comes to the conclusion that the existence of any such land area as Harris postulates is unlikely, although it is admitted that the ocean to the north of the Beaufort Sea may be relatively shallow and dotted with islands. A new co-tidal map is given, in which all known observations are interpreted on the hypothesis of a wave which enters the Arctic Ocean between Spitsbergen and Greenland and reaches the northern shores of Siberia and western North America by direct paths across an unrestricted polar sea. Even if the *Shenandoah* is able to make a successful flight, the annexation of territory may not be so considerable as is hoped for. L. HAWKES.

Bedford College,
Regent's Park, N.W.1,
January 21.

### Chemotaxis of Spermatozoa and its Questioned Occurrence in the Animal Kingdom.

IN an interesting paper in the *British Journal of Experimental Biology* for January, Prof. Dakin and Dr. Fordham have shown that capillary tubes which contain sea water which has been in contact with the ripe eggs of *Echinus esculentus* soon become plugged with spermatozoa after immersion in sperm solution. This result is contrary to that obtained by Buller and Loeb, and appears to prove that chemotaxis is a factor in the fertilisation of Echinus, as claimed already by de Meyer.

Prof. Dakin and Dr. Fordham do not, however, refer to my earlier demonstration of chemotaxis in sponge fertilisation. In 1920 I showed that the oocytes of Grantia lie beneath the collar cells, and that the spermatozoa carried in by the inhalent currents are definitely attracted to the collar cell region overlying the eggs. This was the first "natural" demonstration of chemotaxis made on animal material (Jour. Linn. Soc., vol. xxxiv., Nov. 1920, p. 280).

In the case of the fertilisation of the mammal, where ovarian pregnancies occur, it is difficult to believe that the egg does not exert some attraction for the wandering spermatozoon.

In Saccocirrus, where precocious fertilisation is the rule, it is obvious that the ovary must be a goal towards which the spermatozoa swim, because sperms do not occur, to my knowledge, in any part of the segment excepting the ovaries and receptacles.

A possible explanation of de Meyer's and Dakin's success where Buller and Loeb failed is that the former obtained the eggs at just the right period.

There never has been any doubt in my mind that chemotaxis is a factor in animal fertilisation, and I consider that the observations of de Meyer and the Liverpool workers and my own researches on Grantia place the matter altogether in a new light.

J. BRONTË GATENBY.

Zoological Department,
Trinity College, Dublin,
February 4.

### The Thermal Expansion of Bismuth Crystals.

IN order to provide data which shall form a basis for a theory of non-cubic metallic crystals, Grüneisen and Goens have carried out experiments on the thermal expansion from −180° C. to 100° C. and on other properties of single crystals of zinc and cadmium, the results of which were published in the *Physikalische Zeitschrift* for December 15, 1923. They mention that crystals of bismuth and antimony have not yet been studied. For some time I have been engaged on an investigation of the thermal expansion of bismuth crystals from ordinary temperatures up to the melting-point 269° C. The experiments above 220° C. are not yet quite complete, but the results obtained up to this temperature indicate that the behaviour of bismuth crystals is different from that of the metals examined by Grüneisen and Goens. In the case of bismuth the expansion in either direction, *i.e.* parallel or perpendicular to the axis, is practically uniform over this wide range. The results of Grüneisen and Goens show a considerable variation in both expansion coefficients in the range 0° to 70° C. for cadmium crystals, and in the expansion coefficient perpendicular to the axis for zinc crystals. It is hoped that full details of these experiments will be published shortly. J. KEITH ROBERTS.

National Physical Laboratory,
Teddington, Middlesex,
February 5.

## Early Embryonic Differentiation.

By JULIAN S. HUXLEY.

THE last general work in English on the subject of experimental embryology was that by the late J. W. Jenkinson, published in 1909.[1] Since then, our knowledge of the subject has advanced enormously, not only in detail but also in principle, chiefly owing to the researches of the schools of Spemann in Germany, Harrison in Yale, and Child in Chicago, and of the workers on tissue culture and endocrinology. No connected account of the whole subject has, however, appeared. (That by Dürken,[2] in German, 1919, although interesting, takes scarcely any account of the British and American literature.) No excuse is, therefore, offered for directing attention here to some of the important recent discoveries concerning embryological differentiation, and to a possible scheme for their theoretical explanation.

The Amphibia have been the most fruitful material, in some respects the frogs, in others the newts: and we will take them as our type. According to our present knowledge, three fundamentally different processes, essentially consecutive although here and there overlapping, are to be distinguished in Amphibian development up to hatching. (1) Division and re-arrangement of pre-existing material and structure (up to the end of germ-layer formation). (2) Primary or non-functional differentiation, including (*a*) determination and (*b*) differentiation of the primordia of organs. (3) Secondary or functional differentiation.

Up to 1910, the principal achievements of experimental embryology could be summed up thus: first, that nuclear division in early development was not differential, the nuclei of the embryo all being equivalent; secondly, that (usually and primitively) most fragments of the germ before the onset of gastrulation could, if of sufficient size, regulate themselves to produce a whole embryo or an approximation to it; thirdly, that in a few cases definite "organ-forming stuffs" existed in the fertilised egg — visibly-differentiated regions causally correlated with the development of certain organs; and fourthly, that Roux's doctrine of the "Struggle of the Parts" was valid in later stages. These we assume in what follows.

The Amphibian egg, like most eggs, starts with a definite if simple organisation. It is stratified from animal to vegetative pole as regards the proportion of cytoplasm and yolk, and the nucleus is excentric. This visible polarity or material gradient appears to be the result of a pre-existing metabolic gradient (Child[3]); the rate of metabolic activity (as tested by rate of dying in weak toxic solutions, which in more favourable material has been shown to run parallel with rate of oxidation, carbon dioxide production, and degree of electro-negativity[4]) is greatest at the animal pole, and diminishes gradually to the vegetative. This permits of the accumulation of inert substances like yolk towards the vegetative pole, while they are more readily oxidised towards the animal pole.

The front of the head is predetermined to form near the animal pole, the tail to grow out near the vegetative pole. In addition to this major (polar) axis, and consequent radial symmetry, which is all that the egg possesses before fertilisation, Brachet,[5] Spemann,[5] Jenkinson,[6] and others have shown that the unsegmented but fertilised ovum already possesses bilateral symmetry, since the region of the dorsal lip, which marks the future dorsal side of the embryo, is already fixed. It is usually stated that this is determined by the place of entry of the spermatozoon. Although this is undoubtedly a predominant factor, yet Jenkinson[6] showed that the direction of incident light may play a part. In any event, not only the bilaterality of the future organism, but also, as we shall see, the region which initiates all subsequent differentiation, is determined, at or about the time of fertilisation, by agencies external to the ovum.

The power of regulation is possessed by fragments of the germ during the segmentation stage, but only if (*a*) the division runs more or less along the polar axis, (*b*) if the fragment includes some or all of this future dorsal-lip area. If the division cuts the dorsal-lip area in two, both halves will regulate, and twin embryos are the result; but if all the area is in one half, only this half will form an embryo, the other portion forming a vesicle, fully segmented, and with the three germ-layers, but no differentiation of organs.

Spemann[7] has proved that the dorsal-lip region is a *differentiator* (or "organisator" as he styled it) by grafting some of it to another embryo of a different species, where it can still be recognised by its colour. Even if grafted into an area which should only have formed flank ectoderm, it causes the host tissues between it and the animal pole to form the "primary axial organs" (neural plate, notochord, and somites). It is noteworthy that the dorsal-lip region is the region of most active cell-division and presumably of most active metabolism; it may well be that it is the stimulus of its activity as such which causes the neighbouring cells to differentiate, as would be expected on Child's theory.

Brachet[5] has recently shown that the dorsal-lip region exerts its formative effect both anteriorly and posteriorly. If continuity between the dorsal lip and *e.g.* posterior region is interrupted, no differentiation of axial organs (notochord, nerve cord, and somites) will occur behind the interruption. The influence appears to demand contact for its spread (cf. optic cup and lens—see below). In spite of absence of axial organs, other organs such as Wolffian duct and heart will be normally differentiated. This can be explained on Child's theories, since they form at low levels of the gradient; provided some of the dorsal region is intact, sufficient "potential difference" exists to determine these low-level organs.

It is important to note that the influence of "high-level" active organs on the morphogenesis of other organs is not new, but is well known in regeneration. Child[3] has shown (and the experiment can be easily repeated) that the formation of the pharynx in a piece cut from a Planarian is only possible in the presence either of a head or of other tissues normally anterior to the pharynx.

In our period of primary differentiation the first step is the irreversible decision as to which region shall produce which organ. This occurs some time before

any visible organ-rudiments appear. Thus it is important to distinguish the invisible *determination* from the visible *differentiation* which is its consequence. For example, Spemann [7] has proved that in the early neural plate stage, before the least trace of optic vesicle is to be seen, not only is there predetermination of the eye as a whole, but also of the separate areas for optic stalk, retina, and tapetal layer, each in definite quantity. Bulbar, ventricular, atrial, and sinus substances are similarly predetermined before the heart appears.

We may best sum this stage up by saying that primary differentiation initiates a period in which the organism is essentially a *chemical mosaic* of qualitatively unlike regions. Regeneration (except, in certain cases, of one of two paired organs) during this period is impossible. If a gastrula be cut into two, each half forms only those organs which it would have formed as part of a whole; if a piece of the future brain region is cut out in the neural plate stage, and then grafted back in reversed position, its different parts still produce the structures they would have produced if in normal position. Some *form-regulation* of separate organs is possible (although no approach to the normal form of the whole organism); gastrula-halves round off; both halves of a bisected optic-cup region form miniature eyes, but each chemically differentiated region is separate and irreplaceable. Adult newts, for example, may regenerate disarticulated limbs, even together with their limb-girdles; but a newt embryo from which one of the small "limb-areas" of ecto- and mesoderm has been removed will remain permanently limbless.[8]

Form-regulation is thus largely a matter of physical factors; but differentiation proper depends upon more important chemical differences. This complete lack of regeneration, and the behaviour of the organism during a whole period as a mosaic of independent regions, instead of, as in later periods, a system of interrelated organs, is not only interesting in itself, but also of great theoretical importance in view of the assertions of Driesch,[9] Haldane,[10] and others that regulation is the fundamental property *par excellence* of organisms.

Even in higher forms the same holds good. The head region of a 24-hour chick grafted on to the membrane of a 7-day egg will differentiate essentially as it would have done normally, and without regeneration,[11] and the early rudiment of the metanephros of an older chick, excised and similarly treated, will differentiate in quite a characteristic fashion in the solitude of the chorio-allantois.[12]

Spemann found early gastrulation to mark the onset of chemical determination; it is worth noting that many workers using, *e.g.*, echinoderm and teleost material, and employing quite different methods, have concluded that gastrulation is the time at which the chromosomes first begin to exert a detailed chemical action.[13] It might be well to emphasise this aspect of the matter by using some such term as *chemo-differentiation* for what I have called primary differentiation.

The various irreversibly determined regions appear to differ from each other by the presence of qualitatively different substances, the concentration of which is highest in the centre of the region and diminishes towards its margin.

If it is asked how we can imagine the process as originating, the answer must, I think, follow some such lines as these. During gastrulation every portion of the germ has a definite relation to the germ's system of metabolic gradients. Of these, there are (1) the primary apico-basal gradient; (2) the dorso-ventral, determined by the fact that the active dorsal-lip region is on one side of the organism (as a matter of fact, actively dividing cells pass down the outer limb of the dorsal lip from equator to vegetative pole, others are invaginated and extend on its inner limb almost to the animal pole, so that the whole dorsal region is one of activity).

Both these gradients extend both on the surface and internally, and together constitute a three-dimensional system of "gradient co-ordinates." Every portion of the germ, therefore, has its own rate of activity corresponding to its position in the existing co-ordinate system, and its own characteristic proportions of yolk, glycogen, cytoplasm, etc., depending on the previous effect of the apico-basal gradient during the growth of the egg. When the "differentiator," the dorsal lip, exerts its admittedly as yet unexplained, though not unparalleled, action of initiating differentiation, every region of the germ is in a different condition from every other. The substrate is different from place to place: the result, therefore, also differs.

In addition, one region may have a definite chemical effect on another, as, for example, when the optic cup induces lens formation in the epidermis (Lewis, Spemann, Bell [14]).

It appears that in vertebrates the position of a region in the gradient co-ordinate system is of more importance than the proportions of primary materials it contains. Jenkinson,[15] by centrifuging fertilised frog's eggs, found that qualitative differentiation would still proceed even when the normal proportions of fat, protoplasm, and yolk were much altered. When they were too much altered, development was subnormal, and finally failed to proceed. In much the same way, it would be impossible to build a conservatory if the proportion of steel or wood to glass were too much reduced. The substances which can be distinguished in the unsegmented ovum of a vertebrate are thus merely raw materials. The specific organ-forming materials found elsewhere, *e.g.* in Dentalium,[16] are exceptional specialisations. They represent *precocious* chemo-determination, but differ from the chemically defined regions of the late gastrula of vertebrates in not being formed in their definitive positions, but undergoing a complicated migration. The results of centrifuging invertebrate eggs also bear out the view that the visibly differentiated substances are only the raw materials, the expression of a more ultimate organisation—presumably the living gradient-system—which is relatively unaffected by the process of centrifuging.[17]

Of course, all the organs do not appear simultaneously; but each at its apparition seems to pass through the same stages: (1) indifferent or at least pluripotent material; (2) chemical determination; (3) visible differentiation. For the first origin of late-, as for

early-forming organs, the gradient co-ordinate system appears to be of paramount importance. For example, Harrison[18] has shown that the limb-area before the appearance of the limb-bud is already "polarised" by the main apico-basal (now antero-posterior) gradient of the larva. But its dorso-ventral gradient is not yet irrevocably determined; and if it is grafted in upside-down, the existing dorso-ventral gradient of the whole organism determines the definitive dorso-ventral differentiation of the limb.

An even more striking example is found in another of Harrison's experiments.[19] He grafted the front portion of an embryo of one frog species on to the dorsum of a whole embryo of a lighter-coloured species. When the lateral-line system of the dark graft began to grow out, it could be followed on the light skin of the host. When it had nearly reached the centre of the flank it began to curve, and finally bent right round and grew backward in the proper position—proper relative to the host's organisation. Apparently this means that it is adjusted to a particular "level" in the dorso-ventral gradient, and to an apico-basal direction of growth.

Early histological differentiation appears for the most part to be a direct consequence of the original chemo-determination. But the *arrangement* of the cells and cell-processes is another matter. In great measure this is determined by function, and falls into the period of secondary differentiation; but in one very important case at least—that of the nervous system—it seems to depend largely upon the gradients. In tissue culture, embryonic neuroblasts throw out axons and dendrites in normal fashion, but in random directions. If, however, a weak electric current is passed through the culture medium, all the axons are oriented with respect to the current, as Ingvar's experiments have shown.[20]

Now Child and his pupils, especially Hyman,[4] have established that the gradient in electric potential, originally discovered by Morgan in the earthworm, is a constant feature of organisms, and may properly be considered as one manifestation of the gradient in metabolism. Thus in the undifferentiated nerve-tube there will already exist a gradient in potential from head to tail; and this should cause a growth of axons posteriorly within the nervous system. Once these neurons are differentiated, then, as Kappers[21] has shown, their stimulation will be accompanied by a current in the axon, and this in its turn will determine the growth of the axons of neighbouring neuroblasts at right angles to the existing axons. Thus we get some clue as to how axons should grow down the cord and out at right angles to it, and so (and in Kappers' other principles of neurobiotaxis) we get our first clue as to the mechanism by which the architecture of the nervous system is established in ontogeny.

