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Government Publications and their Distribution.

WHEN a government takes in its own hands the publication of matters of scientific interest, it may be assumed that this is done with three distinct objects in view. In the first place, it wishes to bring to the notice of scientific workers the results of original researches carried out by experts in Departments under its control, in order that these results may form a foundation for further advance in knowledge. So are published the papers comprised in the excellent scientific reports of the Ministry of Agriculture and Fisheries in England, and of the Fishery Board for Scotland. Or it desires to bring to the notice of the public, for the sake of the individual and through him of the nation at large, the condensed wisdom of science as bearing upon matters of practical importance. Such is embodied in the pamphlets and leaflets dealing with agricultural pests and plant diseases, with methods of land-cultivation and stock-raising, issued by the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland. Sometimes these two aims are seen to run side by side, as in the Journals of Agriculture published both by the English Ministry and Scottish Board, in which matters of both scientific and practical interest appear.

The third object is very different from either of the above, its end being to inform the outside world, scientific and non-scientific, regarding the activities of institutions in which a general interest is taken; it takes its typical form in the annual reports of such establishments as the British Museum, the Natural History Museum, and the Royal Scottish Museum. This last object may seem to have little of scientific value to commend it, but it is in reality of prime importance; for institutions of the kind mentioned depend for many of their most valuable acquisitions upon the generosity of the public, and unless public interest is stimulated by full knowledge of progress and requirements, the national collections, and science, must in the end suffer.

The duty of scientific publisher assumed by the Government does not end, however, with the printing of pamphlets, nor are its aims thus attained; the question of distribution is second only to that of printing, and it is to this that we wish particularly to direct attention. Every scientific worker is aware of the generous and even lavish free distribution of scientific publications carried out by Government Departments of the United States of America; and one is tempted to speculate whether the activity and originality of research now apparent there may not be due in part to this sustained appeal to the scientific mind.

At no time could H.M. Government have been charged with a lavish or even generous distribution of the scientific fruits its workers have culled. It now appears that even the meagre distribution of former years is to be curtailed, and a false notion of economy threatens practically to abolish the free circulation of government publications of scientific interest. The new policy affects the three types of publications already mentioned in various ways.

In recent years, the annual reports of the Museums have dwindled until they have become dry skeletons, scarcely worthy of distribution, and quite unworthy of the great national institutions they represent. Compare them with the beautifully printed and illustrated reports of the American State Museums. Surely this is not the way to encourage the free giving of the public, on which the American Museums and our own so largely depend.

The leaflets of the English and Scottish Departments of Agriculture were formerly sent gratis on publication, from a standing list, to gardeners, farmers, and others interested in the checkmating of pests or the improvement of cultivation, and the wide distribution of these concise and generally up-to-date publications played a great part in combating local pests, and possibly in preventing the local pest from becoming a national pestilence. Now, to be received free each leaflet must be applied for in writing, and only one copy of any one leaflet is supplied gratis: the free circulation as a matter of routine has ceased.

As regards research publications, the position is no less serious. Here also free distribution to workers interested in like fields has ceased, and scientific societies no longer receive copies in exchange for their own publications. Yet, curiously enough, the scientific worker in foreign countries is to be given a preference denied to his British colleague, for foreign societies making exchanges are not to be placed under the ban.

A still further restriction has been brought into force. The circulation of the records of scientific discovery has always been greatly aided through the strictly discriminate distribution, by the discoverer himself, of author's separates; and most scientific journals are still willing to present an author with twenty-five copies or so of an original contribution. But personal application to government scientific workers for a particular separate has disclosed the fact that, at any rate in certain important scientific departments, the allowance of author's reprints granted by Government is limited to *three* copies, though indeed if the published price of the pamphlet be less than one shilling he may have six. A joint author, provided he has contributed more than a third of the research, is entitled to one-third of this normal allowance. Could cheese-paring be more ridiculous?

It would seem that, in the desire to save a mite, the Government is in danger of losing a mountain. The cost of a relatively small number of off-prints, once the type has been set up, can scarcely be compared with the gain likely to accrue from a wide circulation of scientific matter of practical and economic importance; and in this respect the Government has duties to the public and the scientific world other than those of a publisher controlling a purely commercial undertaking. As the matter stands, government researches will continue to be made, and the results laboriously gained by trained and expert workers will be printed at very considerable cost—and then consigned to oblivion in the cold storage chambers of H.M. Stationery Office or some other department.

There is no suggestion here that the Government should undertake wasteful distribution. It has always seemed to us unnecessary that when an allotment-holder applied for agricultural leaflets, having in mind garden pests, he should receive also instruction in pig- and poultry-keeping, in the values of farm manures, or in the financial affairs of agricultural co-operative societies. But this danger might be avoided by, let us say, grouping the leaflets for free distribution in distinctive and homogeneous sections for particular classes of inquirers, rather than by the drastic step of abandoning altogether the method of free routine distribution. Perhaps, short of the generous distribution of scientific papers with which the United States have made us familiar, something might be done by the wide circulation of the periodical H.M. Stationery Office lists of Government publications, from which scientific societies or interested individuals might select and apply for such works as concerned their own field of activity.

In any event, the distribution of Government publications dealing with matters of scientific interest cannot remain as it stands at present; it is based upon a narrow idea of the importance of the spread of scientific knowledge, even upon a mistaken computation of the pecuniary value of science. How diametrically opposed it is to the trend of enlightened opinion in Great Britain is indicated by a recent decision of the Carnegie United Kingdom Trustees to increase still further their free circulation of expensive books to whatsoever individuals care to take up any serious study. What is wanted is not less facilities for making scientific knowledge and achievement widely known, but more. It is to be hoped that scientific societies will not permit the recent restrictions to pass unchallenged, and will unite to secure for the public and for scientific workers the fullest publicity for information of service to them as stimulus or as guidance.

The Physiology of Sex-Determination.

The Mechanism and Physiology of Sex Determination. By Richard Goldschmidt. Translated by Prof. William J. Dakin. Pp. ix + 259. (London: Methuen and Co., Ltd., 1923.) 21*s.* net.

PROF. GOLDSCHMIDT gives us an object-lesson in the way in which a single problem, at the outset not apparently more important than a thousand others, may, if pursued to its limit, be made to yield results of the deepest importance and the widest application.

It has long been known to entomologists that crosses between different species, and often also races, of Lepidoptera frequently produce a number of sexually abnormal forms. This was the starting-point of the investigation which has finally enabled Goldschmidt to make his important contribution to the study of sex-determination, and indeed to the problems of differentiation in general.

Put in the briefest possible way, we may sum up the results of his twelve years of work upon the sexual abnormalities arising in racial crosses of the Gipsy moth (*Lymantria dispar*) as follows. In the first place, since moths have two active sex-(X-)chromosomes in the male, and one in the female, the male-determining factors are in double dose in males, single dose in females. The female-determining factor Goldschmidt has finally located in the Y chromosome—an interesting fact, since the work of the Morgan school on Drosophila has shown that there the Y chromosome is without influence upon sex-determination. He has next shown that the strength or "potency" of the sex-determining factors may vary, and does actually do so in the different sub-species and races employed. It follows that when a cross is made, the future distribution of the sex-factors of various strengths, both male- and female-determining, can be prophesied from what we know of the behaviour of the chromosomes, or, in other words, on Neo-Mendelian principles.

As to the mode of action of the female-determining factor, we have the important fact that the Y must exert its effect upon the growing oocyte, since we find that the female-determining factor (which is inherited purely maternally according to expectation) is effectively present in males as well as females, although, of course, in all eggs destined to give males the Y has been eliminated in the polar body. If we are to draw conclusions, it appears that some substance, which Goldschmidt considers as of enzymatic nature, is given off into the oocyte in quantity proportional to the "potency" of the female-determining factor in the Y, and exerts effects in embryonic development proportional to its quantity. It is clear that if this is fully substantiated, it gives us important clues as to the possible mode of action of chromosomal genes.

By these last facts we are introduced to the second part of the problem—the mode of action of the sex-factors during development in contradistinction to their distribution to the gametes and zygotes—a field where Goldschmidt has made his most signal contribution. What do we start with?—the presence in every male moth of two doses of male-determining, and one dose of female-determining substance; whereas in the female, to the same quantity of female-determiner there is only one dose of male-determiner. But, since normally, in spite of the presence in individuals of either sex of determiners for both sexes, we get only the two classes male and female, we must say that (using the symbols M and F for our two sex-determiners) $2M > F$, whereas $F > M$.

When different races were crossed, abnormalities were produced. Goldschmidt was, in the first place, able to demonstrate that, whatever the degree of abnormality (and all degrees are possible), they fell into two classes, those which started their development as females but ended it as males, and those which started it as males and ended it as females. They thus have no kinship with the other main type of sexual abnormality known in insects, in which one half (or some definite section) of the body is of one sex, the other of the other. These latter animals are thus sex-mosaics in space, whereas Goldschmidt's are sex-mosaics in time. The term *gynandromorphs* should be restricted to the spatial type, the term *intersex*, or better *consecutive intersex*, being used for the other. The origin of gynandromorphs is to be sought in an abnormality of mitosis whereby an X chromosome is lost from one embryonic nucleus, whereas that of the intersex is to be looked for in the faulty balance of sex-factors.

It is only in certain crosses that intersexuality appears. An analysis of the families, together with the above-mentioned discovery of the transformation of sex during development in the intersexes, led to the following far-reaching conclusions. Broadly speaking, most of the Japanese races of the species possess sex-factors of high potency, the European races of low potency. Intersexes result (1) when a high-potency or "strong" M (male-determiner) is combined with a "weak" F—in which case the result is a *female intersex*, or one which is genetically female and starts its development as a female, but is later switched over to maleness; or (2) when two weak M's are combined with a strong F, in which case *male intersexes* are found.

Further, within each main group, the separate races may differ in regard to the strength of their sex-factors;

and this will be reflected in the different *degrees* of intersexuality resulting from different crosses.

These facts, and various interesting consequences of the facts, may be regarded as firmly established. It should be noted that there are one or two local races which have given curious results, which will have to be worked out in greater detail.

Goldschmidt's further argument is as follows. The expressions "2M>F" and "F>M" express only the conditions in the fertilised eggs before development has started. The further facts can be explained only if we suppose that, during development, in each cell of the body sex-controlling substances are produced at definite rates, and that these rates are proportional to the original quantities of the sex-factors. When, for example, a strong M and a weak F are present together in an egg, not only is the difference F – M abnormally small, but the rate of increase of F or of substances produced by it is lower, that of M higher, than usual. As a result, the two curves eventually intersect; and, of course, from this moment the individual, hitherto female, is switched over to the male type of development, and a female intersex is the result. The degree of abnormality is of course determined by the relative rates of F- and M-production, and the consequent earlier or later incidence of the intersection-point in the life-history.

If the intersection-point comes early enough, and the change to the "wrong" sex occurs before any chitinisation has taken place, sex-reversal will be apparently complete, and we shall get nothing but one sex from our cross. This does occur.

Let us suppose the sex-reversal is from female to male. Then, in the resultant all-male broods, half the individuals should be genetically females, and therefore be of chromosome-constitution XY instead of XX. If mated with normal females, therefore, they should give an abnormal sex-ratio (2XY = ♀♀ : 1XX = ♂ : 1YY —dies), as was pointed out in general terms by Morgan and by the reviewer some time ago. Similar sex-reversal followed by abnormal sex-ratio in the next generation has since been shown to occur by two independent workers in the frog, and now Goldschmidt has rung the changes upon it in Lymantria and has shown that in every case the results fit with expectation. Thus the final *somatic sex* may be the opposite of the original *zygotic sex*.

But we can go even further than that. The reversal (total or partial) of the original sex may be due either to genetic or to other factors. In Goldschmidt's moths the reversal is due to genetic causes—the fertilised egg contained inevitably within itself the seeds of its eventual change of sex, in the form of a quantitative disharmony of the sex-determining factors.

But sex may be upset by outer agencies: by hormones, in the case of vertebrates, whether the experiment be of Nature's (as in the Free-martin, the female intersex of cattle, owing its abnormality to the male hormones of its own twin brother), or of man's (as in the remarkable castration and grafting experiments of Steinach, Sand, Moore, Lipschütz, Goodale, and others); by parasites, as in crabs and insects; or by interference with the gametes, as in the increased number of males produced in frogs (Hertwig and his pupils) or trout (Mrsic) by over-ripeness of the ova.

The earlier rigid belief that sex-determination was entirely a matter of the chromosome-constitution must therefore be modified. Sex, in all higher animals and in some plants, is *normally* determined by the chromosomes, but (as might have been foreseen) the normal agency can in certain circumstances be overridden.

It is clear that, with the point of view arising from these facts, much that is both new and important has been gained. In the first place, we have the confirmation of the idea, which had become established as a result of the work on Drosophila, especially by Bridges, that sex-determination was an affair of balance between genes contained in the sex-chromosomes and other genes.

Bridges, by the utilisation of triploid strains, showed that in the fly, while the female-determiner was mainly lodged in the X (since here the female is XX, the male XY), male-determination was not an affair of one but of several factors, a disproportionate amount of influence being entrusted to that or those in the diminutive 4th chromosome. Two X's in the presence of three sets of autosomes gave intersexes: if only two instead of three of the 4th chromosomes were present, the intersexes were of more female type. We do not profess to understand Goldschmidt's comments (p. 99):—". . . . instead of speaking of the different quantities of a sex factor he [Bridges] prefers to speak of a more or less greater number of factors. Logically as well as physiologically this is naturally the same."

Although Goldschmidt has shown that his "F" substance is largely due to factors lodged in the Y chromosome, yet it may be confidently predicted that numerous "sex-modifiers" will be discovered in the autosomes.

Our second principle is concerned with development. Goldschmidt's idea of different rates of production of substances in the embryo is in itself very fruitful, while if his correlation of the rate of production of the substance with the amount of some initial ferment contained in the gene, and this amount with the "potency" of an allelomorph in a multiple series,—if this is substantiated, we acquire a new outlook into the relation between Mendelian genes and their mode of action in development.

That a correlation of some sort does exist between rate of developmental processes and nature of gene appears to be established; but whether there exists the exact chain of events imagined by Goldschmidt is a matter for further verification.

How valuable is the conception of rate of production of substances in ontogeny is seen by the rapid application which it has found in other fields. Crew has applied this idea to the explanation of various puzzling abnormalities of the reproductive organs to be found in mammals, and by so doing has removed them from the lumber-room where they lay labelled with the meaningless title of "pseudo-hermaphroditism" to a place in a coherent biological scheme. It appears more than probable that the determining factor in Amphibian metamorphosis, with all its curious variations from species to species, is simply the relative rate of thyroid growth. It will assuredly prove that the same concept will be of prime importance as regards the other endocrine glands in all their functions of growth-regulation and of initiating new phases such as puberty. In brief, the ideas of physical chemistry are thus being introduced into embryology, and dynamic ways of thinking substituted for static.

So much for the important positive results, both of fact and theory, which flow from Goldschmidt's work. It remains to criticise some of his details.

We think it right in the first place to emphasise the fact that the well-known curves illustrating the physiology of intersex production (p. 95) are quite hypothetical in their details—a fact not sufficiently brought out in the text. They could be drawn in a considerable number of quite other ways and still satisfy the facts. In particular, this applies to the representation of the curve for production of "female" substance as rising to a maximum and then sinking again. This is of great theoretical importance if really true; but no adequate discussion is given of the reasons for the adoption of this particular curve, nor for the rejection of, *e.g.*, a curve which continued to rise throughout life.

The same, *mutatis mutandis*, is true of various other of the curves presented later for other organisms—although here their hypothetical nature is made clearer. We think that in many cases it would have been equally easy to employ the idea of alteration in susceptibility of tissues to a constant stimulus (as exemplified, *e.g.* in the alteration in susceptibility of Anuran limbs to thyroid at metamorphosis) instead of that of alteration in the amount of morphogenetic substance (intensity of stimulus).

We note the absence of reference to Haldane's interesting work (in reality a corollary of Goldschmidt's own principles) that when one sex is reduced in numbers or abnormal in structure as a result of a varietal or specific cross, it is—not always the male or always the female, but—always the heterogametic; and also wonder why play is not made (pp. 222-224) with the idea that sex-linked semi-lethal factors account for the well-known differential elimination of males before and soon after birth in man and other mammals—an idea which at least gives full formal explanation of otherwise incomprehensible facts.

In his discussion of human sexual abnormalities (p. 243) the author has only been thinking in terms of his previous Lymantria scheme, which will give greater or lesser sex-transformation as a result of faulty balance of sex-genes: Crew's recent papers on goat and pig intersexuality suggest another and simpler explanation, in the idea of abnormally slow production of the male hormone, but without any switch-over from one sex to the other. No reference is made to the classical work of Pézard on birds, in which the effect of the gonad hormones upon growth-rate of sexual characters is so ably analysed.

These, however, are matters of comparatively minor moment. The main thesis of the book stands, and is of great value. In addition, various subsidiary topics are discussed with great lucidity. We especially commend the section on secondary sexual characters. The treatment is not new, but so clear and incisive that after reading it there should be no excuse for the not uncommon misconception that the inheritance of such characters throws any light upon or is in any way correlated with the inheritance of sex itself, save only that once sex is determined, it controls the *expression* of one or the other set of secondary characters.

The well-known difference between the physiology of sex-determination in insects and vertebrates—in the former independent of all gonadial influence, in the latter put under this influence from a very early period of ontogeny—the author correlates with the general shortness of life in insects as against its greater length in the higher group. This is an extremely suggestive idea; it will be interesting to see whether subsequent research upon the connexion of gonad and sexual characters in other invertebrates will bear it out. Finally, after the mass of nonsense and vague theorising that has been written on the sex-ratio, we commend his chapter on the subject as an admirable tonic.

It has seemed worth while to go into some detail regarding the thesis and scope of the book, in spite of its having been first published in German three years ago, since here for the first time are English readers provided with a translation (which, since Goldschmidt has incorporated recent work, is also a second edition). The book is intended for medical men and others, such as lawyers or sociologists, who may have occasion to study the problems of sex, as well as for the professional

biologist, and it is a fact, however unfortunate, that the great majority will not read a foreign language unless they must. The translation is direct and adequate, and reads smoothly, although a few Germanisms might be got rid of in a second edition.

Work on the problems of sex is proceeding so rapidly that Doncaster's and Morgan's books on the subject, although not ten years old, are quite out-of-date. We have no hesitation in recommending Goldschmidt's work as the best existing introduction to the subject, and tendering our thanks to Prof. Dakin for his translation.

JULIAN S. HUXLEY.

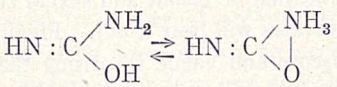
Chemistry of Urea and Resins.

(1) *The Chemistry of Urea: The Theory of its Constitution, and of the Origin and Mode of its Formation in Living Organisms.* By Prof. Emil A. Werner. (Monographs on Biochemistry.) Pp. xii+212. (London: Longmans, Green and Co., 1923.) 14*s.* net.

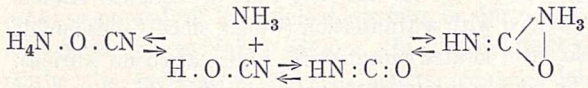
(2) *Synthetic Resins and their Plastics.* By Carelton Ellis. Pp. 514. (New York: The Chemical Catalog Co. Inc., 1923.) 6 dollars.

(1) THE monograph on urea differs somewhat in scope from others of this series of which it forms a part, inasmuch as it deals almost exclusively with one compound. Its importance, however, in animal and vegetable life is unquestioned, and no one will feel that a whole volume devoted to this topic is an unnecessary addition to biochemical literature. The subject-matter is divided into two sections: the first treats of the synthesis and constitution of urea; the second with its origin and occurrence in Nature.

There is no one more competent to write on urea than the author, who for many years past has attempted to unravel its structure. A considerable portion of the first section is concerned with this problem, and it must be confessed that Prof. Werner has made out a strong case for the tautomeric formula



There is no doubt that the majority of changes which urea undergoes with different reagents and by heating, such as the formation of biuret, and the conversion of ammonium cyanate into urea, which is represented thus:



may be equally well explained by the new formula. Moreover, the formation of cyanuric acid and the action of alkalis receive a much simpler interpretation in this way.

(2) As a rule, an organic chemist, when confronted in the course of an investigation with a resinous product, is discouraged from examining it further. It is an amorphous, intractable material which generally defies crystallisation and, consequently, the only satisfactory means of purification. It is therefore consigned to the scrap heap. The technical chemist, on the other hand, whose business it is to manufacture varnishes and composite materials, such as printing-inks, paper and cloth size, linoleum, etc., far from despising such products, is able to utilise many so-called synthetic resins on a very considerable scale. The volume under review gives a very comprehensive account not only of the production and use of synthetic resins; but also a detailed description of the machinery used in their application. He tells us that "the diminishing supply of natural resins, or *gums*, as the trade prefers to call them, has been viewed with apprehension during past years by varnish manufacturers and other large consumers of such products."

It appears that the introduction of phenol-formaldehyde and cumarone resins has opened up a new field for the synthetic organic chemist. There is a remarkable variety of substances now employed and derived from such products as glycerin and phthalic acid, vinyl polymerisation products, urea and thiourea derivatives and sulphur phenol resins. The author advises the chemist to scrutinise carefully every new resin he may obtain and record its formation. Here is a new and interesting field of operations, and instead of feeling thwarted in his aim, the organic chemist may in future turn what he formerly regarded as a failure into a possibly lucrative success. J. B. C.

Micrography as a Fine Art.

Botanical Pen-Portraits. By Prof. J. W. Moll and Dr. H. H. Janssonius. Pp. viii+472. (The Hague: Martinus Nijhoff, 1923.) 30 guilders.

IT was not until about the middle of the nineteenth century that descriptions of microscopical characters were introduced into treatises concerned with the identification of drugs. There are now several books primarily designed for students of pharmacy, but occasionally referred to by botanists who endeavour to demonstrate to their students that even a knowledge of plant histology may have its economic value. The volume by Prof. Moll and his junior collaborator aims at giving greater precision to the description of vegetable drugs and therefore greater accuracy in their identification.

Prof. Moll has devoted himself during the last twenty

years to a subject which demands no little concentration of effort and an enthusiasm that is proof against the dullness of tedious routine; he has devised a method of scientific description which he believes to be an advance upon all previous systems. The technical value of this method can only be thoroughly tested by specialists, but a mere botanist can at least appreciate the soundness of the underlying principles and the meticulous attention to details. The author is to be congratulated on the successful completion of a labour of love which is a contribution of great value to the pharmacologist and to all botanists whose aim is to acquire an orderly and thoroughly sound method of describing plant structures.

An adequate description of a plant must take account not only of the characters in which it differs from allied types, but also of those which it shares with other plants. Pen-portraits aim at furnishing a summation of characters, the replacement of sketches of habit by clear descriptions based on a definite scheme which is given in full and constitutes a very important feature of the book. They do not rely upon detailed anatomical drawings to supplement imperfect descriptions: a pen-portrait, if thoroughly made, is self-sufficient and at most needs only a well-labelled diagrammatic representation of the plant organ under consideration; it brings into the description "as much as possible of what is now generally considered as belonging to the domain of drawings and plastic models, in other words, it tends to make pictures more and more superfluous." The diagrammatic illustrations are exceedingly clear, and of a kind which might with advantage be adopted as a model by authors of botanical text-books.

The value of Prof. Moll's method was demonstrated by the junior author, Dr. Janssonius, in his book, published in 1906, on the micrography of Javan trees: an extension of the same method to timber trees of other regions would be a great boon to botanists, especially to such as are interested in the identification of fossil angiospermous woods.

The preface, which is much more than a preface in the ordinary sense, gives a clear account of the history of descriptive botany, with special reference to microscopical features, and emphasises the importance of a more definite employment of the Linnean method in micrography. Prof. Moll considers that the principal feature of the Linnean method is its conformity to a sequence fixed beforehand; if it is rigorously followed, completeness is achieved and nothing is omitted by chance. A high standard is set, and the "guiding schemes," if the student has sufficient faith and patience to adopt them, supply the means of constructing pen-portraits according to the admirable patterns contained in this great work. Most of the volume is devoted to descriptions of drugs arranged in alphabetical order—Amylum, Cortex, Flores, Folia, Fructus, etc.—and a full bibliography is added. In illustration of the method, the headings of the section dealing with Cortex Cinnamomi may be given: macroscopic characters; anatomical characters, followed by a list of references; epidermis, including measurements of cells; cortex, cork, phellogen, phelloderm; primary cortex; endodermis; stele, including detailed description and cell-contents of the tissues; micrography of the powder, bast fibres and other cells, crystals, starch grains, etc. A word of praise is due to the publishers for the printing and style of the book, and to the authors for their decision to present their work in well-written English. A. C. SEWARD.

Our Bookshelf.

Text-book of Agricultural Bacteriology. By Dr. F. Löhnis and Prof. E. B. Fred. (Agricultural and Biological Publications.) Pp. ix+283+10 plates. (New York and London: McGraw-Hill Book Co. Inc., 1923.) 15*s*.

DR. LÖHNIS' "Vorlesung über landwirtschaftlicher Bakteriologie" has for so long been regarded as an essential text-book, that students of agricultural bacteriology will especially welcome the excellent English edition of this work which the author has produced in collaboration with Prof. E. B. Fred.

The authors devote the first portion of their work to a description of the characteristics and general activities of micro-organisms. This part of the book contains useful chapters in which the general methods used in studying the organisms are discussed. The second half of the book is devoted to the special fields of bacteriology that touch upon the problems of agricultural research and practice. There are chapters on the bacteriology of silage, hay, and other food materials, on milk, butter, and cheese, on the methods of sewage disposal, on the changes involved in the making of farmyard manure and on the problems of soil biology. In these chapters the authors deal with their subjects with remarkable clearness. The very different problems that arise in these fields of work make it very difficult to connect them as though they formed a single branch of applied science. It seems that the sequence of thought would have been better preserved in this portion of the book if the bacteriology of soil had been considered before that of dairy products, because, in the former subject, the problems involved so completely cover the field of microbiology, that the authors have already been obliged to refer to the chief groups of soil bacteria to illustrate the activities of bacteria in general. In dealing with the bacteriology of soil and of dairy products, the authors discuss some of the special methods used in these fields of work. In a later edition, the description of special methods might well be given in greater detail. At present, lack of standardisation in technique greatly hinders work with bacteria, and this is especially the case with soil and dairy bacteriology. A detailed description of the best

methods, given in such a well-known text-book, would greatly assist the adoption of a uniform technique.

In the portion of the book devoted to soil bacteria, the activities of protozoa and other micro-organisms are mentioned, but greater emphasis should have been given to the close interrelation that exists between bacteria and other organisms in the soil. The close connexion found to exist in field soil between the rapidly changing numbers of bacteria and active amœbæ illustrates the fact that the bacteria must be considered as a part of the complex population of the soil. H. G. THORNTON.

Mine Examination Questions and Answers. Compiled from Examinations for Positions of Mine Inspector, Mine Foreman, Assistant Foreman, Fireboss, Hoisting Engineer, Safety Inspector and Shotfirer. By Prof. J. T. Beard. Part 1. Pp. viii+258. Part 2. Pp. vi+259–546. Part 3. Pp. vi+547–872. (New York and London: McGraw–Hill Book Co. Inc., 1923.) 3 parts, 37*s.* 6*d.*

THE object of the work under notice is, as stated by the author in his preface, that of "enabling candidates to pass successful examinations for positions of responsibility in coal mining," and it consists of a set of answers to no less than 2975 questions, set in examinations in the various coal-mining states of the United States of America and in Canada for various grades of colliery officials. Opinions will certainly differ as to whether this is the best way of qualifying a man for the duties that he will have to perform after he has passed such examination; it may readily be granted that a man, gifted with an exceptional memory, might get off by rote the whole of the answers to the questions given in these three volumes and would thus with ordinary luck pass successfully any of the examinations referred to, but it is also very certain that this fact would not qualify him to hold a position as a responsible underground official. The educational value of such a book is therefore very questionable. At the same time the work has been well done. Prof. Beard has been the Principal of the School of Mines, International Correspondence Schools, Scranton, Pa., Secretary to the State Board of Mining Examiners, Iowa, and has held many other positions that qualify him thoroughly for the work that he has undertaken, and his book may be used with every confidence in its accuracy. It must, however, be borne in mind that coal mining methods, legislation, and nomenclature are so different in the United States from what they are in Great Britain that many of the answers given would prove seriously misleading to British candidates for similar positions in the latter country.

The Properties of Matter. By Prof. Basil C. McEwen. Pp. vi+316. (London: Longmans, Green and Co., 1923.) 10*s.* 6*d.* net.