These processes, which in Amphibia are unaccompanied by growth, bring us to the stage at which the organs are ready to begin their specific functions. Once this starts, a new period begins—a period which converts the chemical mosaic into a whole with inter-related parts, by means of functional response, nervous control, and humoral regulation. This, however, cannot be discussed within the limits of the present article.

It will be seen that the discovery of a "differentiator" and of the gradient co-ordinate system enables us for the first time to give a coherent formal account (however imperfect in detail) of the early stages of development. In so doing we sail clear of the difficulty, which has beset so many minds, of understanding how differentiation can be compatible with absence of qualitative nuclear division. Loeb, in his book "The Organism as a Whole,"[22] was driven to assume that the chromosomal (Mendelian) genes were only responsible for minor characters, the main course of development being determined by the ovum, which, owing to its assumed possession of localised organ-forming stuffs (supposedly proteins), was to be regarded as "the embryo in the rough."

It is now seen that the germ cannot be held to become "the embryo in the rough" until chemo-differentiation has started. After this moment, organ-forming substances are all-important, but in most unfertilised eggs scarcely exist. The production of these organ-forming substances depends upon the varying interaction of differentiator and genes in regions of various activity. The differential which determines the variation of activity is the system of metabolic gradients, which, although definitely organised, is very far from constituting the egg an embryo, however much in the rough. One of the two main gradients is determined at or after fertilisation by agencies external to the ovum. The other is determined in the unfertilised egg; but from analogy with other forms, it is to be expected that this too will be found to have been earlier determined by agencies external to the oocyte (position of the oocyte in the germinal epithelium, blood-supply, etc.[23]).

There is thus no reason for calling in question the efficacy of the chromosomes (Mendelian factors) as regulators of development, whether individual, specific, or phyletic. In the absence of evidence to the contrary, and in consonance with all our positive knowledge, it is simplest to assume that they provide both the necessary complexity and the necessary specificity for development, while the two main gradients provide the difference between parts of the germ necessary for the start of localised qualitative differentiation, and the activity of the dorsal lip the energy needed to set the process in action.


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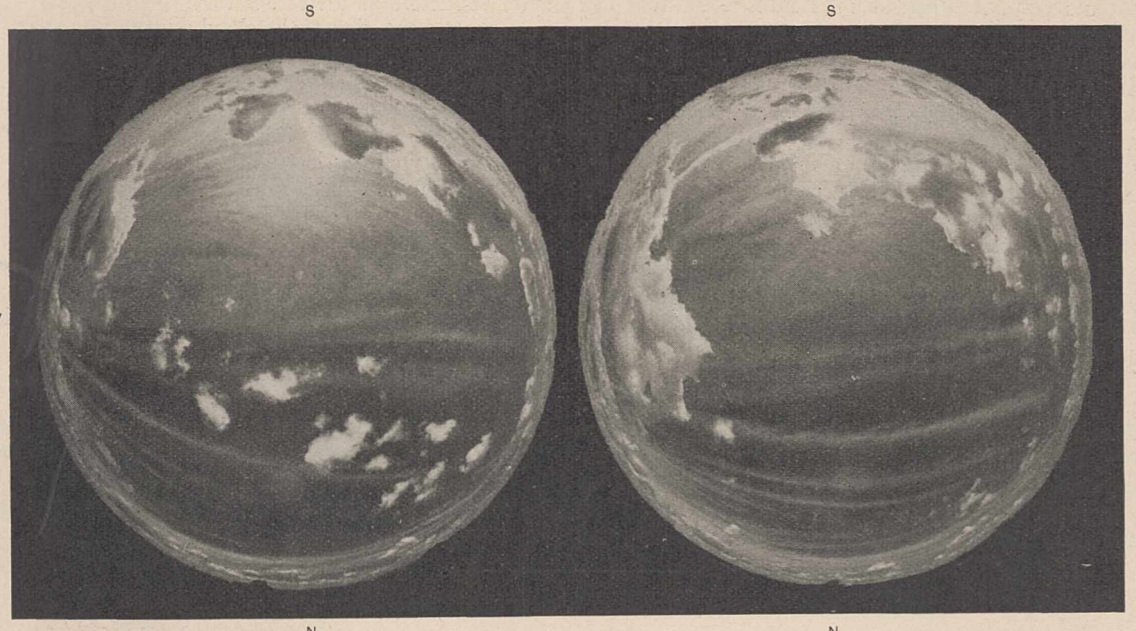
## The International Survey of the Sky.

By Capt. C. J. P. CAVE.

THE Office National Météorologique de France attempted to obtain simultaneous photographs of clouds over France in January of last year. Encouraged by the success of the undertaking, a more extended survey was arranged for the week September 24-30, when photographs were taken over a large part of western Europe. In the British Isles the services of volunteers had to be depended on almost entirely; those professional meteorologists who assisted took photographs unofficially with their own cameras, though they were allowed to do this in their official time. The only official photographs were those taken at the Royal Observatory, Greenwich, and at the Royal Naval School of Photography at Portsmouth. Those who are unfamiliar with cloud photography find some difficulty in getting good results, and therefore all who signified their willingness to help were supplied with instructions drawn up by Mr. G. Aubourne Clarke, of Aberdeen; these instructions were also circulated in other countries by the Office National Météorologique. Even with this guidance, however, the technique is not easy without previous experience, and it was not to be expected that all the amateurs who took part in the survey would be equally successful; but it is a matter for satisfaction that so many useful photographs were taken. Up to the present time, 1844 prints have been received from 63 stations in the British Isles, besides some from Malta and Blue Hill.




FIGS. 1 and 2.—Cirrus and cumulus clouds at Cambridge, September 24, 1 P.M. Photographed by Mr. R. Hill.

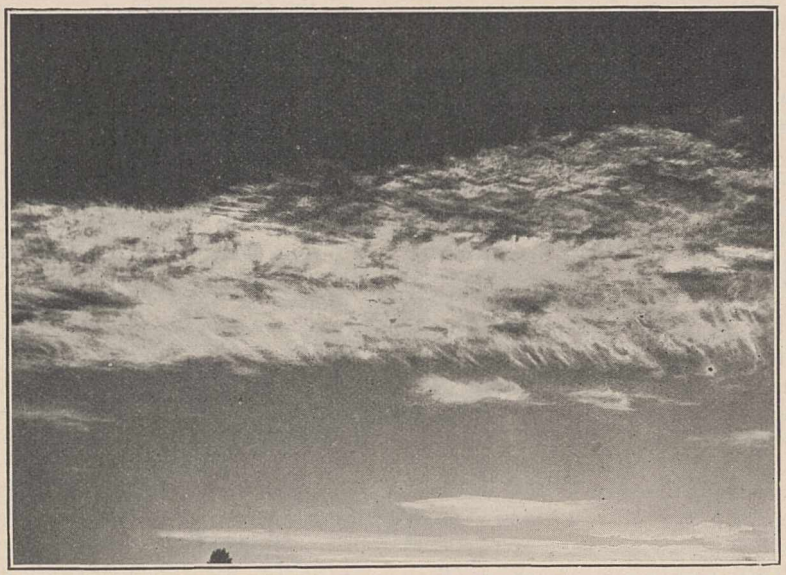


FIG. 3.—Cirrus cloud at Milford, Surrey, September 24, 7 A.M. Photographed by Dr. G. S. Sansom.

Photographs were taken at 7 A.M., 1 P.M., and 6 P.M. The latter hour was rather late, and only occasionally could good results be obtained at a time that was just after sunset. As is inevitable, when volunteers are asked for, the most numerous stations are in the most thickly populated districts: London stations numbered 10; Hampshire 6; Hertfordshire 4; Cambridgeshire, Devonshire, Lancashire, Surrey, 3 each; Cheshire, Cornwall, Derbyshire, Middlesex, Nottinghamshire,

Sussex, Yorkshire, 2 each; Berkshire, Buckinghamshire, Durham, Herefordshire, Kent, Leicestershire, Northamptonshire, Northumberland, Somersetshire, Worcestershire, 1 each; Scotland 4; Ireland 2; and Wales 1. It was suggested that where possible five photographs should be taken at each of the hours, namely, with the camera facing each of the cardinal points and the zenith; it was not to be expected that many amateurs supplying their own materials would take the maximum number, but Mr. C. P. Butler of the Solar Physics Observatory, Cambridge, took 120; Mr. John Ritchie of the Museum, Perth, 105; the Royal Naval School of Photography, 105; Miss A. M. Bulkley of St. Agnes, Cornwall, 86. Long series were also sent in by Mr. Alfred Moore, Lyndhurst; Dr. W. J. S. Lockyer, Norman Lockyer Observatory, Sidmouth; Dr. G. S. Sansom, Milford, Surrey; Colonel Arthur Hill, Selham, Sussex; Mr. Charles Leaf, Cambridge; Mr. F. W. Baker, Royal Aircraft Establishment; Mr. Wilfred Hall, Hepple Woodside, Northumberland; Mr. J. H. Pledge, Harrow; the Astronomer Royal, and Mr. G. Aubourne Clarke.

The part of the country where the best general survey was obtained was on the borders of Hampshire, Sussex, and Surrey, good series being obtained at Blackwater, Portsmouth, Stoner Hill, Selham, and Milford; these stations make an extremely good network, and as photographs were taken at most of the appointed hours and all show the cloud structure, practically the whole sky was surveyed over the district. Several local photographic societies took part in the work, and at the Dudley High School for Girls one of the staff, Miss Stratham Norton, not only took photographs herself but interested some of the pupils in the subject and they also took photographs. At Cambridge, Mr. Robin Hill took a series of pictures in which the whole sky was photographed on one plate (Figs. 1 and 2). In spite of inevitable distortion these pictures give a far better representation of the cloud distribution than can be obtained with an ordinary camera unless a prohibitive number of plates are exposed.

The cloud structure during the week was not particularly interesting so far as the British Isles was concerned; there was a great deal of strato cumulus, and in many places the sky was covered with formless cloud at some of the hours; low cloud made photography impossible at times in hill stations, and the same was the case in the Outer Hebrides, where photographs would have been particularly valuable. The first day was perhaps the most interesting, when there was a great development of high cloud in advance of an approaching depression (Figs. 1, 2, and 3).

The collection of photographs from the British Isles has been sent to the Office National Météorologique, where they will be examined in conjunction with those from France and other countries. It is expected that the complete study of the whole collection will take nearly a year.

## Obituary.

### Prof. G. H. Quincke, For. Mem. R.S.

GEORG HERMANN QUINCKE, whose death took place on January 13, was born on November 19, 1834, in Frankfort-on-Oder. His student days were spent at Königsberg, Heidelberg, and Berlin between 1852 and 1858, and in the year following that of graduation he began his academic career as privatdocent at the University of Berlin. In 1872 he was appointed to the professorship of physics at Würzburg, and three years later he succeeded Kirchhoff at Heidelberg.

Quincke's first two papers were published at the age of twenty-two while still a student, and his scientific productivity continued almost to the end of his life. To have been able to extend active experimental work over a period of sixty-seven years is a rare and perhaps unique distinction. His work covered nearly all branches of physics, and it is not possible here to do more than mention some of his more important contributions. The dissertation for his doctorate dealt with what was then called the capillary constant of mercury and marks the first of a series of investigations on surface tension. In these investigations he found ample scope for his experimental skill, and it is to be noted that at an early stage he became aware of the rapid contamination by greasy matter of solid surfaces when exposed to air. In 1869 he tried to determine by an ingenious method the range of molecular forces, which he found to be about equal to the tenth part of a wave-length of green light. Quincke's optical investigations are numerous. In 1865 he published an extensive investigation on the penetration of light into the second of two media when total reflection takes place at the surface of separation. He points out that the existence of such penetration was already demonstrated experimentally by Newton. It may be, perhaps, not amiss to note in passing that the usual theoretical formulæ which are given for this phenomenon suffer from a serious and even fatal defect, as they only take account of the surface conditions at the boundary of the two media, which is assumed to be infinite, but violate these conditions at infinity, and are correct only with important reservations. But Quincke only dealt with the experimental aspect.

It would lead too far to describe Quincke's optical measurements extending over almost the whole range of interference, diffraction and refraction, and dealing more particularly with elliptic polarisation and the reflection of light from metallic surfaces. In his detailed investigation on the behaviour of gratings, Quincke was the first to note the unexpected appearance of additional spectra which are not accounted for by the ordinary theory. These are now known to be due to periodical variations in the distances of successive grating-spaces, which are so difficult to avoid when the grating is ruled in the usual way.

Turning to electricity, we may note Quincke's discovery of the electromotive forces which are brought into action when an electrolyte is forced through a porous membrane.

Among many new devices for the determination of physical constants which we owe to Quincke, his method of determining the magnetic permeability of liquids is perhaps the most important. Utilising the

theoretical results arrived at by Faraday and Maxwell with regard to the change of pressure in a magnetic field at right angles to the lines of force, he placed the liquid into a U-tube, one branch being placed into the magnetic field. The difference in level when multiplied by a certain constant gives the magnetic constant. The method was afterwards applied to electric fields in order to determine the dielectric constants of liquids.

Within a few months of his death Quincke was engaged in an extension of an investigation published in 1915 on the perforation of glass and other insulators by electric sparks, which gave some curious and interesting results.

Quincke was an experimenter of the highest rank; for theories he had little affection. He looked with disfavour on many of the recent developments of physics, but his scepticism began so long ago that science has, at any rate in one case, justified it. The writer of this notice remembers more than one occasion when he asserted with some warmth his disbelief in the existence of the ether.

Quincke was no respecter of persons, and it was no use to quote a high authority antagonistic to his scientific opinions. High authorities to him were as likely to make mistakes as ordinary mortals. His strong convictions and independence of mind detracted somewhat from his popularity in his own country, but to those who could appreciate these qualities he was a staunch friend and cheerful companion.

ARTHUR SCHUSTER.

THE issue for January 2 of the *Comptes rendus* of the Paris Academy of Sciences contains the president's speech on the life and work of Jean M. E. Stephan, who died on December 31 at the age of eighty-six. In 1866 Stephan was appointed by Le Verrier the director of the new Marseilles Observatory; the old establishment there was well known by the work of Pons, Gambart, and Chacornac, and Stephan worthily carried on the tradition. Much work was done on comets and minor planets; the great reflector of 0·8 m. aperture was used for observation of nebulæ both for position and physical structure. Stephan was the first to attempt to measure star discs by the interferometer method, and succeeded in proving that their diameters were less than 0·158″. He also made successful observations of the solar eclipse of 1868 in Cochin China, and organised the observation of meteors and the determination of their radiants.

WE regret to announce the following deaths:

Dr. J. Loeb, since 1910 the distinguished head of the division of physiology in the Rockefeller Institute for Medical Research, on February 12, aged sixty-four.

Capt. T. H. Tizard, F.R.S., formerly assistant hydrographer to the Admiralty, on February 17, aged eighty-four.