As a text-book, this work differs from its predecessors in the order of treatment of the subjects. Commencing with the First Law of Thermodynamics and the more general Principle of the Conservation of Energy, a logical sequence leads to the study of the kinetic theory of matter, which is most easily treated in connexion with the gaseous state. The continuity of the gaseous and liquid states supplies the natural transition to a detailed study of liquids, and solids are dealt with last of all. The reviewer can recommend this order from his own experience in lecturing to university students, and is of the opinion that the first half of Prof. McEwen's book reaches a high standard of excellence. Some parts of the latter half are not quite so satisfactory. The chapter on capillarity seems somewhat elementary and does not contain many references to modern work. The distinction between surface tension and surface energy is not well brought out. The chapter on solids is very short, and should be greatly expanded when a new edition is called for. We hope the author will then include an account of the crystalline structure of solids as revealed by X-ray analysis. H. S. A.

Medical Climatology of England and Wales. By Dr. E. Hawkins. Pp. xiv+302+149 charts. (London: H. K. Lewis and Co., Ltd., 1923.) 25*s.* net.

EVERY practitioner of medicine is frequently required to recommend a climate suitable for convalescence or for a chronic disease; few doctors can acquire from experience the geographical and meteorological knowledge to enable them to give adequate consideration to this important detail of treatment. Dr. Edgar Hawkins provides a volume on the subject, based on his own experience and the information derived from numerous meteorological publications. The main arrangement of the book is geographical, therapeutic indications following the descriptions of the geology and climate of various districts and towns. There is also a separate chapter on therapeutics of the English climate, in which the classification is based on diseases. In one appendix the health resorts are tabulated according to seasonal suitability, and in the other the waters of the various Spas are described.

In spite of the complexity of the subject, information with regard to locality or disease can readily be found, and reference is facilitated by the inclusion of a large number of meteorological charts and the addition of a well-prepared index. The book will be of considerable value to physicians and others interested in medical climatology.

The Elements of Co-ordinate Geometry. By S. L. Loney. Part 2: *Trilinear Co-ordinates, etc.* Pp. viii+228. (London: Macmillan and Co., Ltd., 1923.) 6*s.*

THIS part of Prof. Loney's "Co-ordinate Geometry" contains, in order, chapters on cross-ratio geometry, trilinear and areal co-ordinates, tangential equations, reciprocation, projection, and invariants of conics. Methods of teaching geometry have advanced considerably in the last twenty years, and the arrangement adopted by Prof. Loney would scarcely be accepted as the natural one now. Trilinear and areal co-ordinates are here introduced from the purely metrical point of view. Now it would be more customary to read the chapters on projection and reciprocation first and then to treat trilinears and areals as particular cases of homogeneous co-ordinates.

Coming from an experienced teacher of mathematics, the book gives all necessary assistance to a student reading its subject-matter for the first time in the order treated. Abundant examples are given, but those on homogeneous co-ordinates include a greater proportion of metrical questions than a present-day teacher would endorse (*e.g.* pp. 85-87, Nos. 1, 2, 6, 7, 16, 17, 20, 22, 23, 24).

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.*]

The Gorilla's Foot.

WITH regard to Mr. Akeley's cast of a gorilla foot discussed in NATURE of November 24, p. 758, I note that Sir Ray Lankester did not wait until he had seen the cast which we sent to the British Museum (Natural History) but has again made the following charges :— (1) The picture of the cast of the foot in Mr. Akeley's book " In Brightest Africa," p. 242, gave a misleading or distorted view of the cast and was in effect an example of bad photography. (2) The gorilla foot as represented by the cast differed in appearance from all previous pictures of and statements about the gorilla's foot and was misleading, chiefly because it did not show the great toe in a divergent position ; it also differed in appearance from the photograph of another gorilla's foot figured by Akeley in the same book (p. 231), in which the great toe was shown in the flexed and abducted position. (3) Therefore Akeley had himself supplied the refutation of his claim that his gorilla's foot was different from any other yet discovered. (4) That it is " highly improbable " that Akeley's photograph of the cast " correctly represents the foot of a normal species or variety of gorilla."

As to (1), I have already stated (NATURE, November 24) that the photograph published in Mr. Akeley's book gave a " very fair " view of the cast in question, and after a careful re-examination of the facts I will add nothing to that statement except that Mr. Akeley has a deservedly high reputation based upon many years of experience both in photographing and in making anatomical casts, and needs no warning from any one as to the precautions to be observed in such work.

As to (2), neither Mr. Akeley nor I ever asserted that the cast in question showed the hallux in the position that it probably assumed when the animal's weight rested upon it. I quoted Mr. Akeley's statement that the cast was taken in the relaxed condition of the foot after *rigor mortis* had passed away, and I also noted that the hallux could no doubt be more or less abducted. The cast was made within twenty-four hours after death, in a cool, moist climate. The foot was cut off from the leg, the muscles and ligaments being relaxed, and was placed in a hollow in the ground with the sole facing upward. The foot and its digits were not posed but were allowed to assume the relaxed position. After being lightly soaped a thin coating of plaster was then applied and allowed to set, in order to prevent distortion by the weight of the plaster. No other outside pressure was exerted in any direction when the plaster was poured around. The whole operation was conducted with exceptional care to avoid distortion.

The outstanding feature of Mr. Akeley's cast is that it shows that in the relaxed condition the hallux assumed a position of lesser divergence, so that it was more nearly in line with the other digits. In this connexion it is pertinent to state that Dr. D. J. Morton is now studying the anatomy of the foot of another one of Mr. Akeley's adult gorillas, and finds that the arrangements of the internal cuneiform and first metatarsal bones are such that it is possible for the hallux to be drawn into the position shown in Mr. Akeley's cast. Dr. Morton has also found that in Mr. Akeley's, as well as in other adult specimens, the distal ends of the metatarsals of all the digits are twisted upon the shafts at different degrees in such a way as to make the volar surfaces face more directly downward, whereas in infant gorillas the volar surface of the hallux is tilted toward that of the other digits, this arrangement being still more pronounced in the chimpanzee. After extensive comparison, Morton concludes that the infant gorilla foot retains more of the primitive arboreal characteristics, while the adult gorilla foot shows numerous man-like adaptations not found in the chimpanzee.

As to (3), Mr. Akeley never claimed that his gorilla's feet were different from all others previously described. Such may yet prove to be the case in regard to the detailed proportions and minor characters of the foot, but it has not yet been asserted by either Mr. Akeley or myself.

As to (4), the original foot from which the cast was made has not yet been compared minutely with the other gorilla feet collected in the same general region, but after a preliminary comparison there seems no reason to brand the individual as representing an " abnormal species or variety."

In brief, Mr. Akeley's cast can be misleading only to those who read into it more than was claimed for it, or who do not realise that a gorilla's hallux may assume a position other than that figured in the previous literature of the subject. A carefully made cast of this kind is of greater scientific value than any photograph of the same object, because it represents the object in the round and without photographic distortion. A good cast, such as this unquestionably is, gives indisputable evidence of fact.

In conclusion, Sir Ray Lankester's statements in his book, " Great and Small Things," about the significance of the differences between human and anthropoid feet, suggest that he is one of several eminent persons (including Mr. H. G. Wells) who do not see that the human foot is an anatomical palimpsest, in which the later record of a long terrestrial life is so deeply impressed that it has largely obscured the underlying older record of a previous arboreal stage with a divergent hallux. This is not a " theory " but a well-founded inference from the many facts that are now being examined by Sir Arthur Keith, Dr. Morton, and others.

WILLIAM K. GREGORY.
American Museum of Natural History,
New York, December 7.

Psycho-Analysis and Anthropology.

REFERRING to the letters in NATURE from Dr. Malinowski (November 3) and Prof. Elliot Smith (November 24) on this subject, I should like to make three remarks.

(1) While agreeing with all that Prof. Elliot Smith says as to " Totem and Taboo," and that Freud failed to acquaint himself with the essential facts and associations of which he writes, this is by no means the case with all of his disciples, while even in " Totem and Taboo " there is stress laid on the quality of ambivalence in savage belief and custom, which, if I judge rightly, had not previously been sufficiently appreciated by anthropologists. It may be that Prof. Elliot Smith has recognised this in his article in the *Monist*, which I have not had the opportunity of reading.

(2) I rather doubt whether time will bear out Prof. Elliot Smith's contempt for typical symbols. Type dreams—that is, identical dreams having the same meaning attributed to them—certainly occur among peoples genetically and culturally remote. Thus, to take an example, quite superficial reading, and the kindness of friends in supplying references, indicates

that the tooth-losing dream occurs in Europe and among Nagas, Malays, and Chinese, also Ashanti, and that in each case it is taken to mean the death of a near relative (Ashanti, loss of near friend). Moreover, this meaning fits well with the individual significance commonly recognised by analysts, namely, the fear of castration.

(3) The question of "Universal Symbolism" is of course the crux of the whole matter. Are the findings of analysis for the individual applicable to the social unit to which he belongs; and if so, do they also apply to other groups which may be genetically remote?

Those interested should shortly have the opportunity of hearing the problem examined from the psycho-analytic point of view, for Dr. Ernest Jones has consented to read a paper upon this subject before the Royal Anthropological Institute on Tuesday, February 19. Tickets of admission will willingly be sent to non-members of the Institute interested in the subject, who should apply to the Assistant Secretary, Royal Anthropological Institute, 50 Great Russell Street, W.C.1.

C. G. SELIGMAN.

Malaria and *Anopheles funestus* in Mauritius.

EARLY in 1922 I was asked by the Secretary of State for the Colonies to undertake an Anopheline and anti-malaria survey in the island of Mauritius. I accepted this mission, and had the pleasure of devoting ten months of intensive investigation to a survey of unusual interest.

Prior to my visit to Mauritius, a somewhat similar survey had been made in 1908 by Sir Ronald Ross, Major Fowler, and Mr. d'Emmerez de Charmoy. The valuable work they accomplished and the many interesting observations made by them are recorded in Ross's report entitled "Prevention of Malaria in Mauritius" (London, Waterlow and Sons, 1908).

In the course of their work, Ross, Fowler, and d'Emmerez de Charmoy made an extensive survey of the mosquitoes of Mauritius, which resulted in the collection of the following species:

OLD NOMENCLATURE.

1. *Myzorhynchus mauritianus*. Daruty de Grandpré & d'Emmerez de Charmoy.
2. *Myzomyia* (*Pyretophorus*) *costalis*. Theobald.
3. *Nyssorhynchus maculipalpis*. Giles.
4. *Scutomyia notoscripta*. Walker.
5. *Stegomyia fasciata*. Fabricius.
6. *Culex fatigans*. Weidemann.
7. *Culex tigripes*. Daruty de Grandpré & d'Emmerez de Charmoy.
8. [1] *Culex annuliorius*. ?
9. *Culex arboricolis*. d'Emmerez de Charmoy.
10. *Culex ronaldi*. d'Emmerez de Charmoy.
11. *Culex fowleri*. d'Emmerez de Charmoy.

MODERN NOMENCLATURE.

1. *Anopheles mauritianus*. Daruty de Grandpré & d'Emmerez de Charmoy. Very common.
2. *Anopheles costalis*. Theobald. Very common.
3. *Anopheles maculipalpis*. Giles. Very rare.
4. *Aëdes albopictus*. Skuse.
5. *Aëdes argenteus*. Poiret.
6. *Culex fatigans*. Fabricius.
7. *Lutzia tigripes*. Daruty de Grandpré & d'Emmerez de Charmoy.
8. [1] *Culex annuliorius*. ?
9. *Orthopodomyia arboricolis*. d'Emmerez de Charmoy.
10. *Culex sitiens*. Weidemann.
11. *Aëdes nigerensis*. Theobald.

[1] *Note.*—*Culex annuliorius* should not be listed among the mosquitoes of Mauritius, as the record is probably due to an error in identification.

It will be seen from this list that three species of Anophelinæ were found, and I have added the remarks made by these investigators relating to the prevalence of the Anopheline species.

By experimental work in Mauritius, Ross was able to prove that of the three Anophelines, *A. costalis* was easily infected with malaria and could be regarded as the chief vector; that *A. mauritianus* apparently could not be experimentally infected with malaria, and by much additional evidence could be regarded as incapable of malaria transmission; while, owing to the great rarity of *A. maculipalpis*, which these investigators state was then the case, there was no opportunity of obtaining *A. maculipalpis* in numbers sufficient for experimental work. Its presence in Mauritius was therefore considered of no practical importance at the time.

Based on these discoveries, Ross indicated the plan that should be adopted for the institution of an anti-malaria campaign in Mauritius. Unfortunately, his recommendations were not thoroughly carried out, and although much useful work was done by the canalisation of streams and the abolition of swamps in many parts of the island, the success of the campaign was vitiated by the neglect of equally important Anopheline breeding-places, and in many cases by allowing the completed anti-anopheline works to revert to natural conditions.

Consequently, fourteen years afterwards malaria in Mauritius was as bad as ever—a fact which, together with the totally insanitary state of the island, led the Governor, Sir Hesketh Bell, to decide to ask the Colonial Office to appoint an expert in tropical hygiene to visit the island and indicate the necessary measures for the correction of the many serious defects.

The Secretary of State for the Colonies called upon Dr. Andrew Balfour to undertake this mission, and Dr. Balfour left for Mauritius in February 1921. The utterly insanitary state of the island, and the very large number of separate problems with which Balfour had to contend, are fully set out in his comprehensive report, entitled "Report on the Medical and Sanitary Matters in Mauritius, 1921," published by the Colonial Office.

With regard to malaria in the island, Balfour speedily saw that, for renewed effort against the Anophelinæ, it was essential to know more of the bionomics of *Anopheles costalis*, the species then thought to be the only species responsible for the intensely malarious condition of Mauritius. His view was that it was highly important to know whether the species did or did not hibernate during the winter months, at least at the higher altitudes of the island, so that future work might take into account this most important fact.

On his return to England, Balfour recommended that investigations to determine the bionomics of *A. costalis* should be undertaken. I therefore left England for Mauritius early in 1922 to carry out this work.

For the first four months after my arrival in Mauritius (then the winter months), my staff and I gave undivided attention to the work of determining whether *Anopheles costalis* exhibited hibernation; and we were successful in showing that hibernation did not occur either at the coast or inland—a matter that is fully dealt with in my report to be published shortly by the Colonial Office.

During the work on *A. costalis*, much to my surprise I discovered that, in spite of what Ross had said in 1908, *Anopheles maculipalpis* was now to be found in very large numbers all round the island and up to an altitude of 1200 ft.

Later, with more time to devote to further studies

after *A. costalis* and the hibernation problem had been settled, my assistant and I while searching a marsh near Port Louis were astonished to find a larva of *A. funestus*. Further search in this marsh demonstrated that *A. funestus* was here in large numbers. The fact that *A. funestus* had not been recorded from Mauritius before, in spite of the work of the previous investigators, coupled with the proximity of the marsh to Port Louis—where all ships enter Mauritius—led me to assume that the species had only recently been imported. I immediately approached the Officer Administering the Government for authority and funds to abolish this marsh; and by the copious use of paraffin castor-oil mixture, while hundreds of men tore up the weeds, by drainage and filling-in operations, within a few days the marsh was changed into dry land.