## Current Topics and Events.

A PARAGRAPH which recently appeared in the *Times*, relative to the action of the Senate of the University of London regarding the Bloomsbury site, may convey a wrong impression as to the actual position of affairs. The position is that the offer by the Government of the Bloomsbury site and its acceptance, under certain conditions, by the Senate, both remain, and there has been no suggestion from either side that another site should be found. It will be remembered, however, that the site is intended to accommodate not only the administrative headquarters of the University, but also King's College, which occupies at present a site in the Strand of great value. It is but natural that the conditions under which that site should be surrendered to the Government should be carefully thought out, and that the Theological Department of the College should be anxious that these existing rights should not be jeopardised by a transfer of the College to a new building in a new situation, and under different conditions of tenure. Questions of this nature take time for their elucidation, and it is these, and not questions as to the possibility of finding sufficient funds, that are causing delay. As no attempt has yet been made to ascertain what funds will be forthcoming, it would be misleading to suggest that finance is proving an obstacle, though the importance of adequate funds for buildings on a scale worthy of the University need not be emphasised. As a temporary measure and pending the removal to Bloomsbury—in any case a matter of some years—the Senate is justified in reminding the Treasury of the claims of the University to adequate accommodation in the Imperial Institute buildings at South Kensington.

A COMMITTEE of the League of Nations has adopted a report in which a proposal is made that scientific men who have made discoveries which lead to new industrial applications shall, for their lifetime and for fifty years afterwards, be regarded as the proprietors of such discoveries, and entitled to a royalty on all applications that may be made of them. The proposal is subjected to a lengthy criticism in *Engineering* for January 25. The complexities and uncertainty of the industrial patent law are notorious; yet as it stands, the patent law in Great Britain and all other countries is clear in repudiating the right to patent a principle. To add to the industrial monopolies within which manufacturers have to work, the far-reaching and overriding network that would have to be considered if laws of Nature could be patented, or even principles, would be to multiply manifold the complexity of what on all hands is already admitted to be too complex and uncertain a set of laws. Our contemporary considers that the provision of adequate remuneration and honourable position is the obvious way to secure the scientific worker from being distracted to commercial interests, and to leave him free to follow his vocation to the best advantage. If he wishes to combine his scientific work with practical applications, he can, under the existing law, receive protection for them. To encourage him to hope that he may share in the profits of applications which,

although he has not shown how to make them, are based on principles that he has discovered, would be to divert him from his true work, and in the long run to degrade its value to himself and to society.

A SLIGHT earthquake (intensity 4 Rossi-Forel scale) occurred in the neighbourhood of Hereford at about 6.10 A.M. on January 26. The disturbed area is 30 miles long, 15 miles wide, and contains about 350 square miles. Its centre lies about six miles south of Bromyard. The interest of the shock is due to its relations with the previous earthquakes of the district. The strong Hereford earthquake of 1896 originated in two foci, about eight miles apart in a N.W.-S.E. line, one near Hereford and the other near Ross, and the earthquakes of 1863 and 1868 probably originated in the same foci. In 1853 a slight earthquake, similar to the recent shock, occurred near Hereford, and the longer axes of the areas disturbed by this shock and the recent earthquake are very nearly in a straight line which passes through or near the Hereford epicentre of the twin earthquakes and is roughly at right angles to the axes of their isoseismal lines. The small size and elongated form of the disturbed areas of the earthquakes of 1853 and 1924 show that their foci were at a small depth. Both earthquakes seem to be superficial consequences of the more deeply seated movements which caused such earthquakes as those of 1863, 1868, and 1896.

IN the *Times* of February 13, an account is given of the raising of the lid of the sarcophagus of Tutankhamen, which took place on the previous day in the tomb at Luxor. The coffin was found to be covered almost entirely with two linen shrouds, much discoloured but in perfect preservation. When these were removed there appeared an anthropoid coffin of wood and gesso, gilt, of colossal size, almost filling the sarcophagus, supported on a low bier, with gilt lion heads superbly modelled at the head. The hands were crossed upon the chest, the right holding a flail, and the left a crook sceptre, both of gold and faience. On each side of the coffin was a protective goddess with arms and wings outstretched and crossing the body. The face was of gold, apparently in one solid piece, with eyes of crystal, and on the forehead were an *uræus* and a vulture of gold faience, encircling the latter being a "Crown of Justification," made of olive leaves. The face was evidently a portrait. On February 14 the announcement appeared that Mr. Howard Carter had felt constrained, as a protest against the action of the Egyptian Public Works Department and the Antiquity Service, to suspend further operations. This was by no means unexpected to those who were acquainted with the vexatious interruptions and restrictions which have affected the work of Mr. Carter and his colleagues since operations were resumed in the autumn. It is little short of a catastrophe that the action of the Department should have led to the interruption of the work at a most critical moment, when it is essential that immediate measures should be taken for the preservation of relics of a kind which may never be discovered again and are of inestimable value for the science of Egyptology.

DR. ELIHU THOMSON, consulting engineer with the General Electric Company, has been awarded the Kelvin gold medal for engineering. The medal, which was founded in 1914 by British and American engineers and is awarded triennially by the presidents of the representative British societies, has been awarded only once before, to Dr. W. C. Unwin. Dr. Thomson has attained a position of eminence as a scientific worker and as an inventor, especially in the field of electrical engineering. He left academic life for industrial work in 1880, becoming head of the American Electric Company, afterwards reorganised as the Thomson-Houston Electric Company, and later as the present General Electric Company. Dr. Thomson has served as president of the American Institute of Electrical Engineers and of the International Electro-Technical Commission, 1908-11.

MR. AMBROSE SWASEY, engineer and manufacturer, of Cleveland, Ohio, has been awarded the John Fritz gold medal for 1924, "for the building of great telescopes, the founding of the Engineering Foundation, and the invention and manufacture of fine machine tools, precision instruments, and military and naval range-finders." Among the famous telescopes built under the direction of Mr. Swasey are the 36-inch Lick refractor at Mt. Hamilton, California, the 26-inch telescope of the Naval Observatory at Washington, the 40-inch telescope of the Yerkes Observatory at Williams Bay, Wisconsin, and the 72-inch reflecting telescope of the Dominion Astronomical Observatory at Victoria, B.C. Mr. Swasey, who established the Engineering Foundation in America as the joint research instrument of the four great national societies of civil, mining and metallurgical, mechanical and electrical engineers, is a past-president and honorary member of the American Society of Mechanical Engineers, and an honorary member of the American Society of Civil Engineers.

MR. W. M. H. GREAVES, who has been appointed Chief Assistant at the Royal Observatory, Greenwich, following the appointment of Mr. Spencer Jones as H.M. Astronomer at the Cape, is a Colonial British subject born in Barbados. He came to England in 1917 with a scholarship to St. John's College, Cambridge, obtained a first class with distinction in Part II. of the Mathematical Tripos, and was awarded the Tyson medal for astronomy. He obtained the second Smith's prize for an essay on the movement of asteroids of the Trojan group, an interesting case of the problem of three bodies. As Isaac Newton student, he continued this research and obtained a fellowship at St. John's College. Mr. Greaves noticed that the same mathematical analysis was applicable to the very different problem of the oscillations of a triode valve. While he was Isaac Newton student he worked for two months at the Royal Observatory, Greenwich, and thus acquired some insight into the observational side of astronomy.

THE Report of the Council of the Optical Society presented at the annual general meeting on Thursday, February 14, shows that the activities of the Society were well maintained during 1923, while the member-

ship roll gives indications of the continued interest that is being taken in the theory and practice of optical science. In addition to the ordinary meetings for the presentation and discussion of papers, three lectures of an historical nature were delivered, which have had the effect of directing attention to the valuable collections of optical and scientific instruments in Great Britain, and particularly those in the Science Museum, South Kensington. Last year's programme also included the Thomas Young oration by Prof. M. von Rohr, of Jena, and the presidential address by the Astronomer Royal. A satisfactory feature of the financial statement accompanying the report is the substantial balance of income over expenditure. While the scope and number of papers published in the Society's Transactions have been extended, there has been an appreciable reduction in the cost of printing them. This is a hopeful sign, suggesting, as it does, that the financial stringency which nearly all scientific societies have been experiencing may be nearing an end.

THE first number of the *Empire Cotton Growing Review*, which is to function as the journal of the Empire Cotton Growing Corporation, has recently appeared (January 1924) and promises to be a useful publication. In addition to recording the development of the Corporation's activities, the review aims at publishing information concerning cotton-growing problems throughout the Empire, thus serving as a clearing house of such intelligence regularly collected from the different dominions and colonies engaged in the industry. It will also include statistics of all kinds relating to the cotton crops of the world, and will endeavour to bring to the knowledge of both spinners and growers the requirements and practical difficulties with which each side is faced. The programme is one of some magnitude, and, if the editor succeeds in getting it under way within a reasonable time, he will have performed a fine service to both sides of the British cotton industry. The number just issued is, of necessity, somewhat tentative, but promises well. The principal contents include an appreciation by Dr. Balls of the late chairman of the Empire Cotton Growing Corporation, Mr. J. W. McConnell; an account of the aims of the Indian Central Cotton Committee by Mr. B. C. Burt, the secretary to the committee; a statement regarding cotton cultivation in Tanganyika Territory, by the cotton specialist in the Territory (Mr. R. C. Wood); while Prof. Todd contributes the first of a series of statistical articles on cotton growing. A very useful feature is the section devoted to current literature. The review is to be issued quarterly by Messrs. A. and C. Black, at the very moderate price of one shilling per number.

THE sixth of a series of lectures on physics in industry was delivered to members of the Institute of Physics on February 6 by Prof. C. H. Desch, who described the applications of physics to metallurgy. Modern manufacturing processes, especially in steel works, demand a knowledge of physics as well as of chemistry from the men who are placed in control of them, whilst the research laboratories possessed by many such works offer increasing prospects of employment for men skilled in the use of physical instruments and gifted with some imagination. The requirements of the electrical and mechanical engineer call for the accurate determination of many physical properties, magnetic measurements furnishing a good illustration. By correlating magnetic and mechanical properties, several useful methods of testing metals have been devised. The measurement of temperature in furnace operations involves the use of thermo-electric, resistance, and optical pyrometers, but whilst the practice of reading such instruments is easily learned, a knowledge of physics is required for their control, in order to avoid errors in the interpretation of readings, as, for example, when an optical pyrometer is directed towards an object which is not under the conditions of a black body. Other illustrations are found in the flotation of ores, an interesting application of surface tension, and in the use of thermionic valves in the determination of slip in metals. The imperfection of the magnetic theory of alloys was mentioned, Heusler's alloys, cobalt magnet steel, and permalloy being cited as magnetic materials the properties of which could not have been predicted. The address concluded with an account of the services rendered to metallurgy by the method of X-ray analysis.

THE Proceedings of the Twelfth International Physiological Congress held at Edinburgh on July 23-27 last have been published as a special volume of the *Quarterly Journal of Experimental Physiology* (London: Griffin and Co., pp. xxiv+243, 30*s*.), which forms an interesting record of a most successful gathering. Three special addresses are printed in full. Prof. J. J. R. Macleod's on insulin covers ground which is by now familiar. Prof. Charles Richet is more unconventional with his claim for the probable existence of "les voies non sensorielles de la connaissance," and his plea that the phenomena of telepathy and kindred appearances are at least worth serious investigation. Prof. I. P. Pavlov deduces from his enormous experience of conditioned reflexes that no sharp line can be drawn between inhibition in the waking state, sleep and hypnosis. The greater part of the volume (pp. 44-243) is occupied with abstracts of communications made to the three sections of the Congress. No more can be said of them than that they worthily illustrate the enormous range and effectiveness of current physiological inquiry. But there seems to be no record of the remarkable communication by Prof. Pavlov on the inheritance of acquired facilities of the nervous system referred to in NATURE of November 3, 1923, p. 664, which seemed to be one of the outstanding papers.

THE Ministry of Agriculture and Fisheries in conjunction with the Meteorological Office has issued a leaflet entitled "The Weather and the Farmer." It directs attention to the fact that the farmer needs to know for as long beforehand as possible what the weather is going to be and he is concerned with what the weather has been. He must exercise his weather wisdom at every stage of his work, and similarly with

the market-gardeners and the fruit-growers. Assistance may be obtained from the Meteorological Office, through weather forecasts, of the likelihood of rain at sowing or planting-out time and warnings of probable night frosts and following sunshine. Forecasts are distributed each afternoon to telephone exchanges, Great Britain for this purpose being divided into 40 districts. The forecasts cover a period of 24 hours, from six o'clock in the evening, and are available between five o'clock and midnight each day on demand by telephone, no charge being made for the forecasts apart from the cost of the local telephone call. District forecasts are broadcasted by wireless from London each day at 9 A.M., 3 P.M., and 8 P.M. G.M.T. Forecasts by telegram can also be obtained for 24 hours in advance by arrangement with the Meteorological Office, and notification of spells of settled weather for harvesting operations from May to September, giving the time of spells of settled weather setting in and of their break-up. These telegrams are issued as called for by the weather conditions, at a small charge. A list of books is given for fuller information.

THE fifth of a series of orations in celebration of the centenary of Birkbeck College (University of London) will be delivered by Dr. W. Bateson, director of the John Innes Horticultural Institution, on March 12, at 8 P.M., whose subject will be "Progress in Biological Science."

MR. J. PIERPONT MORGAN has handed over to six trustees for the public the collection of books and manuscripts comprising the well-known Morgan library, as a memorial to his father, the late Pierpont Morgan. The gift includes the building in New York in which the library is housed and is accompanied by an endowment of about 300,000*l*.

THE following have consented to serve on an advisory committee appointed to administer the funds of the British Empire Cancer Campaign:—Sir John Bland-Sutton, Dr. H. H. Dale, Sir Richard Garton, Dr. F. Gowland Hopkins, Dr. Robert Knox, Sir William Leishman, Prof. C. J. Martin, Dr. Robert Muir, and Sir Humphry Rolleston.

A JUNIOR physicist and a junior analyst are required by the Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1, for work in connexion with the Corrosion of Metals Research Committee. Applications for the posts should be made in writing to the secretary of the department by March 1 at latest.

THE Air Ministry is requiring two university-trained chemists for explosive research. Candidates must have had experience in research, or the manufacture of chemical products, and a knowledge of mechanical drawing, French, German, ammunition, and explosives is desirable. Applications, marked S.2, should be sent to the Secretary, Air Ministry, Adastral House, Kingsway, W.C.2.

THE following officers and members of council were elected at the annual general meeting of the Royal Meteorological Society held on January 16: *President:* Capt. C. J. P. Cave; *Vice-Presidents:* Dr. C. Chree, Mr. J. S. Dines, Dr. A. Crichton Mitchell, Dr. G. T. Walker; *Treasurer:* Mr. W. Vaux Graham; *Secretaries:* Mr. R. Corless, Mr. L. F. Richardson, Mr. G. Thomson; *Foreign Secretary:* Mr. R. G. K. Lempfert; *Councillors:* Mr. R. Arnison, Mr. L. C. W. Bonacina, Mr. C. E. P. Brooks, Dr. J. Brownlee, Mr. J. Edmund Clark, Dr. F. Druce, Mr. M. A. Giblett, Mr. R. H. Hooker, Mr. H. Mellish, Dr. G. C. Simpson, Sir Napier Shaw, Mr. F. J. W. Whipple; *Assistant Secretary:* A. Hampton Brown, 49 Cromwell Road, South Kensington, S.W.7.

THE annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 8 and 9, at the Institution of Civil Engineers, London. The annual dinner will be held on the evening of Thursday, May 8, at the Hotel Cecil, Strand, W.C. In March the Council will consider applications for grants from the Carnegie Fund, in aid of research work on some subject of practical importance relating to the metallurgy of iron and steel, or allied subjects. Special application forms can be obtained from the secretary of the Institute. The results of research work must be communicated to the Institute in the form of a report.