Control of all the nearby waters—fortunately few—was instituted, and no larva appeared in these waters. A few days later, while I was in conversation with one of the chief moustiquiers (mosquito searchers)—an Indian who had been trained by Ross and Fowler—this man told me that he thought he remembered having seen similar larvæ while Ross was in the island, at Schonfeld Marsh, Riviere du Rempart in the north.

I questioned him further, pointing out that it was difficult to remember the appearance of larvæ after the lapse of 15 years; but he seemed so certain that I despatched him to Schonfeld to search. Schonfeld Marsh is rather inaccessible, some 15 miles from the marsh at Port Louis, and as the man had to go on foot it was two days later before he returned.

When he got back, however, he brought with him six larvæ of *A. funestus*. My assistant and I at once left for Schonfeld Marsh in my motor-car, taking the man with us, and after searching for two hours in this extensive marsh, I discovered a larva of *A. funestus* there for myself.

On my return to Port Louis, I issued instructions that all moustiquiers should divide up and proceed to all parts of the island and search only for *A. funestus*. Two weeks later, *A. funestus* had been reported from practically every district of Mauritius, but the numbers found were surprisingly few.

I then decided personally to undertake the study of the bionomics of the species, and I at last found—as I have fully described in my report—that *A. funestus* existed in Mauritius in prodigious numbers, in some localities actually outnumbering *A. costalis*. The failure to discover the larvæ in numbers before was due to the fact that the vibrations transmitted through the earth by the tread of the searchers warn the larvæ of danger, and they all dart to the roots of the vegetation, to which they cling, *or even climb a few inches up the damp surfaces of the leaves* which dip into the water. Once this fact had been discovered, thousands of *A. funestus* larvæ could always be had in suitable breeding-places.

I undertook experiments in malaria transmission by *A. funestus* and *A. maculipalpis* in the island, and found that the former species could very easily be infected, and that *A. maculipalpis* could also be infected without much difficulty. Consequently, instead of *A. costalis* being the only vector of malaria in Mauritius, there are in reality three vectors: *A. costalis*, *A. funestus*, and *A. maculipalpis*.

Now, there are two theories to account for the malaria in Mauritius:

(1) That *A. costalis* (and *A. funestus* and *A. maculipalpis* ?) have existed in Mauritius for centuries, and that it was only the importation of large numbers of Indians to work in the sugar-cane industry, bringing with them in their blood the parasites of malaria, that caused the extensive infection of the local anophelines.

(2) That prior to 1865, when the first considerable outbreak of malaria (?) occurred, no anopheline vector existed in the island, and that it was only by accidental importation of *A. costalis* (*A. funestus* and *A. maculipalpis*?) then that Mauritius became malarious.

Personally I am inclined to favour the first theory, but the following experience shows how impossible it is to be dogmatic.

Towards the end of my work in Mauritius, hearing that the sister island of Rodrigues was free of malaria, I obtained sanction from the Officer Administering the Government to proceed to Rodrigues in order to investigate this report.

The island is so small that it was possible, with the assistance of three skilled helpers, to search all the streams, marshes, and pools. No Anopheles were to be found, and no case of malaria acquired in Rodrigues existed, although on the other hand I was able to find persons with all three species of the malaria plasmodia in their blood, which they had acquired by former residence in Mauritius.

The island of Rodrigues lies 365 miles to the east of Mauritius, and is visited regularly, though only every 3-4 months, by the Government supply steamer from Mauritius. On this ship, which is berthed in Port Louis, *A. costalis* was found even during my voyage, and it seems obvious that the only thing that accounts for the fact that Anophelines have not been introduced into Rodrigues is that the island is completely surrounded by an extensive and remarkable coral reef, running from 1½-6 miles seaward, which forces all vessels to anchor at least 1½ miles from shore. Moreover, a steady wind from the south almost invariably blows across the island from the shore across the anchorage.

In my report I have described these investigations at length, but I am in the meantime asking Sir Ronald Ross if he will be good enough to add any remarks he may care to make on what these investigations have shown.

MALCOLM E. MACGREGOR.

Wellcome Field Laboratory, Wisley, Surrey
(Wellcome Bureau of Scientific Research).

THESE investigations appear to me to be both theoretically and practically important. The question is whether *A. funestus* entered Mauritius after my visit in 1908. Major C. E. P. Fowler and myself were in the island from November 20, 1907, until February 25, 1908, that is, during the summer. Of course, we could not make anything like a complete survey of the mosquitoes in that time, but we were given the assistance of Mr. D'Emmerez de Charmoy, the accomplished entomologist of the island and curator of the museum, and were also provided with ten "moustiquiers," that is, trained mosquito men. Our principal investigations were made close to the Clairfond Marsh at Phœnix—which was drained in 1908; but Major Fowler and Mr. D'Emmerez investigated much further afield than this. It is therefore most surprising that we did not once come across *A. funestus*. I remember that when I first found *A. costalis* in the island I expected to discover *A. funestus* pretty shortly, partly because we had found them in association in Sierra Leone (where indeed we had discovered and named *A. funestus*), and also because we heard that both mosquitoes abounded in the neighbouring island of Madagascar. It seemed surprising to me that only one of these Madagascar Anopheles had managed to drift into Mauritius. Moreover, we heard that it

was absent from the island of Réunion, where *A. costalis* was present. I understand that Mr. MacGregor found *A. funestus* in numbers during the period of summer when we were in the island; but, in addition to all this, it is most remarkable that Mr. D'Emmerez, who was appointed in charge of the antimalaria measures after we left, had not detected this mosquito during all these years. The most likely inference appears to me to be that *A. funestus* has been imported quite recently. I wonder whether it has also appeared in Réunion.

In my report I discussed the question whether malaria had been introduced into Mauritius and Réunion in 1866–7 (as was the case) by the introduction of large numbers of coolies from India, or by the introduction of *A. costalis*, and I preferred the latter theory. Against the coolie theory there was the fact that Indians had been pouring into both islands long before those years. I thought it more likely that *A. costalis* had been brought in some time previous to 1866, possibly by some ship. If therefore *A. funestus* has been a new introduction, this hypothesis of mine will be further supported. The entire absence of both species from Rodrigues is another confirmation. The most likely picture appears to me to be that all three islands were Anopheles-free up to 1865 or so, but that two of the islands have become infected since by shipping from Madagascar. I understand that both species are absent from India, but have not been following the recent literature.

It is very disappointing that all the antimalaria measures advised by me have been allowed to fall into abeyance in Mauritius, and I have long been convinced that anti-mosquito work will not be properly carried out in British dominions until stronger discipline is enforced.

RONALD ROSS.

Methods of Chemical Reactions.

THE general scheme of a chemical transformation can be reproduced by the equation:

$$\left.\begin{aligned} &x_1A_aB_bC_c\ldots+x_2A_dB_eC_f\ldots+x_3A_gB_hC_l\ldots+\\ &=y_1A_mB_nC_p\ldots+y_2A_qB_rC_s\ldots+y_3A_zB_uC_w\ldots+\end{aligned}\right\}\text{I.}$$

A, B, C represent chemical elements or groups of elements, which are transferred as whole complexes from one side to the other of the chemical equation (*i.e.* NH_4, SO_4, NO_2, etc.). We shall call these groups of elements for short the *elementids* of a chemical equation; the chemical elements are thus the simplest elementids. It is evident that in determining the number of elementids of a chemical equation the minimum rule must be observed—that is, the elements must be brought together into groups, so that the number of these groups (elementids) shall be the smallest possible. The composition of these groups must fulfil one condition: that their number taken as a whole and for each formula individually should be the same on the right and on the left side of the chemical equation. In most cases the problem of determining the elementids is simplified by the fact that the number of elementids is the same as the number of elements.

a, *b*, *c*, *d*, etc., as usual in chemical equations, are numbers showing how many times a given element (or elementid) occurs in the composition of a chemical compound. Equation (1) contains molecules composed of all elements of a given chemical transformation; of course, the absence of some elements in the composition of a particular chemical molecule is expressed by making the corresponding multiplier (*i.e.* *a* or *b* or *c*, etc.) equal to zero.

x_1, x_2, x_3, also y_1, y_2, y_3, etc., are the numerical coefficients to be determined by chemists using chemical equations.

To determine these coefficients algebraically, according to the rule requiring an equal number of elements on both sides of a chemical equation, we can write:

$$\begin{aligned} x_1a+x_2d+x_3g+\ \ldots\ &=y_1m+y_2q+y_3z+\ \ldots\\ x_1b+x_2e+x_3h+\ \ldots\ &=y_1n+y_2r+y_3u+\ \ldots\\ x_1c+x_2f+x_3l+\ \ldots\ &=y_1p+y_2s+y_3w+\ \ldots \end{aligned}$$

In calculating the numerical values of the co efficients x_1, y_1, x_2, y_2, etc., as required by stoichiometry, the following rules must be observed: first, all the coefficients must be whole and positive numbers; the coefficients must not have a common divisor. This last condition is satisfied by giving the smallest possible whole number to the coefficient of the molecule occurring the least number of times in a chemical reaction.

It follows from the series of equations that the number of elementids of a chemical equation corresponds to the number of separate equations serving to determine the necessary coefficients; and the number of heterogeneous molecules (separate substances) taking part in a chemical reaction corresponds to the number of unknown quantities. Hence:

In the simplest case the number of separate substances taking part in a chemical reaction will be greater by one unit than the number of elementids.

To illustrate this we shall give several chemical equations:

(*a*) *Two elements and three substances:* An example of the simplest reaction is the formation of water (two elements, H and O, and three substances, H_2, O_2, and H_2O).

(*b*) *Three elements or elementids and four substances:*

(1) $2C_2H_4O_2+Zn=Zn(C_2H_3O_2)_2+H_2$; the three elementids are Zn, H, and $C_2H_3O_2$.

(*c*) *Four elements and five substances:*

$$4S+6NaOH=2Na_2S+Na_2S_2O_3+3H_2O.$$

(*d*) *Five elements and six substances:*

$$2Sr(NO_3)_2+6NH_4Cl=2SrCl_2+5N_2+Cl_2+12H_2O.$$

(*e*) *Six elements and seven substances:*

$$K_2Cr_2O_7+6HI+4H_2SO_4=K_2SO_4+Cr_2(SO_4)_3+7H_2O+3I_2.$$

More complex chemical equations containing more than six elementids are comparatively rarely met with in chemistry.

We shall now investigate an example in which seven elements and eight substances take part in a reaction:

$$x_1K_3Co(CN)_6+x_2H_2SO_4=y_1CoSO_4+y_2K_2SO_4+y_3(NH_4)_2SO_4+y_4CO+y_5CO_2+y_6SO_3.$$

By solving the algebraical equations corresponding to this chemical reaction we get the following:

$$2K_3Co(CN)_6+24H_2SO_4=2CoSO_4+3K_2SO_4+6(NH_4)_2SO_4+11CO+CO_2+13SO_3.$$

This reaction is so complex, that even Prof. Treadwell, who did not know of the algebraical method of finding the coefficients, wrote the equation wrongly from the strictly stoichiometrical point of view. His rendering of it was as follows: [1]

$$2K_3Co(CN)_6+12H_2SO_4+12H_2O=2CoSO_4+3K_2SO_4+11CO+CO_2+6(NH_4)_2SO_4+SO_3.$$

[1] Treadwell, "Analytical Chemistry," vol. ii.

Here there are seven elements, but nine substances. One need not be a profound mathematician in order to understand that according to the scheme of a chemical reaction evolved by us, Treadwell's example just given contains, in the equation of reaction, substances the coefficients of which in certain limits can be arbitrarily changed. Such substances are: on one hand, H_2SO_4 and H_2O, on the other SO_3.

Thus, if we express the number of elementids by the letter L, the number of chemical substances taking part in the reaction by the letter M, we shall get for the simplest case of a chemical equation the expression:

$$M = L + 1.$$

We have looked through a number of chemical works and have found no exceptions to this rule. The seeming exceptions, carefully analysed, were found to be only complications, substantiating the rule announced. In the well-known "Analytical Chemistry" of Prof. Treadwell (vol. i.) out of 1240 reactions, 688 follow directly the rule announced. We shall show below that the seeming exceptions are only more complex cases.

Let us consider a first possible complication: it is evident that by addition of two or several chemical equations, we obtain a new chemical equation, but a more complex one; to find in this case the applicability of the simplest rule governing a simple chemical reaction, a special analysis is required.

Let us consider the case of double decomposition, which from a chemical point of view consists of two reactions: a reaction of combination and a reaction of decomposition. This complication affects adversely the immediate applicability of the rule announced. In this case the number of elementids increases, but the new elementids give algebraical equations resulting in the same solutions as those given by the number of equations demanded by the rule $L = M - 1$, so that to find the necessary coefficients it is sufficient to take only the algebraical equations according to our rule. To demonstrate this we will take an example:

$$x_1AgNO_3 + x_2H_2S = y_1HNO_3 + y_2Ag_2S.$$

Here there are the following equations: for Ag, $x_1 = 2y_2$, for NO_3 (elementid), $x_1 = y_1$, for H, $2x_2 = y_1$. These suffice already, for by taking $y_2 = 1$, we obtain $x_1 = 2$, $x_2 = 1$ and $y_1 = 2$. It is possible to make an equation for sulphur, $x_2 = y_2$, but this equation gives no new data and can only serve to control the preceding equations.

Here is another example [2] of a complex reaction:

$$8KClO_3 + 24HCl = 8KCl + 12H_2O + 9Cl_2 + 6ClO_2.$$

The corresponding simple reactions are:

$$KClO_3 + 6HCl = KCl + 3H_2O + 3Cl_2$$
$$5KClO_3 + 6HCl = 5KCl + 3H_2O + 6ClO_2.$$

Adding together the last two equations and dividing throughout by the factor 3 common to all the coefficients, we obtain a more simple expression than that given above, for we get:

$$2KClO_3 + 4HCl = 2KCl + 2H_2O + Cl_2 + 2ClO_2.$$

Here again the "new condition," regulating the decomposition of chlorate of potassium, will be expressed by the quantitative analytical data of the percentages in the reaction products of chlorine and chlorine dioxide. These last examples show already that, as in the application of the familiar phase rule, the appearance of each "new condition" increases by one the number of substances. Designating the number of new conditions by n as in the phase rule, we get for this case the expression:

$$M_n = L + 1 + n.$$

As in the familiar case in the application of the phase rule, we can designate as *non-variant* chemical reactions those following the simple rule $M = L + 1$, as, of course, the formulæ for these reactions do not admit of a variation of coefficients. A chemical reaction obeying the rule $M_n = L + 1 + n$ has n degrees of freedom. Thus the reaction above investigated of the action of sulphuric acid on $K_3Co(CN)_6$, if written according to Treadwell, will have one degree of freedom (inter-relation of the number of molecules H_2O and SO_3), *i.e.* for this case $n = 1$ and thus $M_1 = L + 2$. Accordingly in Treadwell's equation, we have $M_1 = 9$ and $L = 7$.

The reactions of hydrogen peroxide when hydrogen peroxide acts as a reducing agent show this:

$$x_1Ag_2O + x_2H_2O_2 = y_1H_2O + y_2O_2 + y_3Ag.$$

In this case $L = 3$ (*i.e.* Ag, H, and O), $M = 5$, *i.e.* Ag_2O, H_2O_2, H_2O, O_2, and Ag. It would seem that this is an exception to the rule; but actually there is no exception, as the last equation is subject to a new condition: the quantity of hydrogen peroxide and the quantity of silver oxide are determined by the fact that the molecule of oxygen is formed by one atom of oxygen taken from the hydrogen peroxide and one atom of the silver oxide. Algebraically this condition can be expressed by putting $x_1 = x_2$. The solution is then quite definite.

Lastly, let us investigate the case of reactions often met with in organic chemistry, where a small number of elements forms a great many substances. We will take the decomposition by water of the alloy of iron and carbon at high temperature and pressure:

$$3Fe_pC_q + 4_pH_2O = pFe_3O_4 + y_2C_nH_{2n+2} + y_3C_nH_{2n} + y_4C_nH_{2n2} + \ldots$$

An immediate application of the rule $M = L + 1$ can be made only in the case of the formation of one hydrocarbon (case of double decomposition), as in the decomposition of the carbide of aluminium. To the other case the rule $M_n = L + 1 + n$ must be applied, as each new hydrocarbon must be characterised by quantitative analytical data showing its percentage in the reaction products in order to be able to write a stoichiometrically correct chemical equation.

The expression $M_n = L + 1 + n$ and the simpler one $M = L + 1$ form the basis for deducing the algebraical equations necessary for the determination of the equation coefficients of a given chemical reaction. The general number of algebraical equations will be equal to $n + L$, where L is the number of equations corresponding to the number of elementids, and n is the number of equations which must be deduced to meet n special conditions.

All the rules given in this paper can be formulated also by a single expression:

$$M_n \leqq A + 1 + n,$$

where A is simply the number of elements taking part in a given chemical reaction.

Wl. KISTIAKOWSKY.

Petrograd, June 1923.

[2] Treadwell, "Analytical Chemistry," vol. i.

Mechanism of the Hydrogen Chlorine Combination.

THE object of the present note is to describe some work in progress here on an attempt to test directly the Nernst theory (*Zeit. Electrochem.*, 24, 335, 1918)

for the very wide deviation of the hydrogen chlorine combination from the Einstein photochemical equivalence law. Nernst postulated that the primary action of the light was to split up the chlorine into atoms, and that these were able to react with hydrogen molecules according to the equation

$$Cl + H_2 = HCl + H,$$

and that the atomic hydrogen formed again reacted with chlorine

$$H + Cl_2 = HCl + Cl,$$

and that this cycle was repeated over and over. Hence 1 quantum of light energy was able to cause a very great amount of combination. He showed that all these reactions proceeded with a free energy decrease and hence were possible reactions.

We are attempting to put this theory to a direct test. In our experiments atomic hydrogen, generated by Wood's method (Trans. Roy. Soc., 102-A, 1, 1922), is led into a mixture of hydrogen and chlorine, and if the theory is correct an excessively large amount of hydrogen chloride should be formed. To determine the amount of atomic hydrogen at the moment of reaction the same procedure is used substituting bromine for chlorine. It is known that the hydrogen bromine reaction does not give excessive yields of hydrogen bromide and Nernst has shown that the reaction

$$Br + H_2 = HBr + H$$

will not take place spontaneously. The hydrogen and chlorine are at a partial pressure of about 1 mm. each, and care is taken to prevent illumination of the gas mixture from the discharge tube. It has been shown so far that atomic hydrogen will travel a distance of 15 cm. from the discharge tube when the pressure is 1 mm. If chlorine be permitted to meet the hydrogen stream at this point direct combination takes place at room temperature; in one experiment the yield of hydrogen chloride was 10 per cent. of the hydrogen used. This amount would seem to exceed greatly that due to the atomic hydrogen present, although so far no direct determination has been made of this quantity.

A. L. MARSHALL.
H. S. TAYLOR.
Princeton University, Princeton, New Jersey,
November 7.

Remarkable Ascending Currents at Melbourne.

REMARKABLE ascending currents were observed during a pilot balloon ascent at Melbourne at 11.00 hours on Friday, October 26, 1923. Heights were determined by means of range-finder readings, and should have no error of consequence. The following table gives the results of the ascent:

Time.		Normal Height.	Observed Height.	Wind.	
				Direction.	Velocity.
min.	sec.	m.	m.	°	m./sec.
	45	90		335	6·8
1	30	180	176	332	10·6
2	15	270	351	325	11·3
3	00	360	801	323	10·9
3	45	450	1202	282	8·3
5	15	630	1580	272	8·8

At the first reading the balloon was too near to be observed with the range-finder. The rate of ascent should have been 100 metres in 45 seconds according to J. S. Dines's formula, but for the particular type of balloon used, range-finder observations indicate that the actual rate is about 90 metres. Shortly after the fifth observation the balloon entered thin cloud, but could be seen for some time longer.

Between the second and last reading the air in which the balloon was travelling ascended at the rate of 4 metres per second, while between the third and fourth the ascending velocity was 8 metres per second. On a number of occasions when cumulus cloud was forming, ascending rates of 2 metres per second over considerable ranges have been observed at Melbourne, but nothing approaching the velocities shown above had been encountered previously. It will be noted that the upward current was at times such that no raindrop could descend through it. A remarkable feature was that the cumulus cloud which was forming rapidly at the time was doing so, not in isolated masses, but in an almost continuous sheet. No cumulo-nimbus was present. Above the cumulus layer alto-cumulus was moving from 252°.

As regards the general situation, an anticyclone was passing to the northwards, moving rapidly. During its passage across the continent the anti-cyclone had decreased in intensity. Melbourne was coming under the influence of the succeeding low-pressure trough. The recent weather had been characterised by these fast-moving anticyclones, the intervening depressions being very poorly developed. This weather is one of the pronounced drought types.

EDWARD KIDSON.
Meteorological Bureau,
Melbourne,
October 29.

Long Range α-Particles.

IN a letter to NATURE of September 22, p. 435, we stated that, in addition to the α-rays of range 6·97 cm., radium active deposit emits particles of ranges 9·3, 11·2, and 13·3 cm. respectively. It has since been found that, in addition to the α-rays of ranges 4·8 and 8·6 cm., thorium active deposit emits particles of ranges 11·5 (previously recorded by Rutherford), 15·0 and 18·4 cm. respectively, and that the emission of every 10^6 α-rays of range 8·6 cm. is accompanied by the emission of 220, 47, and 55 particles of the above ranges. In the case of actinium active deposit evidence of particles of range greater than 6·5 cm. was found, but the sources available were not sufficiently intense to allow their range to be determined with accuracy.

By a method devised by Sir Ernest Rutherford we have satisfied ourselves that the long range particles from radium active deposit are α-rays.

Polonium has also been examined and found to emit small numbers of particles of ranges 6·1±0·1, 10·0±0·1 and 13·1±0·2 cm. respectively, in addition to the main group of α-rays of range 3·93 cm. The relative numbers in these new groups are at present being determined; from the brightness of the scintillations it is considered that they are α-rays.

L. F. BATES.
J. STANLEY ROGERS.
Cavendish Laboratory, Cambridge,
December 15.

Continental Drift and the Stressing of Africa.

IN reply to Dr. Evans's letter under the above title in NATURE of September 22, p. 438, may I say that I too shall be surprised, indeed extremely surprised, if further work in Uganda does not "disclose the existence of at least some normal faulting with a north and south strike, showing the former existence of east and west tension." Compression in one area seems to imply tension in another; and it is not very

probable that Africa has always been on one side of the equation. But one would expect that, had the continent been "predominantly in a state of tension," evidence of the fact would not be difficult to find in Uganda.

True, there is no reason why "a change of conditions may not convert a true rift valley formed in a period of tension into one bounded by reversed faults." But it may also be observed that it is certain that tension operating on a rift formed by a thrust action would accentuate the features, provided that the bottom of the valley was not prevented by subterranean support from sinking. Compression would do the same without the last proviso; while some such factor as cooling at depth would achieve a similar result without the assistance of either tension or compression if the faults were reversed.

There can be no shadow of a doubt that the bottoms of the Uganda rift valleys have sunk, and that, too, very considerably. What has happened beyond this it is impossible for any living soul to say with absolute certainty at present; but no theory of the rift will pass muster if it leaves Ruwenzori hanging in the air, and if it fails to explain why planes of weakness to tension have not been utilised.

Assuming a rift-block (by which I mean the mass between the rift features) bounded by reversed faults to sink, something must happen to the valley sides; either one or both will subside as a whole, or great lines of normal faulting will appear in the country on one or both sides; or these two things may happen in combination. The first of these alternatives appears, almost to the entire exclusion of the second, by Lake Albert, in Bunyoro; the second, largely to the exclusion of the first, is seen along the eastern side of Lake George. Moreover, normal faulting may appear in the rift-block itself. But all these things may equally be consequent upon settlement of a rift-block bounded by normal faults. Thus it is easily seen that step faulting is not admissible as evidence as to the nature of the fractures that initiated the rift. The solution of the Great Rift Valley problem must be sought, in fact, in places like Bunyoro, where step faulting is almost completely absent.

Dr. Evans, who combines Wegener's general proposition with a tentative theory of the moon's birth, would expect (subject to the truth of the latter) "The chief period of tension in Africa and its surroundings to have existed in Mesozoic and early Kainozoic times"; but this is precisely when, so Prof. J. W. Gregory argues (and I agree with him), Africa was being hunched up by compression.

As to the date of the moon's birth, or the manner of it, I am not qualified to speak with any authority; but I should have thought that had it taken place as late as the Carboniferous period, the parting at least would have been catastrophic. Also I am tempted to ask (not controversially, but as one seeking information) why if "the bulk of the atmosphere" was "attracted towards the protruding mass of the moon," our satellite has now no atmosphere worth mentioning. Did the moon escape without air or water; or may it not be that it once possessed both, self-elaborated very long ago, as those of the earth, in an early stage of its individual career? May not the absence of atmosphere be indicative of completion in the life of a celestial body of a stage the span of which is a function of the sphere's mass?

I fear that I have somehow created the impression that all the major faulting in this part of the world is more or less north and south. This is not so. In Bunyoro certainly, and one has reason to believe elsewhere, a series of very large east to west faults is traceable. This is clearly brought out in a structure map of part of Bunyoro prepared by Mr. W. C. Simmons a few years ago. Judging by the manner in which they cut off the north to south fractures, the east to west faults are the younger; though both are very ancient.

I believe that the word "rift" was originally applied to the Great East African fracture trough, which is quite a different thing from an ocean-covered area produced by the drifting of continents. Rift valley faults will still remain rift valley faults, whether they turn out to be normal or reversed; otherwise "rift valley" must disappear from our nomenclature should my hypothesis prove true.

I thoroughly agree with Dr. Evans's remarks with regard to the value of speculative hypothesis; and, as he reminds us, "It will only be when we have all the facts before us, that we shall be able to solve with any assurance the problems presented by the present configuration of the surface of the globe."

E. J. WAYLAND.

Mahyuro, Lake George, Uganda,
November 3.

Mrs. Hertha Ayrton.

IN NATURE of December 1 there appears under the above heading an obituary notice of the late Mrs. Ayrton which, I regret to say, is in some matters incorrect and misleading. The article is an unusual one, for in it the writer ventilates his own grievances against his so-called "masters" (The City and Guilds Institute), and disparages and belittles the work and abilities of his lifelong colleagues. To write in this strain about dead friends is in my opinion reprehensible, and it is to be hoped the example will not be followed.

From reading Prof. Armstrong's article one would gather that Mrs. Ayrton had little originality, and that all the scientific work she did was due to her husband's lead. Neither inference would be true, as is proved by the inventions she made before she met Prof. Ayrton and the original work she carried out after his death. In connexion with the latter, Mrs. Ayrton took out eight patents between 1913 and 1918.

The late Prof. Ayrton told me on several occasions that when Mrs. Ayrton took up the study of the electric arc he left the subject entirely alone so that there should be no excuse for any one giving him the credit for her work, and when lecturing to his students on the arc he made similar statements, as many of his pupils can doubtless confirm; it is indeed very probable that Prof. Armstrong heard analogous remarks from Prof. Ayrton's own lips. T. MATHER.

37 Wyatt Park Rd.,
Streatham Hill, S.W.2,
December 10.

A Waltzing Mouse.

IT may perhaps be of interest to record that, in some recent experiments in crossing mice, there appeared in a litter of seven (self-coloured champagne) a female which exhibited all the symptoms associated with the Japanese waltzing mouse of which Yerkes made a fairly exhaustive study. It is dextro-rotatory, if the term be permitted. It is not yet old enough for reproduction. Both parents have, however, since produced litters, the female to a Dutch-marked male, the male on a Dutch-marked female, five and four respectively, but all are normal, nor out of eighty mice recently born to other couples have I had any other that waltzes.

G. W. HARRIS.

The Royal Automobile Club, London, S.W.1,
November 25.

Egypt as a Field for Anthropological Research.[1]

By Prof. P. E. NEWBERRY, M.A., O.B.E.

IT has often been stated that civilisation in Egypt spread from the south, and considerable stress has been laid upon the fact that many pre-dynastic and early dynastic remains have been found in Upper Egypt in the region between Edfu and Thinis, especially at Hierakonpolis and Naqada, and north of Naqada, in the neighbourhood of Abydos. Opposite Edfu is a desert route leading to the Red Sea; at Kûft, opposite Naqada, is the beginning of the road leading to Kosêr, the port on the Red Sea. It has been thought that the people who brought culture to Egypt reached the Nile Valley by one or by both these routes from a "God's Land" situated somewhere down the Red Sea coast. But throughout the whole history of Egypt, culture has always come from the north, and spread southwards.