PROF. A. S. EVE, of McGill University, Montreal, writes that the statement in our issue of January 19, p. 91, that Prof. J. Harkness resigned the chair of mathematics at McGill University in 1913 is incorrect. On the contrary, Prof. Harkness remained Peter Redpath professor of pure mathematics until his death, but latterly he also discharged the somewhat arduous duties of acting dean of the Faculty of Arts.

BULLETIN 57 S., issued by Messrs. Watson and Sons, contains specifications of dental X-ray apparatus; this includes a special type of Coolidge tube, a transformer of the oil-immersion type, and a tube stand of special design intended to give the required rigidity. Dental radiography is now so extensively employed that this is reflected in the attention which is paid to the various accessories. A portable developing outfit suitable for the small size of film and a viewing box with magnifying radioscope are among the items which are illustrated.

WE have recently received from Messrs. C. Baker, 244 High Holborn, W.C.1, a new edition of their Catalogue of Second-hand Scientific Instruments (No. 80). The items listed are conveniently grouped in sections, among which those containing microscopes and their accessories, and cameras and other photographic equipment provide a wide range for choice. The list, though devoted principally to second-hand apparatus, also covers new projection lanterns and wireless receiving sets.

SPECIAL Report, No. 14, of the Department of Scientific and Industrial Research (Food Investigation Board), entitled "The Thermal Properties of Ethyl Chloride," has been compiled by Prof. C. F. Jenkin and Mr. D. N. Shorthose from the point of view of the use of this substance in refrigeration. Many tables of physical constants are given

(*e.g.* solubility in water, latent heats, specific heats, entropy, etc.). Two charts are included, namely, temperature-entropy and total heat-entropy diagrams, the latter being obtainable separately. Experimental details of the determinations of the various constants are also given.

MESSRS. JAMES SWIFT AND SON, LTD. (81 Tottenham Court Road, W.), have recently sent us a copy of their newly issued catalogue of microscopes and accessories. It includes only instruments suited for the biological sciences and for recreative purposes; those specially designed for petrology, metallurgy, etc., are described in separate lists. The "Symposium," "Research," "I.M.S.," and other microscope models are listed and described, together with series of apochromatic and achromatic objectives and various accessories. Among novel features we note the series of new "telangic" oculars, for which is claimed increased diameter of the field combined with flatness and brilliancy; "tank" immersion objectives, for the examination of aquatic organisms, working without cover glass and with the front lens immersed in the water; and an "ultra" condenser, working with a small arc or a Pointolite lamp and having a hollow in the upper lens surface which holds the fluid under examination.

## Our Astronomical Column.

PREVALENCE OF FIREBALLS IN JANUARY.—Mr. W. F. Denning writes: "The past month has proved remarkably abundant in meteoric fireballs of the larger class, and about ten of these objects have been sufficiently well observed to enable their real paths to be computed. Except during the first week of the month, when the special Quadrantid shower supplied the majority of the meteors visible, the objects observed do not appear to have belonged to specially rich streams of these bodies. After the middle of December, and the decline of the Geminids, meteors usually become scarce for the ensuing seven months, but are often plentiful at the time of the Quadrantids (about Jan. 3) and Lyrids (about April 21). Fireballs, however, appear to be somewhat different in their distribution and exhibit no appreciable diminution in numbers in the winter months.

It is unfortunate that many persons who are the fortunate spectators of brilliant meteors do not recognise the necessity of obtaining exact observations and are indeed not capable of recording with precision the data required. Thus the great majority of the fireballs which pass over England escape proper investigation, and it is to be hoped that both astronomical and meteorological observers will endeavour in future to supply the information which has been so often lacking in the past."

ASTRONOMICAL CONTRIBUTION TO ANCIENT CHRONOLOGY.—The utilisation of solar and lunar eclipses for dating ancient events has long been familiar. An important extension, using a record of the appearances of Venus as the morning and evening star, has been successful in carrying the system of trustworthy dates several centuries further back. The record in question has long been known; a translation by Mr. Bosanquet and Prof. Sayce appeared in Mon. Not. R.A.S., vol. xl. No. 9 (1880); it was not, however, until 1910 that Father Kugler succeeded in fixing the approximate date of the observations. There is one particularly useful record for dating purposes: "In the 8th month on the 28th day Venus disappeared in the west, 3 days she delayed in heaven and rose in the east on the 1st of the 9th month." It would need a high north latitude of Venus to make the interval so short, and only a few years are possible. Kugler first decided for 1972–71 B.C., but in 1922 he changed to a date 176 years later. Dr. Fotheringham has recently rediscussed the problem, applying an acceleration of the motion of Venus of $2\frac{1}{2}''$ per century (this was obtained by multiplying the acceleration adopted for the sun from old eclipses by the ratio of mean motions 13/8). He decides for the year 1915 B.C., as by far the most probable.

Prof. Langdon (Oxford Cuneiform Texts, vol. ii.) applies this result, in combination with a recently discovered inscription, containing a list of kings with the duration of their reigns, to extend the period for which fairly exact dates can be assigned back to 4000 B.C. or thereabouts.

THE PHOTO-ELECTRIC PHOTOMETER AT THE LICK OBSERVATORY.—Lick Observatory Bulletin No. 349 gives a full description, by Edith J. Cummings, of this instrument, and the method of using it. It is illustrated by several photographs and diagrams. The cell has to be illuminated, either by twilight or starlight, for some minutes before beginning measurement. Dark-current and sky illumination are also allowed for: the first by shutting all light from the cell and measuring the rate of drift of the thread; the second by noting the amount of drift when the star image is put off the diaphragm aperture.

The Pleiades were first observed for testing the photometer. The results proved to accord well with Schwarzschild's photographic magnitudes. Revolving sectors were used to reduce the brightness of the brighter stars to that of the selected standards. Colour indices were obtained by comparing measured magnitudes with the Harvard visual ones, as follows: Bo −0·14, Ao 0·00, Fo +0·22, Go +0·45, Ko +0·76, Ma +1·10, Mb +1·28.

A detailed investigation is given of the light-curve of $\beta$ Cephei. A secondary maximum is shown in the ascending branch of the curve. Guthnick and Preyer's curve for 1913-1914 shows a slight flattening, but not a maximum, at this point; but that for 1917 does show a maximum, though less marked than the Lick one. The light curve is apparently not constant. The spectroscopic measures of the star are also discussed, and it is shown that it is difficult to explain the observations on the assumption of orbital motion. The light maximum occurs 0·033 day before the maximum velocity of approach.

PUBLICATIONS OF THE AMERICAN ASTRONOMICAL SOCIETY.—Volume 4 of the Society's Publications contains the collected papers read at the five annual meetings of the Society from 1918 to 1922. The papers have already been in print, but they are well worth collecting into a volume, many of them being of a practical character. The frontispiece is a portrait of Prof. E. C. Pickering, who died in 1919.

The subject index shows that the papers deal with a very wide range of subjects: sun, moon, planets, including the spectrum of Venus and variability of asteroids; comets, including both orbits and spectra; stellar work in all its branches, including several papers on the interferometer work at Mt. Wilson. Altogether it is a most serviceable volume for reference.

## Research Items.

EXCAVATIONS AT UR.—A further report by Mr. C. Leonard Woolley on the discoveries at Ur and Tel-el-Obeid appeared in the *Times* of February 11. The finds at Ur include gate sockets of Bur-Sin and Gimel-Sin, kings of the Third Dynasty (*circa* 2200 B.C.) and a number of terra-cotta figures and reliefs, pottery and inscribed cylinder seals of that period. At Tel-el-Obeid more than a dozen examples of the copper friezes of cattle in relief have now been recovered, as well as a number of statues of oxen in the round made of plates of copper on a wooden core and originally with golden horns. Sections 3-4 feet long of a frieze which adorned the front wall of the Temple show cattle walking in line, a reed enclosure, from which two heifers are walking, milking operations and men pouring a liquid into jars. The prominence of the cow suggests an agricultural fertility cult, possibly of the goddess Nin-khursag. A gold scaraboid bead bearing the name and title of the king of the First Dynasty by whom the Temple was founded, was also discovered. This, on the Sumerian reckoning which placed the First Dynasty at about 4600 B.C., is the oldest known piece of royal jewellery.

THE CULTURAL HISTORY OF THE PACIFIC.—In *Discovery* for February, Dr. A. C. Haddon considers the application of Mr. Perry's theories on the diffusion of culture as they affect Melanesia. It seems impossible to escape from the conclusion that the first influx of the archaic civilisation into Melanesia was due to Austronesian-speaking peoples, who came originally from the mainland of Asia and immediately from Indonesia, and that the Polynesians came from Indonesia, the earlier, perhaps, with an intermediate stage in Melanesia. The traces of a physical type suggestive of the Armenoid among existing Polynesians points to direct intercourse with maritime Armenoid or Phœnicians, though the language precludes the view that Polynesia was originally colonised by the Phœnicians or allied voyagers. The burial of embalmed chiefs in cavities hollowed out of mounds, often made of stone and of pyramidal form, by the Araha clan of San Cristoval, as well as the dolmen and stone image in human form associated with them, presents a close parallel to the customs of Egypt in the Pyramid Age.

RESPONSIBILITY IN INSANITY.—In the *Fortnightly Review* for February, Dr. John Warnock discusses the difficult question of the responsibility of the insane. The disagreement between the lawyers and the psychologists is analogous, he thinks, to that once holding between the orthodox theologians and the Darwinians. In each case one party to the dispute laid down an *a priori* generalisation; with the lawyers it is that the lunatic is responsible unless he can be proved to be irresponsible. The psychologists, from a study of observed facts, claim that the evidence shows that in practice all lunatics should be considered irresponsible. In the face of what is known of the working of the mind, it is impossible to declare that any act of a lunatic may not be related to his insanity, or that his appreciation of right and wrong may not have been affected by his insanity. Dr. Warnock criticises the present procedure whereby a number of human beings are sentenced to death and have their sentences revised because they are afterwards found to have been insane. The existing practice of leaving the decision as to the accused's insanity to a jury is, he thinks, absurd. Jurymen have not the necessary knowledge. The question of a person's sanity should be judged by experts and away from the prison environment, just as the food analyst and poison expert give their decisions as to the presence or absence of a certain substance. The problem for the jury should be that of determining whether the accused actually committed the alleged act. The procedure of sentencing the insane to be hanged is not far removed from that of sentencing witches to be burned. We, however, possess the necessary scientific knowledge, which should be utilised to its fullest extent. Lawyers, too, might with advantage be trained in the psychology of insanity.

MONOZOA.—The small but very interesting group of tapeworms known as the Cestodaria, or Monozoa, forms the subject of a memoir by Dr. W. N. F. Woodland in the *Quarterly Journal of Microscopical Science* (vol. 67, part iii.). The author deals more especially with the family Caryophyllæidæ, well known parasites of fresh-water fishes and oligochætes, amongst which he recognises three genera, Caryophyllæus, Archigetes and Wenyonia. The last-named is a new genus (with three new species) from the Anglo-Egyptian Sudan. The material, which includes also a new species of Caryophyllæus, was collected by the late Dr. A. J. Chalmers, when Director of the Wellcome Tropical Research Laboratories at Khartoum, and forms a notable addition to the family.

POLYPLOIDY.—Prof. R. R. Gates's paper upon this subject, published in volume i. of the *British Journal of Experimental Biology*, impresses upon the reader the surprisingly wide distribution of this phenomenon in plants. In the table on p. 165, 15 genera are cited as containing polyploid species in which the normal $2n$ number of chromosomes may be replaced by $3n$, $4n$, etc., even $10n$ having been recorded. These 15 genera cited are not the only examples, but are those genera in which more than one "polyploid" number has occurred; genera containing species with $4n$ chromosomes would make very numerous additions to this list. Polyploidy has occurred in many of our cultivated plants—wheat, oats, sugar-cane, bananas, pineapples, etc. Prof. Gates suggests that in these cases man may have selected polyploid forms on account of their larger size, but he points out that the same evolutionary tendency to polyploidy has occurred in many genera of wild plants, notably the roses. The paper terminates with a very valuable bibliography of literature on a specialised field of growing importance.

INVESTIGATIONS ON DINOFLAGELLATES AND ECHINODERMS.—The Report of the Marine Biological Station at Port Erin (37th Annual Report of the former Liverpool Marine Biology Committee, now the Oceanography Department of the University of Liverpool), drawn up by Dr. J. Johnstone, contains a short summary of the work carried on during the year 1923 and shows that various improvements have been made both as regards the staff and the general equipment for research. Facilities for biochemical work are much increased, and Mr. J. R. Bruce submits an attractive programme for prospective work. At the end of the report are two interesting short papers, one by Miss Herdman on the dinoflagellates on the Port Erin sands, and the other by Prof. Dakin on the effect of sealing up the madreporite in certain echinoderms so that sea-water could not pass directly into the water vascular system. In these experiments it was found that Echinus can live some weeks under such conditions. Miss Herdman's contribution is her third paper on the subject, and in it she shows how members of different families are similarly adapted

for living in the sand, where they are covered and uncovered diurnally by the tide. A much flattened body, with mobile lips bordering the longitudinal sulcus, are the main characteristics, enabling the cell to lie close to the sand grains and thus obtain shelter. A species, which is presumably a Phalacroma, seems to be very closely related to Amphidinium, thus bearing out Kofoid's theory of its ancestry; and of great importance is the discovery of an entirely new species of Polykrikos, which possesses no nematocysts at all and only two nuclei in a colony of eight inseparable individuals. This most interesting form is much flattened laterally and is of the typical build of an arenaciphilous dinoflagellate. It is to be hoped that this work will be continued, especially as it is proposed by Mr. Bruce to work at various biochemical problems of the same beach.

UTILISATION OF ATMOSPHERIC ELECTRICITY.—We are informed in a letter from Mr. K. P. Bhattacharyya that at Pabna, a remote village in Bengal, a successful beginning has been made in the extraction of electricity from the atmosphere on a commercial scale. The preliminary experiments commenced in November 1922, and were made with large paper and linen kites, wound with a network of copper wires connected to tufts of pointed wires, and communicating with the ground by a cord formed of silk-covered copper wire. It proved desirable later to replace the copper wire by silver, owing to the rapid oxidation of the copper surface which became coated over with a non-conducting film. The kites rose to eight or nine hundred feet, when it was found that sparks could be drawn at short intervals from an insulated rod attached to the lower end of the metal kite-string. The sparks varied in length with the condition of the atmosphere, but were always obtainable, by day and by night, in good weather and in bad. The intermittent sparks were made to yield a continuous alternating current by means of a special transformer device. The results were encouraging enough to lead to development on a larger scale, in which the kites are replaced by aluminium balloons filled with hydrogen gas, and intended to float at a height of 1000 ft. On their outer surfaces there is a network of thin pointed silver rods attached to the metal cable and conductor. If it is demonstrated that a large supply of current can be drawn from this comparatively low height in the atmosphere, the results will be of great interest; at present we have received no details as to the actual cost and output.