From a study of the monuments of the First Dynasty that had been found at Abydos and elsewhere in Upper Egypt I ventured, nearly twenty years ago, to suggest the existence in pre-dynastic times of a Delta civilisation which, in culture, was far advanced beyond that of Upper Egypt, and I pointed out that it was probably to a Delta civilisation that the Dynastic Egyptians owed their system of writing. I was led to this conclusion by the following facts. Although many pre-dynastic cemeteries had been thoroughly explored in Upper Egypt, no grave had yielded a single fragment of hieroglyphic writing. The only inference that can be drawn from this is that hieroglyphic writing was unknown, or at all events unpractised, by the inhabitants of Upper Egypt before Dynastic times. On the other hand, the discoveries at Naqada, Hierakonpolis, and Abydos had shown us that all the essential features of the Egyptian system of writing were fully developed at the beginning of the First Dynasty. Hieroglyphic signs were already in full use as simple phonograms, and their employment as phonetic complements was well established. Determinative signs are found beginning to appear in these early writings, but, as Erman and Griffith have noticed, even as late as the Fifth Dynasty their use was very restricted in the monumental inscriptions, although they were common in the cursive and freely written texts of the pyramids. At the very beginning of the First Dynasty the numerical system was complete up to millions, and the Egyptians had already worked out a solar year of 365 days. This was indeed a remarkable achievement.

These facts are of great significance, for it is clear that the hieroglyphic system of writing, as we find it at the beginning of the First Dynasty, must have been the growth of many antecedent ages, and yet no trace of the early stages of its evolution have been found on Upper Egyptian soil. There is no clear evidence, however, that the system was borrowed from any country outside Egypt; the fauna and flora of its characters give it every appearance of being indigenous. It is apparent, therefore, that we must seek the cradle of the Egyptian system of hieroglyphic writing elsewhere than in Upper Egypt, and as the fauna and flora of its characters are distinctly Egyptian, the presumption is that it must be located in the Delta. An important indication as to the original home of Egyptian writing is given by the signs which, in historic times, were used to designate the points of the compass. The sign for "east" was a drop-shaped ingot of metal upon a sacred perch, and this was the cult-object of a clan living in pre-dynastic times in the Eastern Delta. The sign for "west" was an ostrich feather placed in a semicircular stand, and this was the cult-object of the people of the Western Delta. The sign for "south" was a scirpus-reed; this was the cult-object of a clan which dwelt on the east bank of the Nile a little above the modern village of Sharona in Middle Egypt. The country south of the apex of the Delta was known as Ta Shema, "Reed Land." It must, therefore, have been at some point north of the apex of the Delta that the scirpus-reed was first used to designate the south. It must also have been somewhere in the Central Delta that the cult-objects of the peoples of the Eastern and Western Delta were first used to designate east and west.

For the Delta being the early home of writing another fact has to be taken into consideration. Thoth, the Ibis-god, was to the Egyptians the god of writing, and it was to him that they attributed its invention. The principal seat of his worship in historic times was Hermopolis, in Middle Egypt. But Thoth's original habitat was situated in the north-east corner of the Delta, where, in pre-dynastic times, had resided an Ibis clan. The tradition that named Thoth as the god and inventor of writing would, therefore, point Delta-wards. This tradition is significant also in another way. Although we cannot doubt that the Egyptian system of writing was evolved in the Delta, the germs of writing may have come into Egypt from Western Asia *via* this north-east corner of the country. In this connexion it may be pointed out that the hieroglyphic signs for "right" and "left" were the same as those for "west" and "east"; the Egyptians who evolved the hieroglyphic system of writing orientated themselves facing south.

It is remarkable that so little is known about the early history of the Delta. Few excavations have been carried out there, and nothing of pre-dynastic, or early dynastic, times has, so far, been brought to light from the country north of Cairo. We do know, however, that before the arrival of the Falcon-kings from Hierakonpolis in the south, Middle and Lower Egypt had been, probably for many centuries, united under one sceptre, and that before these two parts of the country were united there had been a Delta Kingdom which had had its capital at Sais. The names of some of these early kings are preserved on the Palermo fragment of the famous Annals Tablet, and the list there given would alone be enough to prove how ancient the Delta civilisation must have been. There was certainly nothing comparable with it in Upper Egypt in those far-off days.

What were the physical conditions prevailing in the Delta and in the regions to the east and west of it immediately preceding the arrival of Menes in Lower Egypt? For the eastern side the evidence is exceedingly scanty, but there is one fact which is significant.

[1] From the Presidential Address delivered to Section H (Anthropology) of the British Association at Liverpool on September 17.

The chief god of the eastern nomes of the Delta in the Pyramid Age was Anzety, a pastoral deity who was the prototype of Osiris. He is represented as a man holding in one hand the shepherd's crook, and in the other the goatherd's ladanisterion. There can be little doubt, therefore, that in the Eastern Delta there lived a pastoral people who possessed flocks of sheep and goats, and this is evidence of a certain amount of grass-land. In the Central Delta at the same period there lived a series of clans, among which a Bull Clan was predominant. In historic times in Egypt the ox is often figured roaming in papyrus and reed marshes, and it may be that the Central Delta marshes supported herds of domesticated cattle.

Much more is known about the western side of the Delta at the time of Menes. It formed, I believe, part of what was called Tehenu-land; at all events this name was given to the region immediately to the west of the Canopic branch of the Nile. There can be no doubt that this part of the country was a very fertile and prosperous region in the period immediately preceding the First Dynasty. Its name signifies "Olive-land," and we actually see these trees figured, with the name of the country beside them, on a pre-dynastic Slate Palette; on this Palette, above the trees, are shown oxen, asses, and sheep of the type later known as ser-sheep. It was Menes, the Falcon-king of Upper Egypt, who conquered the people of Tehenu-land. This conquest is recorded on a small ivory cylinder that was found at Hierakonpolis. Another record of the southerner's triumph over these people is preserved on his famous Slate Palette; here the Upper Egyptian king is depicted smiting their chieftain, while on the verso of the same Palette is the scene of a festival at the Great Port, which was perhaps situated near the Canopic branch of the Nile. The mace-head of Menes, which is now in the Ashmolean Museum at Oxford, has a scene carved upon it which shows the king assuming the Red Crown of Sais, and the inscription accompanying it records that he had captured 120,000 prisoners, 400,000 oxen, and 1,422,000 goats. This immense number of oxen and goats is clear evidence that the north-western Delta and the region to the west of it (Tehenu-land) must have included within its boundaries very extensive grass-lands.

The history of this part of the Delta is most obscure. During the period that elapsed from the end of the Third Dynasty to the beginning of the Twenty-third, when Tefnakht appears upon the scene, we have scarcely any information about it. What was happening at Sais and other great cities in the north-west of Egypt during the period from 2900 to 720 B.C.? There is an extraordinary lacuna in our knowledge of this part of the country. The people living there were certainly of Libyan descent, for even so late as the time of Herodotus the inhabitants deemed themselves Libyans, not Egyptians; and the Greek historian says that they did not even speak the Egyptian language. The pre-dynastic people who inhabited the greater part of the Lower Nile Valley were apparently of the same stock as these Libyans. There is a certain class of decorated pottery which has been found in pre-dynastic graves from Gizeh in the north to Kostamneh in the south. On this decorated pottery are figured boats with cult-objects raised on poles. Altogether some 170 vases of this type are known, and on them are 300 figures of boats with cult-signs. Of these, 124 give the "Harpoon" ensign; 78 the "Mountain" ensign; and 20 the "Crossed Arrows" ensign. These cult-objects all survived into historic times; the "Harpoon" was the cult-object of the people of the Mareotis Lake region; the "Mountain" and "Crossed Arrows" were the cult-objects of the people dwelling on the right bank of the Canopic branch of the Nile. Thus it will be seen that out of 300 boats figured on vases found in graves in the Lower Nile Valley south of Cairo, 222 belong to cults which can be located in the north-western corner of the Delta. At the beginning of the historic period the cult-objects of the people of the north-western Delta included (1) the "Harpoon," (2) the figure-of-eight "Shield with Crossed Arrows," (3) the "Mountain," and probably (4) the "Double Axe," and (5) a "Dove" or "Swallow." With the exception of the "Harpoon" all these cult-objects are also found in Crete, a fact which is significant in view of Sir Arthur Evans's remark to the effect that he considers the possibility of some actual immigration into Crete of the older Egyptian element due to the first Pharaohs. The "Harpoon," it should be noted, is the prototype of the bident, and later, of the trident of the Libyan god Poseidon. Here in this western side of Lower Egypt is an almost wholly unexplored field for the anthropologist.

I have already referred to the pastoral deity Anzety, who, in the Pyramid Age, was chief of the nomes of the Eastern Delta. Among all the nome-gods he is the only one that is figured in human form; he stands erect holding in his right hand the shepherd's crook, and in his left the goatherd's ladanisterion. On his head is a bi-cornate object that is connected with goats. In the Pyramid Texts, Anzety is entitled "Head of the Eastern nomes," and these included the ancient one of the Oxyrrhynchus-fish, where, later, the ram or goat was the chief cult-animal. Neither the domesticated sheep nor the goat can be reckoned as Egyptian in origin; they both came into Egypt from Western Asia. We have, therefore, in this pastoral deity Anzety evidence of immigration from the west.

Among the cult-objects of the cities over which the god Anzety presided were two which, I believe, can definitely be referred to trees that were not indigenous to the soil of Egypt but to Syria. One of these cult-objects is the so-called Ded-column. This was one of the holiest symbols of the Egyptian religion. It has four cross-bars at the top like superposed capitals. Sometimes a pair of human eyes are shown upon it, and the pillar is draped: sometimes a human form is given to it by carving a grotesque face on it, robing the lower part, crowning the top with ram's horns, and adding two arms, the hands holding the crook and ladanisterion. Frazer has suggested that this object might very well be a conventional representation of a tree stripped of its leaves. That it was, in fact, a lopped tree is, I believe, certain. In the Pyramid Texts it is said of Osiris, "Thou receivest thy two oars, the one of juniper (*uan*), the other of *sd*-wood, and thou ferriest over the Great Green Sea." The determinative sign of the word *sd* is a tree of precisely the same form as the Ded-column that is figured on early Egyptian monuments, *i.e.* it has a long, thin stem.

This tree-name only occurs in inscriptions of the Pyramid Age, and it is mentioned as a wood that was used for making chairs and various other articles of furniture. In the passage quoted from the Pyramid Texts it is mentioned together with juniper, and the latter was employed in cabinet-making, etc., at all periods of Egyptian history. There is no evidence that juniper ever grew in Egypt, but we have numerous records of the wood being imported from the Lebanon region. The *sd*-tree, as we see from the determinative-sign of the name, had horizontally spreading branches, and was evidently some species of conifer. No conifers, however, are known from Egypt; the *sd*-wood must, therefore, have been of foreign importation. As it is mentioned with juniper, which we know came to Egypt from Syria, it is possible that it came from the same region. Among the trees of the Lebanon there are four that have horizontally spreading branches. These are the cedar (*Cedrus libani*), the Cilician fir, *Pinus laricio*, and the horizontal-branched cypress (*Cupressus sempervirens* var. *horizontales*).

Much misconception at present exists with regard to the Lebanon Cedar, because the name "cedar" is applied to a large number of woods which are quite distinct from it, and the wood which we generally call cedar (*e.g.* the cedar of our "cedar" pencils) is not true cedar at all, but Virginian juniper. The wood of *Cedrus libani* is light and spongy, of a reddish-white colour, very apt to shrink and warp badly, by no means durable, and in no sense is it valuable. Sir Joseph Hooker, who visited the Lebanon in 1860, notes that the lower slopes of that mountain region bordering the sea were covered with magnificent forests of pine, juniper, and cypress, "so that there was little inducement for the timber hewers of ancient times to ascend 6000 feet through twenty miles of a rocky mountain valley to obtain cedar wood which had no particular quality to recommend it. The cypress, pine, and tall, fragrant juniper of the Lebanon, with its fine red heart-wood, would have been far more prized on every account than the cedar." The *sd*-tree was, I believe, the horizontal-branched cypress, which is common in the wild state. In the Middle Ages this tree was believed to be the male tree, while the tapering conical-shaped cypress was considered to be the female. This is an interesting fact, because there is some evidence to show that the tapering variety was the symbol of Hathor-Isis, while the horizontal-branched one was the symbol of Osiris.

Not far from the city of Osiris in the Delta was Hebyt, the modern Behbeyt el Hagar. Its sacred name was Neter. The Romans called it Iseum. It was the ancient seat of Isis-worship in Egypt, and the ruins of its temple to that goddess still cover several acres of ground in the neighbourhood. On the analogy of other sacred names of cities the primitive cult-object here was the *ntr*-pole. This was not an axe, as has so often been supposed, but a pole that was wrapped around with a band of coloured cloth, tied with cord half-way up the stem, with the upper part of the band projecting as a flap at top. Dr. Griffith conjectured that it was a fetish, *e.g.* a bone carefully wound round with cloth, but he noted that "this idea is not as yet supported by any ascertained facts." As a hieroglyph this wrapped-up pole expresses *ntr*, "god," "divine," in which sense it is very common from the earliest times; gradually it became determinative of divinity and of the divine names and ideographic of divinity. Another common ideograph of "god" in the Old Kingdom was the Falcon (Horus) upon a perch, and this sign was also employed as a determinative of divinity and of the names of individual gods; it even sometimes occurs as a determinative sign of the *ntr*-pole, *e.g.* Pyr. Texts, 482. This use of the Falcon indicates that in the early dynasties the influence of the Upper Egyptian Falcon-god (Horus) was paramount.

There is reason, however, for believing that the *ntr*-pole cult had at an earlier period been the predominant one among the writing people of the Delta; this, I think, is shown by the invariable use of the *ntr*-pole sign in the words for priest (*hm-ntr*, god's servant) and temple (*ht-ntr*, god's house). Now, on a label of King Aha of the First Dynasty there is a representation of the temple of Neith of Sais. Here two poles with triangular flags at top are shown on either side of the entrance. Later figures of the same temple show these poles with the rectangular flags precisely as we find in the *ntr*-sign. A figure of the temple of Hershef on the Palermo Stone shows two poles with triangular flags, while a Fourth Dynasty drawing of the same temple shows the same poles with rectangular flags. We see, therefore, that the triangular-flagged pole equals the rectangular-flagged one, and that the *ntr* is really a pole or mast with flag.