SOUTHPORT WEATHER OBSERVATIONS.—The Southport Corporation has recently issued the annual report and results of meteorological observations for the year 1922, with hourly averages from twenty years' observations of the duration, amount, and intensity of rainfall, prepared by Mr. Joseph Baxendell, meteorologist to the Corporation. The Fernley Observatory is now an auxiliary observatory of the Meteorological Office, and the Air Ministry is associated with the Southport Corporation in the publication of the report. So far as the wind is concerned, 1922 was unusually quiet, even more so than in the remarkably fine weather of 1921. Wind speed was under the average in every month except June and July, and the number of days with gales was only one-half of the normal. The outstanding features of the year were the fine weather of spring and autumn, the extremely inclement summer, and the general wetness of the winter. The rainfall in 24 hours on August 31–September 1 amounted to 2·59 in., which is the largest amount in any one day since the Observatory has been established. October was unprecedentedly dry, and the most notable wind direction feature of the year was the large amount of north-easterly and easterly winds in October, for which no parallel exists in the oldest records for the district. The highest temperature in 1922 was 79·5° on June 1, the lowest 24·2° on February 6. Duration of sunshine for the year totalled 1533 hours. Rainfall measured 35·11 in. for the year, 2·13 in. above the normal, and rain fell on 200 days, which is 12 more than usual. The hourly averages of rainfall for 20 years, 1902–1921, show that, for amount, the fall is least round about midday, but the period of maximum is irregular. The duration is greater in the morning hours, from about 5-7 A.M., and least about midday, 11 A.M.-1 P.M.

THEORY OF SHIP WAVES.—A further contribution to this subject, being a continuation of the paper noted in our issue of August 25, 1923, p. 294, has been written by Einar Hogner and is published in the Arkiv for Matematik, Astronomi och Fysik, Band 18, No. 10 (Stockholm). The previous paper dealt only with the wave motion in the neighbourhood of the boundary planes, but an attempt is made in this later work to extend the results to the motion in the neighbourhood of the vessel itself. The results have not yet been worked out in detail, but the mathematical solutions required are indicated. Some interesting results previously found by the author concerning two-dimensional ship waves are also given.

ATMOSPHERICS AND THEIR EFFECT ON RADIO RECEIVERS.—The most important and difficult problem which radio engineers have to solve is to find a method of eliminating the effects produced by atmospheric disturbances on their circuits. The recent experimental researches of R. A. Watson Watt and E. V. Appleton (Proc. Roy. Soc. A., 1923), on the nature of atmospherics, have enabled E. B. Moullin to draw some interesting conclusions as to the magnitude of the effects produced. In a paper read to the radio section of the Institution of Electrical Engineers on February 5, he finds by mathematical analysis the results produced by waves of the types which actually occur. The effects produced on a tuned antenna, on an aperiodic antenna, on a tuned loop aerial, and on the combination of each of these with a selective amplifier, are investigated. The important result is deduced that the formulæ for each case are identical. He discusses the possible advantages to be obtained from the use of an aperiodic antenna and from the use of a slightly distuned periodic circuit. The rectified current produced by the atmospheric is compared with that produced by the signal. He concludes that to get the best results the decrement of the aerial should always be reduced to the point where bad shaping of the signals commences.

A NEW BRIDGE AND POTENTIOMETER.—Messrs. Crompton and Co., Ltd., of Chelmsford, have sent us a leaflet describing the Crompton-Robertson combination bridge and potentiometer. The apparatus has been designed by Prof. David Robertson, of Bristol, for use in electrical test rooms. It can be used as an ordinary four gap slide wire bridge and as a simple form of potentiometer for ampere, volt and resistance measurements. The accuracy of the instrument is not so high as that of a standard potentiometer, yet in many cases a maximum inaccuracy not greater than 1 in 1000 can be obtained. All currents less than 100 amperes and voltages less than 600 can easily be measured. Special advantages are that each scale division of the slide wire is exactly one milli-ohm. The slide wire, although fully visible and completely protected from accidental injury, is easily accessible for dusting. The keys also for the battery and the galvanometer are included in the bridge.

## The Third Cincinnati Meeting of the American Association for the Advancement of Science.

THE seventy-eighth meeting of the American Association for the Advancement of Science, and of associated societies, was held in Cincinnati during convocation week, December 27-January 2, by invitation of the University of Cincinnati. This was the annual meeting for the fiscal year 1924, which began October 1. The various sessions were held in the buildings of the University of Cincinnati and in the Hughes High School nearby. Many features of the programme bore on the jubilee character of this meeting, in celebration of the seventy-fifth anniversary of the founding of the Association, which occurred at Philadelphia in September 1848.

The arrangements for the meeting were very efficient and satisfactory, and in some respects they greatly excelled those for any earlier meeting of the Association. In every way the meeting was entirely successful. The total number of persons who registered is 2211, and it is probable that a considerable number were present who failed to register. In attendance, this meeting therefore almost equalled the Boston meeting of the previous year; it did not fall far short of the last Chicago meeting, held in December 1920, which was the largest on record, having a registered attendance of 2413. All of the fifteen sections of the Association were well represented in the programme, and thirty-four societies and other organisations were also represented. Of the latter, twenty-four are officially associated with the Association, eighteen of these being affiliated and therefore taking part in the direction of the work of the Association. One hundred and sixty-six scientific sessions were held, at which 1139 papers were read. In addition, there were many business sessions, dinners, and other social functions.

The fine hospitality of the University of Cincinnati and of the Cincinnati people, which made this meeting such a pronounced success, will not soon be forgotten by those who were fortunate enough to be able to attend. The local committee, under the able chairmanship of Prof. Louis T. More, of the University of Cincinnati, contributed invaluable services to the Association and the societies. Special mention should be made of the very efficient work of Profs. More, Edgar Dow Gilman, C. N. Moore, Nevin M. Fenneman, and Ralph E. Oesper.

The preliminary announcement of the meeting, a booklet of 90 pages, was sent to all members of the Association about December 1, and to other members of the societies that took part in the meeting. The booklet contains more information than has been possible in the case of any similar announcement in past years. Copies of a second edition of the announcement were distributed in the registration room during the meeting. About 26,000 announcements, of both first and second editions, were distributed.

The General Program — a book of 182 pages — contains for the first time a series of cross references, which greatly enhances its usefulness. Another new feature is the use of tinted paper for the summary of events, arranged by session periods. Supplements to the General Program were introduced at this meeting, in which were published additions, corrections, etc.

It is impossible to present here anything more than an inadequate statement regarding the Cincinnati Exhibition. It represented the rapid development of research apparatus in America, and the very high standards that have been attained by American manufacturers since the War. The Exhibition included a wide range of materials, embracing many intricate electrical instruments for controlling conditions and automatically recording the results of experiments. The latest potentiometers, electrometric titration and electrical conductivity apparatus, galvanometers, rheostats, etc., were displayed; a large assortment of medical instruments and research accessories were to be seen, as were also some very fine binocular and high-power microscopes, with dark field illuminators of most recent types. A very interesting exhibit was a nitrogen-fixation plant in operation. Wax models and mounted biological specimens were to be seen, one of the exhibits being specimens of Peripatus. There were the latest models of balances, both torsion and swing, with devices to facilitate accuracy and speed in weighing. One of the chemical exhibits consisted of more than a thousand kinds of chemicals, stains, and dyes, useful in biological research, histology, cytology, and colorimetric determinations of all kinds. Cases suitable for the storage of apparatus and chemicals and for the filing of reprints and manuscripts were exhibited. Special mention should be made of the exhibit of the Bausch and Lomb Optical Company, which had twenty projection lanterns in operation in as many session rooms where projection was needed. Besides instruments, some very fine specimens of lithographic reproduction were shown, illustrating scientific and commercial uses of lithography. Books and periodicals were to be seen, illustrating the last word in the art of presentation and preservation of knowledge in printed form. In addition to the general exhibition, many societies had special exhibits in connexion with their session rooms, which were of great interest and value to these special groups.

The Association's collection of portraits and autograph letters of all past presidents were on display for the first time at this meeting. They proved to be a very attractive feature, being hung on the walls of the rest room near the registration room.

One gratifying feature of the annual exhibitions is the growing interest in them shown by visiting men of science and the general public. The attendance grows each year, and in time these exhibitions will become, it is hoped, an exceedingly valuable means of disseminating knowledge of research methods, apparatus, and results, not only among scientific specialists but also to others. It represents an educational and informational project that deserves to be fostered by the Association.

The publicity arrangements at the meeting were in charge of the sub-committee on publicity, which included C. N. Moore as chairman, W. H. Bucher and A. F. Stanley.

The committee was again helped by Science Service, as in previous years. That organisation was represented at Cincinnati by its director, Dr. Edwin E. Slosson, and by its managing editor, Mr. Watson Davis. As advance programme material came in at the Washington office, the permanent secretary sent a request to each person who was to give a paper, asking him to supply Science Service as soon as possible with a copy of his paper or an abstract. About 275 speakers responded and their manuscripts began to arrive early in December. Advance publicity material began to appear in the local newspapers on Sunday, November 25, and it appeared in increasing amounts up to the opening of the meeting. There is no doubt that this served very considerably to stimulate public interest in the convention and resulted in the newspapers devoting more attention

to the actual covering of the meeting than would otherwise have been the case.

For the first time in the history of the Association a prize was awarded for a paper presented at the meeting. To mark the anniversary, a member of the Association gave the sum of one thousand dollars "to be awarded to some person presenting at the third Cincinnati meeting a notable contribution to the advancement of science." All papers presented at the meeting were eligible for consideration, whether or not the authors were members of the Association. The secretary of each section and society meeting at Cincinnati was asked to consult others and submit titles of papers presented in the sessions of his organisation that should be considered in making the award. These suggestions were carefully considered by a special committee named by the council, which worked throughout the meeting. The award was made to Dr. L. E. Dickson, professor of mathematics in the University of Chicago, for his paper on "Algebras and their Arithmetics" (presented at the Friday afternoon session of Section A with the Chicago Section of the American Mathematical Society and the Mathematical Association of America), together with his papers on "The Theory of Numbers and Generalised Quaternions," and on "Quadratic Fields in which Factorisation is always Unique," presented at the Saturday afternoon session of the Chicago Section of the American Mathematical Society. Prof. Dickson has been able to unify and enlarge the whole subject of the theories of algebra.

There were four general sessions of the Association at Cincinnati. The meeting was formally opened on the evening of Thursday, December 27, in Emery Auditorium. Prof. Louis T. More, chairman of the local committee on arrangements, presided at the opening session and introduced President F. C. Hicks, of the University of Cincinnati, and Mr. George P. Carrel, mayor of Cincinnati, each of whom spoke a few well-chosen words of welcome. Then the president, Dr. Charles D. Walcott, was introduced and responded for the Association. He introduced the main speaker of the evening, the retiring president, Prof. J. Playfair McMurrich, of the University of Toronto. Prof. McMurrich delivered a very inspiring and scholarly address, entitled "A Retrospect." (For this address, see *Science*, December 28, 1923, vol. 58, pp. 521-31.) Prof. McMurrich, on whom the degree of LL.D. *honoris causa* of the University of Cincinnati was conferred, was at one time a professor in the University of Cincinnati, and the conferring of the degree was specially appropriate on this occasion.

The opening session was followed by a general reception in the ballroom of the Hotel Sinton, given by the Cincinnati Chamber of Commerce and the University of Cincinnati in honour of the president and retiring president of the Association. The reception was exceptionally well attended. The second general session was held in the auditorium of Hughes High School on the evening of Friday, December 28. This session was under the joint auspices of the Society of Sigma Xi and the Association, the president of the Society, Dr. Henry B. Ward, presiding. The address of the evening was the second annual Sigma Xi lecture, given by Dr. Willis Rodney Whitney, director of the research laboratory of the General Electric Company, Schenectady. Dr. Whitney spoke on "The Vacuum, there's something in it." The lecture was accompanied by striking experimental demonstrations of some of the latest developments in the field of vacuum tubes.

The third general session was held under the joint auspices of the Association and the Cincinnati Garden Club, in the auditorium of the Cincinnati Women's Club, on Saturday afternoon, December 29. Dr. George T. Moore, director of the Missouri Botanical Garden, St. Louis, introduced Mrs. Charles D. Walcott, who showed selections from her fine collection of lantern slides, hand-coloured by herself and made from her own photographs of wild flowers of the Canadian Rockies. Wonderful scenic and geological features of the region were also shown. Mrs. Walcott has devoted many years to the preparation of these pictures, and their exceptional beauty and general excellence won enthusiastic praise from all who were able to be present.

The fourth general session was devoted to the intimate history of the Association, with special reference to the celebration of the seventy-fifth anniversary. Dr. Charles D. Walcott presided. Dr. Herman L. Fairchild, emeritus professor of geology in the University of Rochester, and long a member of the committee on policy and the executive committee of the Association, read a paper on the development of the present organisation from beginnings made seventy-five years ago. Following Dr. Fairchild's paper, Dr. T. C. Mendenhall, president of the Association at the Toronto meeting in 1889, read a letter from Dr. Edward S. Morse, the past president of longest standing—he was president at Buffalo in 1886—and then Dr. Mendenhall spoke in his characteristic way of some of his own recollections of the earlier days of the organisation. Dr. T. C. Chamberlin, president at Baltimore in 1908, spoke of some of his experiences and of the advance of science during the life of the Association. Dr. L. O. Howard, for many years permanent secretary, and president at Chicago in 1920, made some interesting and amusing remarks; and Prof. J. Playfair McMurrich, the present retiring president, closed the session with very good advice for the Association drawn from a study of the past and a look into the future.

The newly elected president and the vice-presidents for 1924 are as follows:

*President:* J. McKeen Cattell, editor of *Science*.

*Vice-presidents for the Sections:* Section A (Mathematics), J. C. Fields, University of Toronto; Section B (Physics), E. F. Nichols, Nela Research Laboratory, Cleveland, Ohio; Section C (Chemistry), W. F. Hillebrand, Washington, D.C.; Section D (Astronomy), John A. Miller, Swarthmore, Pa.; Section E (Geology and Geography), W. C. Mendenhall, U.S. Geological Survey; Section F (Zoological Sciences), Edwin Linton, Augusta, Ga.; Section G (Botanical Sciences), G. R. Lyman, University of West Virginia; Section H (Anthropology), E. A. Hooton, Cambridge, Mass.; Section I (Psychology), R. S. Woodworth, Columbia University; Section K (Social and Economic Sciences), Thomas S. Baker, Carnegie Institute of Technology; Section L (Historical and Philological Sciences), L. C. Karpinski, University of Michigan; Section M (Engineering), A. E. Kennelly, Harvard University; Section N (Medical Sciences), William A. MacCallum, Johns Hopkins University; Section O (Agriculture), L. R. Jones, University of Wisconsin; Section Q (Education), L. A. Pechstein, University of Cincinnati.

Under the present rules the Association holds its main meeting each year during convocation week—at the time of the Christmas vacation in schools and colleges. It frequently holds a smaller summer meeting also. Because of the early date set for the Toronto meeting of the British Association for the Advancement of Science, it has been decided to hold no summer meeting of the American organisation this year. The American Association will do all in its power to aid in making the Toronto meeting of the British Association a pronounced success.

SAM F. TRELEASE.

## The β-rays of Uranium-$X_1$.

IT has been assumed by C. D. Ellis that, in radioactive substances which disintegrate with the emission of β-rays, monochromatic γ-rays are first produced in the nucleus, by quantum springs of the nuclear electrons. In the course of the resulting changes an electron, in the end, comes into a position which produces instability of the nucleus, and disintegration takes place, the electron being ejected. The ejected electrons have no defined velocity, but are spread over a continuous velocity region, giving a continuous β-ray spectrum. The β-lines observed in the spectrum are caused by electrons, which are ejected from the K, L, and M levels by the γ-rays.

S. Rosseland disputes the above views, on grounds connected with the quantum theory; and L. Meitner has decided against them on experimental grounds, ascribing the so-called β-ray continuous spectrum to instrumental defects. In a paper in the *Zeitschrift für Physik*, July 30, pp. 54-66, he adduces new evidence, based on a careful study of the β-radiation from uranium-$X_1$. The following band and lines were observed:

| | Velocity. | Energy of Electrons. | Intensity. | Origin. |
|---|---|---|---|---|
| 1. Band | $0.598c$ to $0.556c$ | $2 \times 10^{-7}$ ergs to $1.72 \times 10^{-7}$ | weak | nucleus. |
| 2. Line | $0.529c$ | $1.52 \times 10^{-7}$ | weak | N layer. |
| 3. ,, | $0.519c$ | $1.37 \times 10^{-7}$ | medium | M layer. |
| 4. ,, | $0.48c$ | $1.44 \times 10^{-7}$ | medium | L layer. |

Since uranium-$X_1$ is an isotope of thorium, the energies of separation of thorium, for the N, M, and L levels, are to be made use of in calculation; and, since all these levels are multiple, the mean values should be employed in each case. These may be written $L_{II}$, $M_{III}$, and $N_{IV}$, the symbols denoting the levels, and the energy values belonging to them. Bohr and Coster give, for thorium, $L_{II} = 0.3121 \times 10^{-7}$ ergs, $M_{III} = 0.641 \times 10^{-8}$ ergs, and $N_{IV} = 0.11 \times 10^{-8}$ ergs. Adding these values to the measured energy values of the β-ray electrons, the total energies imparted to them are found to be $1.451 \times 10^{-7}$, $1.436 \times 10^{-7}$, and $1.443 \times 10^{-7}$ ergs, which are practically identical values. This suggests that the three groups are due to the same radiation.

It is surprising that this energy agrees numerically with the $K_\alpha$ X-radiation from thorium. The energy values of $K_{\alpha_1}$ and $K_{\alpha_2}$ are $E_K^{\alpha_1} = 1.4765 \times 10^{-7}$ ergs and $E_K^{\alpha_2} = 1.4239$ ergs; and the intensities of the two lines are not very different. The energy values for the β-rays given above lie nearly midway between those of the $K_\alpha$ rays; and it appears probable that the $K_\alpha$ radiation of the uranium-$X_1$ atom liberates the electrons from the L, M, and N levels. The intensity of the $K_\beta$ and $K_\gamma$ radiation is so small that it can produce no perceptible action.

The conditions of the experiment are such that it seems certain that the whole process takes place in the same atom. It is probable that the production of the $K_\alpha$-radiation is due to the β-rays which produce the band (1), with electron velocities of about $0.59c$; the centre of this band corresponds to $1.84 \times 10^{-7}$ ergs of energy, and the energy necessary to eject an electron from the K level of thorium is about $1.736 \times 10^{-7}$ ergs. The energy of the β-rays of the band, the primary nuclear β-rays of uranium-$X_1$, will be strongly absorbed by the K electrons of the same atom, since their energy lies so near that required to eject the latter; this is also the reason why only a weak β-ray band gets through. In this way the K X-ray series is excited, while the electrons thrown out from that layer have very small kinetic energy, and cannot be observed by the method employed.

The γ-radiation from uranium-$X_1$ has been shown to be identical with the $K_\alpha$ radiation of thorium by absorption experiments in lead; and no faster γ-rays are emitted, as required by Ellis's theory.

The broadening of the primary β-ray band in uranium-$X_1$ seems due to the action of the L electrons; the field of the nucleus may also have some influence, as Rosseland has supposed.

## Endemic Floras.

THE old problem of endemic species is continually being investigated by naturalists, either from the old or from new points of view. A number of papers recently issued refer to various aspects of the problem or provide additional material for its consideration. Thus, for example, the value of Wallace's and Weber's lines in the Malay Archipelago is discussed by Merrill ("Distribution of the Dipterocarpaceæ," *Philippine Journ. of Science*, vol. 23, pp. 1-33, 1923) on the evidence offered by the Dipterocarpous trees. These are dominant in great areas of the primary forests of Malaysia, particularly of Borneo and the Sunda Islands; they do not occur on open or cleared country, and their fruits cannot be widely dispersed by either wind or water. Their distribution should therefore give evidence as to where land connexions have existed. Merrill points out that the evidence both from this and from geological sources supports the assumption that the Philippines, Celebes, and the eastern Sunda Islands have for long been subject to archipelagic conditions. On the contrary, western Malaysia and the New Guinea regions have belonged respectively to the Asiatic and Australian continents. Wallace's line is therefore modified to cut off Borneo and Palawan from the Philippines, and thus to form the western boundary of the unstable area, the eastern limit of which is defined by Weber's line.

A somewhat different aspect of the problem is raised by Burkill and Holtum ("A Botanical Reconnaissance," etc., *The Gardens Bulletin*, Straits Settlements, vol. iii. p. 1, 1923). They analyse a typical rain-forest flora in the Malay Peninsula, and point out that fully sixty per cent. of the species are endemic. The typical Malayan species are, in fact, largely rain-forest species, and this highly specialised rain-forest flora has its centre in western Malaysia, particularly in Borneo, where the most highly developed rain-forests in the world occur. The development of this flora must have involved a very long period of constant climatic conditions, and its absence from adjacent regions may as easily be due to *climatic* variations in these regions as to *orographic* changes.

F. B. H. Brown ("Secondary Xylem of Hawaiian Trees," Bishop Museum of Polynesian Ethnology and Natural History, vol. viii. pp. 217-371, Honolulu, 1922) has considered the wood structure of seventy Hawaiian trees in detail and finds that the endemic species all possess vessels of exceptionally small size, a feature which he attributes to the slow evolution of the species in a relatively humid climate. Most of these species are apparently of American affinities, and it is suggested that, when the Central American peninsula was submerged in late Eocene times, the Atlantic equatorial currents would extend into the Pacific and provide a means of transport from America to Hawaii.

The islands of Santa Catalina and Porto Rico are rich in endemic species, and their floras are described in detail by Millspaugh and Nuttall ("Flora of Santa Catalina," Field Mus. Nat. Hist., Chicago, *Bot. Series*, vol. v. No. 212), and Britton and Wilson ("Botany of Porto Rico and the Virgin Islands," N. York Acad. Sci., 1923).

## Problems of Race.[1]

IN addressing the Eugenics Education Society and recalling the memory of Sir Francis Galton, it is surely unnecessary to insist upon the reality of the hereditary transmission of bodily traits and mental aptitudes. No one who has the slightest acquaintance with the evidence of biology or is capable of observing his fellow-men is likely to deny these fundamental facts of inheritance. Hence the best use can be made of the opportunity afforded by this address, not by emphasising principles which are generally admitted, but by discussing certain factors that affect the full expression of hereditary qualities of body and mind, and especially certain trends of opinion that at the present time are threatening to reduce the study of these anthropological problems to a chaotic condition, and are seriously hampering real progress in the understanding of the nature of man and the proper appreciation of his intellectual powers.

The assumption pervading most modern teaching on this subject, that the form assumed by culture is wholly or primarily a question of race, is a matter that urgently calls for inquiry. The varying temperaments of different races are patent enough, and their influence upon the intellectual and moral aspects assumed by culture in different communities can be clearly demonstrated; but it has not been generally recognised how large a part has been played by the social environment created by historical circumstances in shaping customs and beliefs and in determining intellectual and industrial progress. Many travellers, like Galton himself, have been impressed by the high intelligence and ability of certain peoples of lowly culture, and have realised that only the lack of opportunities for profiting from what civilisation has put at our disposal has prevented such people from attaining a cultural status such as we enjoy and suffer.

It was the people to whom geographical circumstances and a special series of events presented the opportunity that prompted them to devise the practices of civilisation who in fact became the inventors of civilisation. Although this necessarily implied that they were capable of seizing the chance thus forced upon them, it does not imply, as so many writers assume, that the people who actually attained such great achievements were better equipped than others to whom such opportunities never presented themselves. Popular doctrines of the dominant influence of geographical environment upon human structure and behaviour are, however, wholly incorrect. In particular, people had uncritically accepted the exaggerated claims for the influence of desiccation of territories upon human history. Elsworth Huntington's hypothetical "pulsations of Asia" have had as little effect upon the history of civilisation as Griffith Taylor's "isothermal zones" have had upon human structure. Such speculations have done immense harm in impeding serious research.

After dealing with the present attitude of writers towards the problem of race, the lecturer proceeded to emphasise the need for the application of serious scientific methods for classifying the human family. This must be based upon accepted principles of biology and the frank admission of the fact of evolution. If this were done—and it is now possible to adopt such a trustworthy classification—the study of man would be established on sound historical basis, and the wild speculations that at present pass for serious science would be estimated at their true value.

[1] Synopsis of the Galton Lecture delivered before the Eugenics Education Society on February 18 by Prof. Elliot Smith, F.R.S.

If the biological aspect of anthropology needs the correction and stimulation of the infusion of true scientific methods, what is to be said of the Augean stables of psychology? Students of man have not yet got rid of the hoary fallacy expressed in the terms "psychic unity of mankind" or "the similarity of the working of the human mind." Analysis of the implications involved in these expressions reveals only confusion of thought and inconsequence of logic; but for half a century this view has wrought untold havoc and involved a tacit negation of the historical factor in the growth of civilisation. Now this false interpretation of man's intellectual processes is tottering towards its eventual extinction, certain ethnologists—fortunately a small minority only—are trying to bolster it up with the so-called "universal symbolism" of Freud and his disciples.

The problems of the differences of races will not be solved by such expedients. The historical method is as essential for the interpretation of man's intellectual achievements as it is for the understanding of his evolution. But even the fringe of these questions will not be touched until anthropologists and psychologists recognise that, with all his instinctive tendencies, man is not merely a passive and plastic instrument to be shaped simply by his environment, but an active agent with a power of choice to take the fullest advantage of his hereditary qualities. The explanation of his beliefs is not to be sought in a sort of instinct with a Freudian tinge, but in the historical circumstances which provided him with the materials for his selection.

## University and Educational Intelligence.

CAMBRIDGE.—Mr. R. E. Priestley, Clare College, has been appointed secretary of the Board of Research Studies in succession to Sir G. G. Butler.

Dr. Adrian, Mr. J. T. MacCurdy, Corpus Christi College, and Mr. A. F. Reardon, superintendent of the Cambridge Mental Hospital, have been appointed members of the managing committee of the diploma in psychological medicine.

OXFORD.—A director of the Institute of Research in Agricultural Engineering will shortly be appointed. Application forms are obtainable from the Secretary to the Committee for Rural Economy, to whom they must be returned by March 15.

In the Report recently issued of the Committee for Forestry, attention is directed to the fact that there will in future be a separate School of Forestry providing for a complete training in forestry and accessory subjects, both theoretical and practical, leading to the B.A. degree. The Diploma in Forestry, as also the Diploma in Rural Economy, will in future be practically a post-graduate distinction for specialised work.

On February 19 Congregation assented to the allocation of 9 acres of the University Park for the extension of the Science Department. Of the alternative proposals put forward by the Hebdomadal Council that providing for the extension eastwards of the present Museum site was carried by 97 votes to 39.

LORD GLANELY, in resigning from the office of president of the University College of South Wales and Monmouthshire, Cardiff, has supplemented his previous donations to the college funds by a gift of 12,500*l.*, bringing his contributions to a total of 65,000*l.*

DR. J. E. HOLLOWAY, well known for his researches into the life histories of the Lycopods and of that interesting plant Tmesipteris, and for his systematic

work on the filmy ferns (Hymenophyllum) of New Zealand, has been appointed lecturer on botany in the University of Otago, Dunedin.

APPLICATIONS are invited for the position of research physicist in the University of Melbourne, Victoria. Particulars as to the conditions of the appointment are obtainable from the Agent-General for Victoria, Melbourne Place, Strand, W.C.2. The latest date for the receipt of applications is March 31.

THREE fellowships, each of the annual value of 200*l.* and tenable for two years, are offered to graduates of the University of Wales for award in 1924. Information concerning the fellowships may be obtained from the Registrar, University Registry, Cathays Park, Cardiff. The latest date for the receipt of applications for the fellowships is May 31.

THE examinations for the award of Tate and Morgan scholarships in engineering, science, domestic science, hygiene, and art at the Battersea Polytechnic for the session 1924–25 will be held on Wednesday, June 11, and succeeding days. The scholarships vary in value from 20*l.* to 30*l.* per annum with free tuition, and are tenable for two or three years. The last day of entry is April 19.

IN reply to a question asked in the House of Commons on February 14, Mr. Trevelyan, president of the Board of Education, said: "I propose to renew the State scholarships for students from State-aided schools to the same extent as formerly. I hope to address a communication very shortly to the schools and the examining bodies with reference to the award of scholarships in the coming financial year."

WE are informed that the provincial authorities of Hainaut in Belgium have recently taken steps to open the School of Agriculture and Animal Breeding at Ath to British students of agriculture. The school is situated in the centre of an area devoted to intensive culture, where draught-horse and cattle breeding is carried on. Students of fourteen years of age are admitted, provided they can prove their general knowledge to be satisfactory. Full particulars of the courses can be obtained from the principal, M. Paul Evrard.

A "HOMAGE Celebration of the Scientist," arranged by Dr. F. H. Hayward, is to be held at Birkbeck College on March 1. The celebration, which will be general in scope, will consist of a series of discourses, readings, and recitations with a musical setting borrowed from Mozart's opera "The Magic Flute." There are two rather different aspects of science, says the prospectus: that of its past achievements and that of its insatiable pursuit of the yet undiscovered. In this celebration the former will receive the greater stress, though the latter will not be neglected. In the discourses Aristotle, Roger Bacon, and Francis Bacon will be specially honoured as archetypes of the man of science. The "readings in praise of science" will include extracts from the writings of Spencer, Kingsley, Soddy, Keats, and others. Verses from Sir Ronald Ross's "Philosophies" will be sung. The object seems to be to propagate intelligent appreciation of the disinterested pursuit of science and of the value for mankind of the achievements of scientific workers, and to inform this appreciation with a religious or quasi-religious emotion somewhat in the manner of Comtism (called by one of its champions "Catholicism plus Science"). The programme recalls descriptions of the *cultus* of saints of the early Christian church, of pagan religious rites, and of Education weeks in America.

## Early Science at the Royal Society.

**February 17, 1663.** Ordered that Mr. Hooke set down in writing and produce his whole apparatus for speedy intelligence.

1669. There was read a letter from Dr. Edward Brown of Norwich, giving an account of several [natural] baths in Germany, Hungary, and Turkey.

1675. Divers experiments made in the air-pump at Paris, by M. Huygens and M. Papin, were read.

1685. Mr. Hooke affirmed that Mr. Hubin's contrivance of the barometer was brought in by himself, and that he in truth was the inventor thereof.

**February 18, 1662.** Dr. Charleton promised to shew his experiment of killing fishes by gagging them.

1674. Mr. Isaac Newton was admitted.

1684. Dr. Papin discoursed on experiments with gellies. "So that both rich and poor, either for health or pleasure, may receive a great benefit from this invention."

**February 19, 1661.** The vegetation of plants was discoursed of. Dr. Henshaw was desired to try the experiment of the increase of weight in a tree; and Dr. Wilkins to make a trial of mint growing in a vial with water.

1672. Mr. Oldenburg produced and read a letter in Latin, by M. Leibnitz, containing his desire of being received into the Society, and his engagement of serving them to the utmost of his power. This gentleman having been lately present at several meetings, and at one having shewed an ingenious arithmetical machine, Sir Robert Moray proposed him as candidate.

**February 20, 1667.** Dr. Clarke mentioned that there was a poor distracted woman, who seemed to him a fit subject to try the transfusion upon, but that, she not being provided for, would be upon the Society's hands after the experiment. He was therefore desired to speak with some of the officers of the parish, where she was then maintained.