Poles of this kind were probably planted before the entrances to most early Egyptian temples, and the great flag-masts set up before the pylons of the great temples of the Eighteenth and later dynasties are obviously survivals of the earlier poles. The height and straightness of these poles prove that they cannot have been produced from any native Egyptian tree; in the Empire, flag-staves were regularly imported from Syria; it is probable, therefore, that in the earlier times they were introduced from the same source. A well-known name for Syria and the east coast of the Red Sea, as well as of Punt, was Ta-ntr, "the land of the *ntr*-pole." This was the region in which the primitive Semitic goddess Astarte was worshipped. In Canaan there was a goddess Ashera whose idol or symbol was the ashera pole. The names of Baal and Ashera are sometimes coupled precisely as those of Baal and Astarte, and many scholars have inferred that Ashera was only another name of the great Semitic goddess Astarte. The ashera-pole was an object of worship, for the prophets put it on the same line with the sacred symbols, such as Baal pillars; the ashera was, therefore, a sacred symbol, the seat of a deity, the mark of a divine presence. In late times these asherîm did not exclusively belong to any one deity; they were erected to Baal as well as to Yahw. They were sign-posts set up to mark sacred places, and they were, moreover, draped. They correspond exactly to the *ntr*-poles of Egyptian historic times.

I have noted that these *ntr*-poles were tall and straight. What tree produced them? In Egyptian inscriptions there is often mentioned a tree named *tr.t.* It was occasionally planted in ancient Egyptian gardens, and specimens of it were to be seen in the Temple garden at Heliopolis. The seeds and sawdust were employed in medicine, and its resin was one of

the ingredients of the Kyphi-incense. Chaplets were made of its twigs and leaves. The tree was sacred to Hathor; branches of it were offered by the Egyptian kings to that goddess. In a Saite text it is mentioned with three other trees, pine, yew, and juniper; these are all found in Northern Syria, where they grow together with the cypress; the *tr.t* tree may therefore be the cypress. Evidence has been brought forward to show that the *sd*-tree is the horizontal-branched cypress, which was believed to be a male tree, while the tapering, flame-shaped cypress was believed to be the female tree. The Ded-column was the symbol of Osiris, and at Busiris a festival of raising this column was celebrated. The *tr.t* tree was sacred to Hathor, who is often identified with Isis, and there was a festival of raising the *tr.t* tree that was celebrated on the nineteenth day of the first month of the winter season. It is not known where this festival was celebrated, but it may well have been at Neter, the seat of the Isis cult near Dedu-Busiris. The two tree-cults point to Northern Syria as the country of their origin.

In the architecture of ancient Egypt two distinct styles can be recognised. One is founded on wattle-and-daub, the other on wood construction. Wattle-and-daub is the natural building material of the Nile Valley and Delta, and the architectural forms derived from it are certainly indigenous. Those styles derived from wood construction, on the other hand, could not have originated in Egypt; they must have arisen in a country where the necessary timber was ready at hand. Egypt produces no coniferous trees and no timber that is at all suitable for building purposes, or indeed for carpenter's work of any description. The wood of the sycomore-fig is very coarse-grained, and no straight planks can be cut from it. The sûnt-acacia is so hard that it requires to be sawn while it is green; it is very irregular in texture, and on account of the numerous branches of the trunk it is impossible to cut it into boards more than a couple of feet in length. The palaces of the early kings of the Delta were built of coniferous wood hung with tapestry-woven mats. The tomb of Menes' queen, Neith-hotep, at Naqada, was built of brick in imitation of one of these timber-constructed palaces, and smaller tombs of the same kind are known from the Second and Third Dynasties, but not later. As early as the reign of King Den (First Dynasty) the palaces of this type were beginning to be built of the native wattle-and-daub in combination with wood, and by the end of the Pyramid Age the style disappears entirely, though the memory of it was preserved in the false-doors of the tombs and stelæ. Brick buildings similar to those of the "palace" style of Egypt are also known from early Babylonia, and they were at one time regarded as peculiarly characteristic of Sumerian architecture. These, obviously, must have been copied, like the Egyptian, from earlier timber forms. In Babylonia, as in Egypt, timber was scarce, and there are records that it was sometimes obtained from the coast of Syria. This was the region from which the Egyptians throughout historic times obtained their main supplies of wood, so it is not improbable that they, as well as the Sumerians, derived this particular style of architecture from Northern Syria. I may observe in passing that in this "palace" style we have the transition form between the nomad's tent and the permanent building of a settled people.

The lack of native timber in Egypt is significant in another direction. Boats of considerable size are figured on many pre-dynastic monuments. They are long and narrow, and in the middle there is usually figured a reed or wicker-work cabin. In my view these boats were built, like many of those of later periods in Egypt, of bundles of papyrus reeds bound together with cord; they were, in fact, great canoes, and, of course, were only for river traffic. They were not sailing boats, but were propelled by means of oars. No mast is ever figured with them, but they generally have a short pole amidships which is surmounted by a cult-object. On one pre-dynastic vase there is a figure of a sailing ship, but this is totally different in build from the canoes, and it has a very high bow and stern with its mast set far forward in the hull. Similar vessels are figured on the ivory knife-handle of pre-dynastic date from Gebel el Araq, but these vessels appear to be in port and the sails are evidently lowered.

I have already referred to the Great Port mentioned on the Palette of Menes. A port implies shipping and trade relations with people dwelling along the coast or across the sea. It may be that the people of the north-western Delta built wooden ships, but if they did they must have procured their timber from some foreign source. Coniferous wood was already being imported into the Nile Valley at the beginning of the First Dynasty from the Lebanon region, and it must be remembered that the Egyptian name for a sea-going ship was *kbnyt*, from Keben, "Byblos," the port of the Lebanon, where these ships must have been built and from whence they sailed. The sacred barks of the principal gods of Egypt in historic times were invariably built of coniferous wood from the Lebanon. Transport ships on the Nile were sometimes built of the native sûnt-wood, and Herodotus describes them as made of planks about two cubits long which were put together "brick-fashion." No masts or sail-yards, however, could possibly be cut from any native Egyptian tree. In the Sûdan at the present day masts are sometimes made by splicing together a number of small pieces of sûnt and binding them with ox-hide, but such masts are extremely liable to start in any gale, and they would be useless for sea-going ships. It may be doubted whether the art of building sea-going ships originated in Egypt.

It may be doubted also whether the custom of burying the dead in wooden coffins originated in Egypt. In countries where a tree is a rarity a plank for a coffin is generally unknown. In the Admonitions of an Egyptian Sage written some time before 2000 B.C., at a period when there was internal strife in Egypt, the Sage laments that "Men do not sail northwards to [Byb]-los to-day. What shall we do for coniferous trees for our mummies, with the produce of which priests are buried, and with the oil of which [chiefs] are embalmed as far as Keftiu? They come no more." This ancient Sage raises another anthropological question when he refers to the oil used for embalming. The only oils produced by native trees or shrubs in Egypt were olive oil, ben oil from the moringa, and castor oil from the castor-oil plant. The resins and oils used for embalming were principally

those derived from pines and other coniferous trees. Egypt produced no kinds of incense trees or shrubs. The common incenses were pine resin, ladanum, and myrrh, and all these were imported. It is difficult to believe that the ceremonial use of incense arose in Egypt.

These are a few of the questions raised by a study of the material relating to the origins of the ancient civilisation of Egypt. An immense vista has been opened out before our eyes by the discoveries of the last thirty years, and now, in Egypt better than in any other country in the world, we can see man passing from the primitive hunter to the pastoral nomad, from the pastoral nomad to the agriculturist, and then on to the civilised life which begins with the art of writing. We can see in the Delta and in the Lower Nile Valley tribes becoming permanently settled in fixed abodes around primitive cult-centres, and then uniting with others into one community. We can trace the fusion of several communities into single States, and then, later, the uniting of States under a supreme sovereign. What other country in the world preserves such a record of its early history?

Rare Gas Discharge Lamps.

By J. W. RYDE, Research Laboratories of the General Electric Company, Ltd., Wembley.

A DISCHARGE of electricity through a gas at atmospheric pressure generally takes the form of a luminous spark which will pass only under a potential gradient of several thousand volts per centimetre. If, however, the pressure of the gas is reduced, the appearance of the discharge changes. First it spreads out into wavy streamers; the streamers then broaden until the discharge tube is filled with a diffuse luminous glow extending from the positive electrode to within a short distance of the cathode. This glow is known as the positive column. The cathode is now covered with a layer of bright luminosity called the negative glow, and on close inspection is seen to be not quite in contact with the electrode but separated from it by a thin and sharply defined region, known as the Crookes's dark space. Another less well-defined dark region, the Faraday dark space, is between the negative glow and the positive column. Further reduction of the pressure results in a widening of both dark spaces and the negative glow, the positive column at the same time becoming correspondingly shorter. At still lower pressures the Crookes's dark space increases until finally it fills the whole tube and there is no further luminosity of the gas.

The potential necessary to start the discharge depends on the pressure and nature of the gas, the form and material of which the electrodes are made, and also on the distance between them. In a given gas with given electrodes the starting potential is large at high pressures, but decreases, in an almost linear relation, with decrease of pressure, reaching a minimum at what is called the critical pressure, after which it rises again very rapidly. The pressure at which the minimum occurs depends on the form of the electrodes, their distance apart and the nature of the gas, but the minimum itself depends on the nature of the gas and the material and form of the cathode employed. It is about 200 volts for neon, 280 volts for hydrogen, 340 volts for air, and 420 volts for carbon dioxide. Small traces of impurity affect these values to a great extent; thus, the addition of only 0·5 per cent of pure hydrogen to neon reduces the minimum starting potential by nearly 50 volts, 5·0 per cent reduces it by about 60 volts, but if more than 5·0 per cent is added the hydrogen ceases to act as an impurity and begins to show its own characteristics, so that the starting voltage rises again. On the other hand, small quantities of other gases, such as oxygen, raise the starting potential instead of lowering it. The material of which the cathode is made has also some effect. The figures given above refer to cathodes of ordinary metals such as iron, nickel, or copper, etc., between which there are only small differences, but with magnesium, barium, or the alkali metals the starting voltage is considerably reduced; in fact, with certain alloys of these metals, the glow discharge can be started in neon at a potential so low as 90 volts and may be maintained at 58 volts.

When once the discharge has started, the potential can be lowered somewhat before the discharge stops.

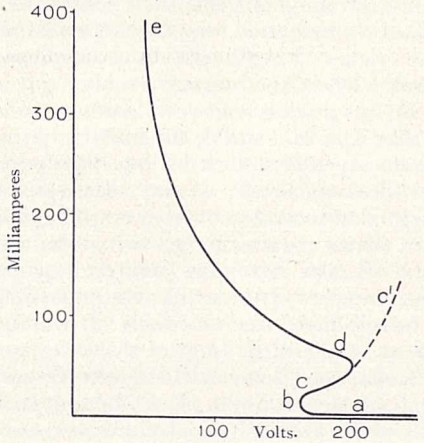


FIG. 1.

The curve connecting this "going out" voltage and the pressure is roughly similar to the starting voltage curve, but is displaced to a position somewhat below it on the voltage ordinate.

If the electrodes are only a short distance apart, so that the positive column is absent, the relation between the current flowing and the potential applied across the electrodes is that shown in Fig. 1. The states represented by the lower and upper parts of the curve are unstable, and can be observed only if there is in series with the discharge an appropriate resistance, by means of which the current may be varied. With this arrangement, when the current is only of the order of a micro-ampere, a faint glow is seen some distance from the cathode. The potential between the electrodes falls rapidly as the current is increased, and at the same time the glow becomes brighter and assumes the form of a sharply defined patch moving nearer and nearer to the cathode as the current rises. The voltage now remains sensibly constant, being that known as the normal cathode fall, which is the lowest potential at which

the unsupported discharge can be maintained. With a further increase of current, the glow spreads laterally over the cathode, its intrinsic brilliancy and the current density remaining practically constant. A value of the current is eventually reached at which the cathode becomes completely covered with a layer of glow separated from it by the Crookes's dark space, which is only a fraction of the width of the layer of glow itself. Any further increase in current brings us to the part *c* of the curve; the voltage now increases with increase of current and the glow becomes brighter and the dark space narrower. The curve eventually becomes very steep, following the path *cc'*, and currents of the order of several amperes per square centimetre of cathode surface can be passed. At some part of the curve *cc'* the cathode begins to heat up considerably, and if composed of a refractory metal such as tungsten, will become white-hot; thermionic emission then takes place and the glow discharge passes over to the arc discharge. As soon as this begins the potential difference between the electrodes begins to decrease as the current rises, and may finally drop to only a few volts.

Gas discharge lamps may be divided into three classes, namely: (1) Lamps in which practically all the light is emitted by the positive column, (2) negative glow lamps in which the positive column is absent, and (3) lamps in which the light is emitted not from the gas but from the cathode itself, which is rendered incandescent by the discharge.

Lamps of the Moore type belong to the first class. They consist of a long glass tube filled with gas to a pressure of a few millimetres and having an electrode at each end. On account of the distance between the electrodes, the operating potential usually amounts to several thousand volts and is inconveniently high. Recently, short tubes of this type containing neon, and having electrodes made of alkali metal alloys, have been developed which will run on 220 volt A.C. supply, but require a special device giving a higher voltage for starting. These lamps are very efficient; with some of the tubes an efficiency of 0·65 watts per candle is obtainable. The colour of the light, however, is a brilliant orange red, which for many purposes is objectionable.

The second class of lamp was developed to run directly on ordinary lighting circuits. The electrodes are placed a few millimetres apart in a small bulb, the distance between them being such that the positive column is absent; this is to enable them to start and run at ordinary supply voltages. The gas used for filling the lamps is neon with about 20 per cent. of helium, which is separated with it during the process of extraction from the air. The advantages of neon are threefold. In the first place, most of the energy radiated from the glowing gas lies in the visible spectrum; secondly, the starting potential is lower than in other gases; and thirdly, the colour of the light emitted, being a yellow orange, is more suitable for illumination purposes than that from any other gas. By using hydrogen to reduce the starting voltage as explained above, and by filling the lamps to about the critical pressure (10 mm.), it is possible to make lamps having iron electrodes in which the discharge will start at about 150 volts.

The whole of the light from these lamps comes from the negative glow, which appears as a layer of bright orange luminosity about two millimetres thick completely covering the cathode, whatever its size or shape. The Crookes's dark space at the pressure used is only a fraction of a millimetre thick and is not easily seen. In consequence, the luminosity takes the form of the cathode, so that if this electrode is formed out of a sheet of metal in the shape of a letter, numeral, or similar sign, it will appear brilliantly illuminated when the discharge is passing. It is in this form that the tube is used for advertising purposes. In cases where the lamp is required for dim illumination, the cathode is made of a spiral of wire in the shape of a beehive, which ensures an approximately even distribution of light in all directions. The other electrode is either an iron wire hidden behind the letter, or a plate inside the spiral. On direct current only one electrode becomes illuminated, but on alternating current the small electrode also glows during the half cycle when it becomes the cathode.