1683. The plague was said to be natural in Asia, and not bred here; the small-pox to be first mentioned by the Arabians; and the new griping of the guts to be natural to India.

**February 21, 1666.** The operator was again ordered to attend Dr. Wren to receive his directions for the making his new kind of lamp.

1677. Dr. Allen presented for the repository a natural bee-hive from Virginia.

**February 22, 1664.** There was made an experiment with nitre, put in an earthen crucible upon the fire; and sulphur being cast on the top of it, it gave a very bright vivid flame.

1668. Ordered that the treasurer pay Mr. Christopher Cock eight pounds for the large microscope made by him. That the history of the silk-worm, in Latin, by Signor Malpighi, be printed.

**February 23, 1660.** Experiments having been made at the Tower of London, on the weight of bodies increased in the fire, the Lord Viscount Brouncker drew an account.

1670. Mr. Hooke reported concerning the air-vessel, that he had been in it for about a quarter of an hour. He was ordered to prosecute this experiment, and to take some animals and lighted candles, &c., with him into the vessel.

1679. That Mr. Hunt prepare a silver box for the diploma to be sent to Mr. Leewenhoeck.

1680. Mr. Hooke presented Dr. Papin's engine for boiling bones, &c.

1686. Mr. Halley read a paper of his concerning an experiment for finding the comparative force of a loadstone at several distances.

## Societies and Academies.

LONDON.

**Royal Society**, February 14.—C. **Chree** and R. E. **Watson**: Atmospheric pollution and potential gradient at Kew Observatory, 1921 and 1922. The pollution results were obtained from one of Dr. Owens's pollution recorders, while the potential gradient results were obtained from the records of the Kelvin water-dropping electrograph. Absolute values of pollution and potential in general increase together, while the range of the regular diurnal variation of potential gradient is larger on days of high than on days of low pollution. The diurnal inequalities chiefly employed were based on the 10 selected days a month used in the ordinary course for the Kew annual tables.—E. **Wilson** and E. F. **Herroun**: On the electrical conductivity of magnetite. The effects of impressed voltage, temperature, compressive stress, and magnetisation upon the electrical conductivity of certain varieties of magnetite are recorded. At constant temperature, electrical resistance fell as impressed voltage increased, the gradient increasing with voltage. Specimens heated to a moderate temperature (150° C.) showed no change in resistance on return to room temperature, but when heated to the region of 900° C. permanent reduction in resistance was produced in the highly permeable magnetites. In all cases resistance was reduced by increasing temperature, the coefficient reaching or even exceeding 0·012, diminishing rapidly as temperature was raised. The ratio of resistance found at liquid-air temperature to that at room temperature reached the value 972 in the highly permeable magnetite, and was as low as 165 in the other variety. No permanent change in resistance followed cooling in liquid air. The maximum value of the compressive stress used was about 1000 kg. per square centimetre. At atmospheric temperature the resistance in the direction of stress and at right angles thereto was diminished by loading. At about 900° C. the reduction in resistance was of the order of 10 per cent. The effect of magnetisation was in all cases to reduce resistance. In a field of 1520 C.G.S. units the reduction in one variety amounted to 3·3 per cent. —C. E. T. **Mann**: The determination of coefficients of diffusion in gels by means of chemical analysis, and a comparison of results obtained from those yielded by the indicator method. Chlorides were used, but the method is equally applicable to other substances. A relationship, apparently linear, between diffusion and the degree of dissociation of the solute is recorded. —C. E. P. **Brooks**: The difference-periodogram—a method for the rapid determination of short periodicities. A period of approximate length 2U being suspected, the series of observations is divided into sections of length U, and the mean values for each of these sections evaluated. If these mean values are $a$, $b$, $c$, $d$, etc., a new series of figures $(a-2b+c)-(b-2c+d)$, etc., is formed, and a graph drawn with a horizontal time scale. In the resulting curve all periods except those between 1·4U and 4U are eliminated. If this curve shows a cycle of length C, the corresponding cycle in the original observations is of length $2CU/(C\pm 2U)$. In order to discriminate between the two possible cycles, the process is repeated with another value of U.—J. **Proudman** and A. T. **Doodson**: The principal constituent of the tides of the North Sea. The principal lunar semi-diurnal constituent of the tides is discussed. A chart has been constructed showing the co-tidal and co-range lines over the whole area of the North Sea. These lines are characterised by three amphidromic points—one in the Flemish Bight, one about 100 miles to the west of the coast of South Denmark, and one just off the south-west coast of Norway. A chart showing the mean flow of energy indicates a counter-clockwise circulation much stronger on the west than on the east.—D. H. **Bangham** and F. P. **Burt**: The behaviour of gases in contact with glass surfaces. The rates at which different gases are taken up by a large surface of glass have been measured at different pressures and at 0° C. The data indicate that equilibrium was not achieved, even though in one case the experiment was extended for five weeks. Practically all the time-sorption data are fairly represented by the empirical equation $S^m = Kt$, where S is the sorption value at time $t$, and $m$ and $t$ are constants. The quantities of different gases taken up under similar conditions are closely parallel with their solubilities in water, but even when the surface is highly desiccated these quantities exceed those required to form molecular layers.

**Zoological Society**, February 5.—Sir Sidney F. Harmer, vice-president, in the chair.—C. Tate **Regan**: Reversible evolution with examples from fishes.—Miss Mary L. **Hett**: (1) On the family Linguatulidæ, (2) Zoological results of the third Tanganyika Expedition conducted by Dr. W. A. Cunnington, F.Z.S., 1904–1905: Report on the Linguatulidæ.—M. A. **Smith**: New tree-frogs from Indo-China and the Malay Peninsula.—R. R. **Mole**: The Trinidad snakes.

**Linnean Society**, February 7.—Dr. A. B. Rendle, president, in the chair.—E. J. **Collins**: Sex-conditions in *Silene nutans* Linn. Two plants and seed of *S. nutans* var. *Smithianus* were planted, and in flowering in 1918, one plant was female and one hermaphrodite; the female plant threw a few hermaphrodite flowers in the following year and afterwards became wholly hermaphrodite. Seedlings of varied parentage have now been raised and their sex condition recorded. Female plants capable of bearing seed may continue for one or more years, but soon or late maleness appears in varying degree, and finally the hermaphroditic condition may be reached. No definite change in the reverse direction has been noticed. Plants of mixed sex may show a bias either towards hermaphroditism or femaleness during the season.—Teïzo **Niwa**: The forms cultivated in Japan from the original types of *Chrysanthemum indicum* Linn. and *C. sinense* Sabine. Among the many species of Chrysanthemum which are wild in Japan, there are two which approach nearest to the cultivated chrysanthemum, namely, *C. indicum* and *C. sinense* Sabine. There are over fourteen sections of the species, which rarely transmit their characters by seed.—H. H. **Pugsley**: An undescribed Statice from Pembrokeshire. The name *S. transwalliana*, in allusion to the district where it occurs, is proposed. It grows on the coast in company with *S. binervosa* C. E. Sm., from which it differs in its much more dwarf habit, remarkably narrow, linear-oblong leaves, and very dense spikes of small flowers with stellate corollas only half as large as those of *S. binervosa*.—T. A. **Sprague**: Seedling of *Galium Aparine* with three branches in the axil of each cotyledon. Accessory buds are characteristic of many plants of different orders, usually on the adult plant. They seem to occur less frequently in the axils of the cotyledons. In the case of *Galium Aparine*, however, the reverse is the case.

CAMBRIDGE.

**Philosophical Society**, February 4.—Mr. C. T. Heycock, president, in the chair.—Sir William **Pope**: The preparation of sulphuryl chloride. Sulphuryl chloride, $SO_2Cl_2$, can be prepared by the direct combination of sulphur dioxide and chlorine in the presence of charcoal as a catalyst. Highly absorbent bone charcoal, or the activated charcoal used in the military service respirator, is packed into a glass

U-tube provided with a delivery tube in the bend; the U-tube is kept at about 30° by means of a water-bath and a mixture of sulphur dioxide and chlorine in approximately equal volumes passed rapidly through the charcoal. Combination occurs immediately, and the resulting sulphuryl chloride drains away through the delivery tube. The only limit to the speed with which charcoal effects the combination of the two gases seems to be the efficiency of the cooling, and no indication is obtained that the activity of the catalyst diminishes with use.—T. M. **Lowry**: A geometrical pattern having the symmetry of quartz.—C. T. **Heycock** and W. H. **Mills**: The heat of combustion of ethylene. The mean of seven fairly concordant experiments gives the heat of combustion as $C_2H_4$, $O_6 = 337{\cdot}1$ kilogram calories. This leads to the heat of formation of ethylene $C_2$, $H_4$ as $-6{\cdot}5$ kilogram calories.—A. J. **Berry**: The thallous thallic halides. By the action of thallous chloride on thallic bromide, products approximating in composition to the formula $TlBr_3 . 3TlCl$ are obtained. With thallous bromide on thallic chloride, the corresponding isomeric compound is not produced, but a double chloride containing small quantities of bromide probably present in solid solution is formed.—W. G. **Palmer**: The stability of gas films adsorbed on tungsten. The "cohering" voltage of a loose contact formed by two fine tungsten filaments is characteristic of the gas surrounding the filaments, and constant for any gas over a large range of pressure. Assuming that the cohering of the contact is due to the dispersion of a gas-film previously held on the filaments, the latent heat of desorption was calculated, and from the values of this latent heat two types of bond between the metal and the gas are suggested.—W. H. **Mills** and E. H. **Warren**: The configuration of the ammonium radical. In the spirocyclic ammonium salt 4-phenyl-4′-carbethoxybispiperidinium–1 : 1–spiran bromide, which has been synthesised, the configuration of ammonium is tetrahedral, and hence the molecule is asymmetric.—E. K. **Rideal**: A note on protecting and sensitising colloidal sols. The addition of emulsoids to suspensoid colloids affects the susceptibility of the colloid to electrolytes. In its cationic form gelatine will sensitise colloidal gold. A decrease in sensitivity may result from a shift in the equilibrium between colloidal micellar and ionic forms of a protecting agent on the addition of salts; thus soaps protect by virtue of the content of the colloidal form, the ionic and miscellar forms being inactive; addition of salts increases the colloidal form and hence enhances the protective power. The lyotropic series of precipitating electrolytes, which represents the differential adsorption of anion and cation for the colloid, varies with the nature of the latter, and will thus follow a different order for a suspensoid and for the same when protected with the adsorbed emulsoid envelope.—R. G. W. **Norrish**: The mechanism of molecular activation. Activation may occur both by radiation and by collision, singly or simultaneously. In catalysis, the critical increment represents the energy required to displace the bonding electrons to higher quantum orbits. Thus activation is a quantum phenomenon. Evidence for this is afforded by the reactions of sulphur with hydrogen and with oxygen; here the critical increment of some seven reactions is always a simple multiple of a constant quantity.—U. R. **Evans**: The mechanism of the rusting of iron. When drops of water or salt solution are placed on iron, corrosion is caused by electric currents flowing between the margins and the interiors; the special susceptibility of the interiors to corrosion and the relative immunity of the margins persist even when the metal is uniformly wetted. Several salts which actually favour corrosion nevertheless decrease the rate of transport of oxygen, and their presence may accelerate or retard rusting according to conditions.

EDINBURGH.

**Royal Society**, February 4.—Prof. F. O. Bower, president, in the chair.—David **Ellis**: An investigation into the intimate structure and the main features in the life-history of *Beggiatoa alba*. The details of the process of autolysis which characterises certain conditions of the organism were investigated. A method of a sexual reproduction, new to the sulphur-bacteria, was announced.—R. A. **Fisher** and Sven **Odén**: The theory of the mechanical analysis of sediments by means of the automatic balance. A simplified mathematical statement of sedimentation theory confirms Odén's formula, and shows that the errors of Schloessing's approximations are large. Statistical methods are developed for using Odén's formula, and applied to duplicate data for a Rothamsted clay. These indicate technical improvements for the control of fluid motion.—P. A. **MacMahon**: On an X-determinant which includes as particular cases both "determinants" and "permanents."

MANCHESTER.

**Literary and Philosophical Society**, February 5.—W. L. **Bragg**: Crystal structure. When in the past the physicist has wished to deduce the properties of atoms and molecules by a study of matter, he has generally fixed his attention on the properties of a gas. Attention is now being focussed on matter in the crystalline form. The carbonates of the bivalent metals, and the nitrates of the univalent metals, build a series of crystal structures closely interrelated in their atomic arrangements. The great similarity in all these carbonates and nitrates is due to fundamental simplicity in the disposition of the interatomic forces. Models of crystals enable one to trace the influence on the form of the crystal of the substitution of one metal for another combined with the acid radicle, and also offer an explanation of some of the properties of the crystals themselves. For example, the double refraction of calcite and aragonite is due to the peculiar form taken by the $CO_3$ group. The oxygen atoms are arranged in a triangle around the central carbon, and when the light vibration is in the plane of the triangle the response of the atoms to it is much greater, and so the velocity of light much less than when the light vibrates perpendicularly to the triangle.

SHEFFIELD.

**Society of Glass Technology**, January 16 (Manchester meeting).—Prof. W. E. S. Turner, president, in the chair.—W. E. S. **Turner**: Specifications for glass. General agreement was reached as to the desirability of drawing up specifications for food containers, and it was decided that the matter be referred to the Council for draft specification to be prepared.—A. **Cousen** and W. E. S. **Turner**: The production of colourless glass in tank furnaces with special reference to the use of selenium. Soda-lime glass, coloured deeply yellow by means of selenium, becomes distinctly bleached when exposed to sunlight for thirteen months. On the other hand, decolorised or faintly coloured selenium glasses, such as are obtained when arsenious oxide as well as selenium occurs in the glass, develop a yellow tint on exposure. The yellow selenium glasses when reheated at temperatures of 500° to 600° C. become more intensely coloured. The pink colour such as is often found in selenium-arsenious oxide glasses is diminished at the same temperature, the loss of colour being fairly rapid at 575° C., the upper annealing temperature of the glass.

## PARIS.

**Academy of Sciences**, January 28.—M. Guillaume Bigourdan in the chair.—W. **Kilian** and G. **Sayn**: An important tectonic fault at the southern edge of the plateau of Vercors. The strata in the neighbourhood of the Col du Rousset (Drôme), a section of which is shown, have a more complex structure than has been hitherto supposed; there is evidence of folding and inversion of strata.—C. **Guichard**: Systems of asymptotes which correspond to the N networks of which the equation is integrable by Laplace's method.—C. **Camichel** and M. **Ricaud**: Surfaces of discontinuity.—N. **Hatzidakis**: The curves of Bertrand and the curves of Césaro.—Bertrand **Gambier**: Surfaces with geodesics entirely closed.—E. **Cartan**: The affine connexion of developable surfaces.—Maurice **Fréchet**: The prolongation of semi-continued functionals.—M. **Leau**: The use of certain functions in the theorems of existence.—N. **Lusin** and J. **Priwaloff**: Unicity and multiplicity of analytical functions.—M. **Iswech**: The conditions of the dynamic possibility of the movement of viscous and compressible fluids.—Charles **Nordmann**: The mechanism of flight of the hovering birds. Reply to a criticism by V. Karpen.—M. **Lémeray**: The curvature of the universe.—E. **Brylinski**: The interpretation of Michelson's experiment. Reply to a criticism by M. Metz.—C. **Gutton**: Electric discharge at very high frequency. For wave-lengths of 25 metres or less the voltage producing luminous discharge in rarefied tubes falls regularly as the pressure of the gas in the tube is reduced. For wave-lengths of 27 metres or more, there is a critical pressure above or below which the voltage producing luminous discharge increases.—Henri **Chrétien**: The objectives of Clairaut-Mossotti.—Léon and Eugène **Bloch**: Extension of the spark spectra of lead, bismuth, antimony, and thallium in the extreme ultra-violet. An improved arrangement of the apparatus described in earlier communications now permits of measurements of wave-lengths down to about 1300 Å.—M. **Duffieux**: The mass of the particles which emit several band spectra attributed to nitrogen. The author attributes the bands of the second negative group, of the second positive group, and of the so-called cyanogen bands to the nitrogen atom; the first positive group is attributed to the molecule.—A. **Dauvillier**: The distribution of the electrons between the L levels of the elements.—J. **Safranek**: The magnetisation of the electrolytic nickel-chromium alloys.—Paul **Pascal**: The constitution and evolution of precipitates of alumina. As a result of the magnetic analysis of aluminium hydroxide precipitates produced by various methods, it is concluded that the precipitate produced by ammonia is a gel of anhydrous $Al_2O_3$. Hydrated alumina, whether crystallised or not, is not $Al(OH)_3$ but $Al_2O_3 . 3H_2O$.—J. **Lacroix**: The preparation of 3.3′-diaminodiphenylsulphone by the electrolytic reduction of 3.3′-dinitrophenylsulphone.—Albert **Nodon**: Researches on cellular disintegration. From experiments (not described) the author concludes that living organisms, both plants and animals, are the seat of a radioactivity which appears to be a function of the degree of vitality of the organisms.—Daniel **Berthelot**: Remarks on the preceding note. Experiments on the radioactivity of animals and plants, carried out in 1909 and 1910, appeared to indicate a marked radioactivity, but control experiments proved that the phenomena observed were due to moisture. As the results were negative they were not published.—Antoine **Lacassagne** and Mme. J. Samuel **Lattès**: An auto-histo-radiographic method for the detection of injected polonium in organs. Reproduction of a radiogram of the organs of a rabbit after injection of polonium into a vein. The photographs were due to the α-particles emitted by the polonium, and the selective absorption by the different organs is well shown by the depth of shade of the impressions.—M. **Cornillot**: The constitution of phthalonic acid. The experiments described do not confirm the oxylactone structure suggested by Perkin and Kuroda.—Ch. **Courtot** and A. **Dondelinger**: The synthesis of indanylamine and its nitrogen substituted derivatives.—L. J. **Simon**: The sulphochromic oxidation of coal. The oxidation to carbon monoxide and dioxide by this reagent at 100° C. is not complete, about one-eighth of the carbon in the coal being unattacked.—J. **More**: The oxidation of uric acid by iodine in an alkaline medium.—L. **Maurice**: The presence of the lower Eocene and the existence of Bartonian pebble marls from eruptive rocks in the south-west of the Maritime Alps.—B. Darder **Pericás**: The age of the transport phenomena in the island of Majorca.—P. H. **Fritel** and **Carrier**: The remains of Devonian and Carboniferous plants collected in Ouadaï by the expedition of Lieut.-Col. Grossard.—Ch. **Maurain**: The detailed study of a strong magnetic anomaly in Brittany.—P. **Lasareff**: The magnetic anomaly of Koursk.—Edward **Stenz**: Measurements of the solar radiation at the Jungfraujoch.—P. **Freundler**: The measurable iodine in *Laminaria flexicaulis*.—H. **Colin** and R. **Franquet**: The migration of inulin in grafts of Compositæ.—M. **Bach**: Variations in hydrogen ion concentration under the influence of the assimilation of nitrates by *Aspergillus repens*.—Jules **Amar**: Coagulation and surface tension.—M. de **Luna**: The participation of a peroxydase in the appearance of the pigment in *Drosophila melanogaster*.—L. M. **Bétancès**: The origin of reticular fibrillæ.

## SYDNEY.

**Royal Society of New South Wales**, December 5.—Mr. R. H. Cambage, president, in the chair.—R. H. **Cambage**: (1) Acacia seedlings. Pt. ix. Seedlings of ten species were described. Seeds of *Acacia podalyriæ folia* and *A. penninervis* germinated after having been immersed continuously in sea-water for four and six years respectively. The period between flower-buds and flowers is only two months in the case of *Acacia conferta*, but is as much as nine months in some species. (2) Plant invasion of a denuded area. The earth and rock to a depth of from one to four feet was removed from an area of 8 acres some 68 miles from Sydney about five years ago, and as this denuded rock is in virgin forest and securely fenced, it is proposed to observe the natural invasion of plant-life which may take place. At the end of five years thirty-three species had established themselves on this uninviting spot, composed of rock containing 78 per cent. silica.—A. R. **Penfold**: The essential oil of *Backhousia angustifolia*. This tree yielded 1·05 per cent. of oil heavier than water and of pleasant characteristic odour, containing 75 per cent. of a hitherto undescribed phenol, $C_{10}H_{14}O_3$, d-a-pinene, B-pinene, cineol, d-a-terpineol, and a stearoptene, $C_{15}H_{16}O_5$, melting-point 118-119° C.—M. B. **Welch**, W. **McGlynn**, and F. A. **Coombs**: Some notes on wattle barks. An investigation into the structure of the wattle bark, and the distribution of tannin in *Acacia decurrens* and its varieties. Potassium bichromate is the most efficient precipitating agent, and, moreover, has no effect on the soluble non-tannins. Probably the maximum percentage of tannin is present at the end of the winter, particularly in the oldest cells of the phloem parenchyma and medullary rays.

## Official Publications Received.

Bulletin of the National Research Council. Vol. 7, Part 3, No. 39: The Quantum Theory. By E. P. Adams. Second edition, revised and enlarged. Pp. 109. (Washington, D.C.: National Academy of Sciences.) 1.50 dollars.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-Verbaux des Réunions. Vol. 32: Procès-Verbaux (Octobre 1923). Pp. 76. (Copenhague: Andr. Fred. Høst et fils.)

The Proceedings and Transactions of the Nova Scotian Institute of Science, Halifax, Nova Scotia. Part 3: Session of 1920–1921. Part 4: Session of 1921–1922. Pp. xxix-xxxiv+137-160+xxxv-xliii+161-196+iii+ix. (Halifax, Nova Scotia.) 50 cents.

The Astrophysical Journal. A General Index by Authors and by Subjects to Volumes 26-50 (July 1907 to December 1919). Compiled by Storrs B. Barrett. Pp. iii+111. (Chicago: University of Chicago Press.) 2.50 dollars.

The Great Barrier Reef of Australia: a Popular Account of its General Nature. Compiled by the Great Barrier Reef Committee, Brisbane, 1923. Pp. 32. (Brisbane: Queensland Government Intelligence and Tourist Bureau.)

Věstník Královské České Společnosti Nauk: Třída Matematicko-Přírodovědecká. (Mémoires de la Société Royale des Sciences de Bohême: Classe des Sciences.) Ročník 1921–1922 (année 1921–1922). Pp. iv+32+135+44+20+8+9+14+12+12+18+29+111+16+25+20. (Prague: F. Rivnáč.)

Výroční Zpráva Královské České Společnosti Nauk za Rok 1922. (Résumé du compte rendu annuel de la Société Royale des Lettres et des Sciences de Bohême, 1922.) Pp. 47. (Prague.)

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 47: A Biennial Survey of Public School Finance in the United States, 1920–1922. By Prof. Fletcher Harper Swift. Pp. 34. (Washington: Government Printing Office.) 5 cents.

Ministry of Public Works, Egypt: Physical Department. Helwan Observatory Bulletin No. 28: Observations of Wireless Time Signals, 1922 November–1923 June. By H. Knox-Shaw. Pp. 17-59. (Cairo: Government Publications Office.)

The Carnegie Trust for the Universities of Scotland. Twenty-second Annual Report (for the Year 1922–23) submitted by the Executive Committee to the Trustees on 13th February 1924. Pp. iv+133. (Edinburgh.)

Department of the Interior: United States Geological Survey. Professional Paper 132-B: A New Fauna from the Colorado Group of Southern Montana. By John B. Reeside, Jr. Pp. 25-33+plates 11-21. Professional Paper 132-C: Notes on the Geology of Green River Valley between Green River, Wyoming, and Green River, Utah. By John B. Reeside, Jr. Pp. 35-50. Professional Paper 133: The Correlation of the Vicksburg Group, by C. Wythe Cook; and The Foraminifera of the Vicksburg Group, by Joseph A. Cushman. Pp. ii+71+8 plates. (Washington: Government Printing Office.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 477: Spectroradiometric Analysis of Radio Signals. By Chester Snow. Pp. 231-261. (Washington: Government Printing Office.) 10 cents.

Department of Commerce: Bureau of Standards. Technologic Papers of the Bureau of Standards, No. 241: A Comparison of the Deoxidation Effects of Titanium and Silicon on the Properties of Rail Steel. By George K. Burgess and G. Willard Quick. Pp. 581-635. (Washington: Government Printing Office.) 10 cents.

United States Department of Commerce. Simplified Practice Recommendation, No. 9: Woven-Wire Fencing. Pp. 7. (Washington: Government Printing Office.) 5 cents.

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1923. (Publication 2749.) Pp. iv+125. (Washington: Government Printing Office.)

Report of the Commissioner of Education for the Year ended June 30, 1923. Pp. iii+34. (Washington: Government Printing Office.) 5 cents.

Smithsonian Miscellaneous Collections. Vol. 73, No. 1: Smithsonian Mathematical Formulæ and Tables of Elliptic Functions. Mathematical Formulæ prepared by Prof. Edwin P. Adams; Tables of Elliptic Functions prepared under the Direction of Sir George Greenhill by Col. R. L. Hippisley. (Publication 2672.) Pp. viii+314. (Washington: Smithsonian Institution.)

Library of Congress. Report of the Librarian of Congress for the Fiscal Year ending June 30, 1923. Pp. xi+217. (Washington: Government Printing Office.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 239: Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Vieques, P.R., 1919 and 1920. By Daniel L. Hazard. Pp. 100. 20 cents. Serial No. 242: Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Sitka, Alaska, in 1919 and 1920. By Daniel L. Hazard. Pp. 102. 25 cents. (Washington: Government Printing Office.)

## Diary of Societies.

*SATURDAY*, FEBRUARY 23.

BRITISH PSYCHOLOGICAL SOCIETY (Joint Meeting of the Society and the Cambridge Psychological Society) (in the Psychological Laboratory, University of Cambridge), from 2.30 to 6.—Prof. K. Koffka: Introspection and the Methods of Psychology.—Dr. G. W. Allport: Personality as an Object of Perception.—Dr. Morton Prince: The Problem of Awareness and the Self.

*MONDAY*, FEBRUARY 25.

ROYAL SOCIETY OF ARTS, at 8.—E. V. Evans: A Study of the Destructive Distillation of Coal (Cantor Lectures) (1).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—W. W. James: Hæmorrhage following Tooth Extraction.—J. G. Turner and others: Adjourned Discussion on Pyorrhœa.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Prof. A. P Brigham: American Dependence on Foreign Products.

*TUESDAY*, FEBRUARY 26.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft The Respiratory Pigments in Animal Life and their Significance (3).

ROYAL SOCIETY OF MEDICINE (Medicine, Neurology, Ophthalmology, Otology), at 5.30.—Sir Humphry Rolleston, Dr. G. Holmes, S. Scott, and J. H. Fisher: Joint Discussion on Vertigo.

INSTITUTION OF MECHANICAL ENGINEERS AND THE SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group), at 6.—Symposium of Papers on The Treatment of Water for Industrial Purposes.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 6.30.—H. K. Thomas: The Fundamentals of Cost Reduction.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—L. Rothera: Electricity as the Motive Power for Ships.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.—The Mechanism of the Cine Camera: (1) The Intermittent Motion, by W. Vinten; (2) Front Gadgets and Trick Mechanism; (3) Focusing Devices.

*WEDNESDAY*, FEBRUARY 27.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—W. B. Wright: Age and Origin of the Lough Neagh Clays.

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7.—J. E. Barnard: Lecture Demonstration.—R. Daubney: Notes on some Parasitic Worms of Importance to Agriculturists.—H. J. Denham: Practical Microscopy in Research on Textile Fibres.—Exhibits by J. W. Atha and Co. and Ogilvy and Co.

ROYAL SOCIETY OF ARTS, at 8.—Dr. C. S. Myers: The Use of Psychological Tests in the Selection of a Vocation.

*THURSDAY*, FEBRUARY 28.

ROYAL SOCIETY, at 4.30.—Prof. O. W. Richardson: Thermodynamics of Electron Emission.—Prof. W. A. Bone, D. M. Newitt, and D. T. A. Townend: Gaseous Combustion at High Pressures. Part IV.—J. E. P. Wagstaff: An Electrical Method of determining the Velocity of Detonation of Explosives.—*Paper to be read in title only*:—Prof. W. L. Bragg: The Refractive Indices of Calcite and Aragonite.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: The Crystalline Structure of Organic Substances (4).

INSTITUTION OF ELECTRICAL ENGINEERS (Special General Meeting), at 5.30.—At 6.—A. S. FitzGerald: The Design of Apparatus for the Protection of Alternating-Current Circuits.

INSTITUTION OF AUTOMOBILE ENGINEERS (Informal Meeting) (at Royal Society of Arts), at 6.30.—A. E. Cowper: The Requirements for Motor Delivery Vans, with particular reference to the type of unit, accessibility, length of chassis, weight of goods to be carried, and other points in connexion with appearance combined with utility.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (in the Psychological Laboratory, University College), at 6.30.—Miss May Smith: The Psychological Aspect of Occupational Diseases.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 8.—Prof. J. Joly: Hugo Müller Lecture.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Dr. W. MacAdam: Cholesterol Content of Blood in relation to Genito-Urinary Sepses.—H. W. White: Subparietal Injury of the Kidney.

*FRIDAY*, FEBRUARY 29.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—T. A. Scotton: The Making of a Railroad Locomotive.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. A. Rhind: The Manufacture of the Incandescent Electric Lamp.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—F. E. Smith: Modern Navigational Devices.

ROYAL SOCIETY OF MEDICINE, at 9.—Dr. A. Chaplin: Famous Medical Men of the 18th Century.

*SATURDAY*, MARCH 1.

RADIO SOCIETY OF GREAT BRITAIN (at Institution of Electrical Engineers), at 2.—Annual Conference of Affiliated Societies.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Sir Sidney F. Harmer: Whaling Research and the New *Discovery* Expedition.

### PUBLIC LECTURES.

*SATURDAY*, FEBRUARY 23.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Animals in the Religion of the Ancient Egyptians.

*MONDAY*, FEBRUARY 25.

INSTITUTION OF CIVIL ENGINEERS, at 5.—O. C. A. Van Lidth de Jeude: Practical Hydraulic Engineering Problems in connexion with Navigation. (Succeeding Lectures on February 27, 29, March 17, 19, and 21.)

*WEDNESDAY*, FEBRUARY 27.

UNIVERSITY COLLEGE, at 5.30.—R. A. Peddie: Printing Presses and Machinery from the Earliest Times, and their Influence on the Book and Newspaper.—At 6.—Miss Ethel M. Elderton: Inheritance in Finger-prints, and the Possibility of their Use in Cases of Disputed Paternity.

*SATURDAY*, MARCH 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Animals which live in Trees.

BIRKBECK COLLEGE, at 6.—Dr. F. H. Hayward: Homage Celebration to the Scientist.