On account of the rigidity of the mechanical construction, the lamps are robust and their life is limited only by their progressive blackening. This blackening is due to particles of the cathode which are shot off during the passage of the discharge and collect in the form of a film on the bulb. The rate at which the blackening takes place depends on the current passing through the lamp, and also varies very greatly with the particular metal used for the electrodes and the nature of the gas. The addition of impurities which lower the starting potential of the gas also considerably reduces the blackening. Thus, with iron electrodes and pure neon, the useful life of the lamp would only be about 80 hours, while with an addition of a small percentage of hydrogen the life becomes of the order of 1000 hours or more. A series resistance placed in the caps of the lamps makes them suitable for various voltages, and at the same time reduces the current to a value leading to a reasonable life.

These lamps, in common with all forms of Geissler discharge tubes, possess many properties which are valuable for purposes other than that of lighting. For example, when running on the part *ab* of the curve of Fig. 1 they can act as a negative resistance and can be used to generate oscillations. They are also sensitive detectors of current; the luminosity produced by a current of one microampere is easily seen if the lamp is shielded from direct daylight. But these other developments cannot be treated here.

In the third class of lamp, the electrodes are usually tungsten spheres about one millimetre in diameter and placed one millimetre apart. The bulb is filled with neon to about 50 mm. pressure. When first switched on, an intense glow discharge takes place which heats the cathode white-hot; a thermionic emission then ensues and the potential across the lamp drops to about 25 volts, the current being 1·0 to 1·25 amperes, the remaining volts being dropped in the series resistance. The lamp at this final stage operates in the region *e* of the current voltage curve shown in Fig. 1. The white-hot tungsten ball acts as a very intense point source of light suitable for projection purposes. The Pointolite lamp is a variant of this form, in which the discharge is initiated by means of a tungsten spiral heated electrically, the heating current being cut off when the lamp has started.

Obituary.

LIEUT.-COL. H. H. GODWIN-AUSTEN, F.R.S.

THE death, on December 2, of Lieut.-Col. Henry Haversham Godwin-Austen in his ninetieth year removes the last of the great pioneers in the geography of the Himalaya and a leading authority on Indian Mollusca. Col. Godwin-Austen was born at Teignmouth, July 6, 1834. He was a fellow-student with Lord Roberts at Sandhurst, whence they both went to India at the end of 1851. Godwin-Austen saw service the next year in the second Burmese War. His scientific tastes, which were hereditary—for his father, R. A. C. Godwin-Austen, was a geologist who has left an enduring reputation owing to his exceptional insight—led him in 1857 to join the Indian Survey Department. It was his privilege to survey northern Kashmir, where he discovered the Baltoro, Hispar, and Biafra Glaciers—the greatest group of valley glaciers in the world. They were afterwards traversed and mapped by Sir Martin Conway, who named the tributary glacier to the Baltoro from K_2 the Godwin-Austen glacier. The glaciers were described by Godwin-Austen in a short paper in the Proceedings of the Royal Geographical Society (vol. viii., 1864), the discussion on which is remarkable for Falconer's advocacy of the pre-glacial age of the Alpine lake basins and their preservation by the protective action of glaciers. During this survey Godwin-Austen fixed the position and heights of many of the giant peaks of the Karakorums, including K_2, which had been previously discovered by Montgomerie. It is often known as Mt. Godwin-Austen, and according to the heights adopted by the Indian Survey Department is the second highest mountain in the world.

While Godwin-Austen was working in this district he made many mountain ascents, of which his highest was on Mata, 20,600 ft., in 1862. In 1863–64 he was engaged in the survey of the eastern parts of the Himalaya around Darjeeling and in Bhutan, and, later still, further east on the Khasia Hills and in Assam. His views on the geographical structure and classification of the Himalaya were stated forty years ago in his presidential address to the Geographical Section of the British Association, which is his most important geographical paper. He contributed to the Geological Society several papers which made important additions to the geology of the Himalaya, including the discovery of the extension into Kashmir of the Spiti series, the most significant horizon in the Himalaya. In 1884 he described the drifts exposed in a new railway cutting near his home at Guildford, and the paper was illustrated by sections, characterised by the same precision and detail as those issued with his Indian papers.

After leaving the Indian Survey, Godwin-Austen's main interest was in the land mollusca. He was described as having "a unique knowledge of Indian molluscs." He contributed to "The Fauna of British India" the volume on the Testacellidæ and Zonitidæ. The value of his work on that group is shown by his election as president of the Malacological Society in 1897–9, and of the Conchological Society in 1908–9. His later years were burdened by financial embarrassment due to an unfortunately worded will. He inherited the paternal estate of Shalford, which proved a vampire instead of the source of a comfortable income. His interest was subject to fixed charges which, when the value of land fell, used up more than the whole of the income from the property. He bore this trouble with his characteristic courage and cheerfulness. Great sympathy was also recently felt for him, owing to the unfortunate loss of the portofolio of sketches and maps made during his Kashmir service, sixty years ago.

Godwin-Austen was elected F.R.S. in 1880, and received a belated Founders' Medal from the Royal Geographical Society in 1910.

HERLUF WINGE.

IT is with much regret that we record the sudden death, on November 10, at Copenhagen, of Herluf Winge, who for many years, and until his death, was "Viceinspektor" in the Zoological Museum of the University of Copenhagen. As a lad Winge began to study the small mammals of Denmark, and his earliest papers upon this subject were full of promise. A little later, in 1877, while still a student in the University of Copenhagen, he published an account of some of the skull characters in the mole, shrew, and other Insectivora, in which he displayed not only remarkable learning but a most clever technique. In 1882 he gave his views upon the mammalian dentition and his theory of cusp homologies in a paper which will ever be regarded as a classic. In the same year appeared an account of a collection of mammals from Greece; and in preparing this Winge was led so far afield investigating the relationships and special adaptations of the species before him that he himself regarded this piece of work as the foundation of the important publications next to be noticed.

Between 1887 and 1915 Winge published a series of works which ostensibly are descriptions of the fossil bones collected by Lund in the caves of Lagoa Santa, Minas Geraes, Brazil, and of the recent mammalia obtained in the same region by Lund and Reinhardt. Taking these mammals order by order (Rodents, 1887; Chiroptera, 1892; Carnivora, Primates, 1895; Marsupials, including Monotremes, 1897; Ungulates, including Sirenia, 1906; Edentates, 1915), Winge commenced each memoir with a description of the Brazilian material; but, that finished, he proceeded in each case to give a review of the whole order, bringing out his views of the evolution and relationships of the orders and of every fossil and living family and genus in a wonderfully clear and concise style. He seems to have prepared a complete monograph of each genus dealt with; and then to have compressed each monograph into a short paragraph and very often into a single sentence. But in this small space he contrives not only to state all that is essential, but to throw many a brilliant beam across what was previously obscure. Companion reviews of the Insectivora (1917) and the Cetacea (1919), the two orders not represented in the Lagoa Santa material, have since been published by Winge. That dealing with the Cetacea has recently been translated from the Danish by Mr. G. S. Miller

and published in the Smithsonian Miscellaneous Collections.

A collected and revised edition of these reviews, in three volumes, under the title of "Pattedyr-Slægter," is at present passing through the press; and the first volume of this work was received in London on the day before Winge's death. This new and more convenient edition will be welcome, for it is but bare justice to state that the reviews in question constitute together the finest, most comprehensive, and most inspiring technical account of the class Mammalia that has ever been written.

Many other papers dealing with the mammals of Greenland and the fossil mammals and birds of Denmark were published by Winge. In 1908 he contributed the volume on Danish Mammals to the series of handbooks entitled "Danmarks Fauna"; and this little book, illustrated by Winge himself, is at once admirable and inimitable.

Reviewing the whole of Winge's published work, one cannot fail to be struck by an extraordinary fact. It is that in his writings one does not mark the flight of time. He seems to have acquired his full mental power and his own peculiar way of looking at things at an extremely early age; for his early papers of 1877 and 1882 read to-day, exactly like that of 1919, as the work of a great master. M. A. C. H.

WE regret to announce the following deaths:

Prof. F. Clowes, emeritus professor of chemistry and metallurgy and first principal of University College, Nottingham, and the author of well-known text-books on analytical chemistry, on December 18, aged seventy-five.

Canon T. Wood, well known for his natural history studies, on December 13, aged sixty-one.

Current Topics and Events.

TWO octogenarian fellows of the Royal Society celebrated their birthdays this week. Sir Archibald Geikie, O.M., the Nestor of British geology, who was elected to the Royal Society so long ago as 1865, attained the age of eighty-eight on December 28, and another distinguished geologist, Sir W. Boyd Dawkins, elected to the Society in 1867, was eighty-five on December 26. To both of them the congratulations of all scientific workers will be heartily accorded. Sir Archibald Geikie, who figured as a "Scientific Worthy" in NATURE thirty-one years ago (January 5, 1893), has a world-wide reputation. As a geologist, and as the author of the "Text-book of Geology," originally published in 1882, and of other standard works on geology and geography, he is known everywhere. This is in great measure due to the way in which Sir Archibald is able to quicken interest in his subject by the expression of his deep and intense feeling for Nature. No one has done more to link geology with appreciation of the natural beauty of scenery. His work as an original investigator in geology and as a writer of inspiring volumes on this subject and on physical geography won for him the Royal medal of the Royal Society in 1896. From 1908 until 1913 Sir Archibald served as president of the Royal Society, while he was president of the British Association at the Edinburgh meeting in 1892. For the period 1882–1901, he was Director-General of the Geological Survey of the United Kingdom and Director of the Museum of Practical Geology. In spite of his advanced age, Sir Archibald maintains his active interest in both science and literature, and so recently as 1918 he produced a notable volume of Memoirs of John Michell, who died in 1793, one of the early workers in geology.

SCIENTIFIC societies and other bodies organising conferences for next year should know that the authorities of the British Empire Exhibition to be held at Wembley have constructed an admirable congress building containing four conference halls, with appropriate committee rooms, etc., capable of seating 2140, 550, 180, and 150 persons respectively. These halls are being allocated to responsible organising committees free of charge, and early application should be made for the use of any of them, as the dates are being filled up rapidly. The following scientific and technical societies, among others, have already booked one or more of the halls for conferences on different dates: The British Engineers' Association, the British Electrical and Allied Manufacturers' Association, the Institution of Sanitary Engineers, the Textile Institute, the Society of Dyers and Colourists, the North-East Coast Institution of Engineers and Shipbuilders, the Institution of Automobile Engineers, the Museums Association, the Horace Plunkett Foundation, the Health Propaganda Association, the Association of British Chemical Manufacturers, the Institution of Mining and Metallurgy, the Municipal Electrical Association, the Electrical Contractors' Association, and the Gas Association. Applications for use of the halls on dates still open should be sent to the Secretary, Conference Committee, British Empire Exhibition, 16 Grosvenor Gardens, London, S.W.1.

WITH the approaching retirement of Prof. S. Alexander from its chair of philosophy, the University of Manchester loses the services of one of the most original of the elder generation of thinkers. Nearly fifty years ago, he came from Australia to Oxford, where he gained reputation by a rare power of winning first classes. He soon, however, deserted other pursuits for philosophy, and won an assured position before he was thirty by his remarkable book on "Moral Order and Progress." Called in 1893 from a tutorship at Lincoln College to succeed Robert Adamson at Manchester, he has represented philosophy there for more than thirty years. At Oxford he was conspicuous in the reaction against the philosophy of T. H. Green, and was among the first to preach to an unheeding university the importance of modern psychology. But he never lost a bent for metaphysics and for vigorous thinking about fundamentals. His philosophic position was fully revealed in his Gifford lectures at Glasgow on "Space, Time, and Deity," published in 1920. A book so technical defies

analysis, and it is enough to say that, though many disagreed with his doctrine, there was an absolute consensus among experts that it was a contribution of the first importance to philosophic thought. Yet few philosophers have lived less in the clouds, and Alexander has not only discharged meticulously the duties of an exacting chair, but has also been prominent in many university and public activities. Ever a keen champion of the higher education of women, he took a foremost part in the foundation of Ashburne Hall, the women's hall of residence, the secretaryship of which he is resigning on his retirement from university life.

THE first part of the funeral service for Canon T. G. Bonney was held in the Chapel of St. John's College, Cambridge, on December 12. Among those present were the following fellows of the Royal Society: Prof. A. C. Seward and Prof. J. E. Marr (Geological Society), Mr. C. T. Heycock (Cambridge Philosophical Society), Prof. E. J. Garwood (Alpine Club), Sir Clifford Allbutt, Prof. H. F. Baker, Mr. F. F. Blackman, Sir Joseph Larmor, Dr. G. D. Liveing, Sir Ernest Rutherford, Prof. W. T. Sollas, Sir Joseph Thomson, Prof. W. W. Watts, and Prof. J. T. Wilson.

THE Council of the Royal Meteorological Society has awarded the Symons gold medal for 1924 to Dr. Takematsu Okada, Director of the Central Meteorological Observatory, Tokyo, Japan. The medal is awarded for distinguished work in connexion with meteorological science, and will be presented at the annual general meeting on January 16.

THE discussion before the Illuminating Engineering Society on December 11 was concerned with a problem that confronts many of those who are associated with applied science—the best method of disseminating technical information amongst the general public. Illumination involves an appeal to the eye, and influence is best brought to bear through the medium of actual demonstrations of good and bad methods of lighting. Details of actual experience in practice, for example, of improved output and greater freedom from accidents resulting from better lighting, are also of great value. But in order to be convincing, such data must be derived from scientifically conducted tests and backed by recognised authority. Mr. Dow mentioned some of the work which the Society is doing in this connexion—for example, in co-operation with representatives of the printing trade and with the British Industrial Safety First Association. A considerable part of the discussion was devoted to the question of the high values of illumination now being advised in some quarters. The view was expressed that such recommendations must be based on scientific method, and that the desired conditions are best ascertained by experiments conducted with the aid of leading industrial councils. This same point also came up for consideration in a discussion initiated by Mr. W. P. Fanghaenel and Mr. W. N. Booth before the Institution of Civil Engineers on December 12, when Mr. L. Gaster explained the procedure of the Home Office Departmental Committee concerned with industrial lighting and emphasised the distinction between values desirable in practice and legal minima.

IN order that donors might have the opportunity of seeing the premises and the equipment of the Department of Glass Technology at the University of Sheffield, a series of luncheons have been arranged, the first having been given by Mr. W. F. J. Wood, chairman of the Glass Research Delegacy, on November 15, and the second of the series by Prof. W. E. S. Turner, president of the Society of Glass Technology, on December 13. The new premises, which cover three-fourths of an acre, were, until the end of 1920, in occupation as an actual glass works. Since being purchased at a price of 9000*l.*, considerable alterations have been made, a set of laboratories and small library constructed, whilst the other buildings have been adapted and equipped with plant for experimental glass melting. In this connexion there are furnaces capable of melting glass on any scale between a few grams and about 120 lb., the firing being by town's gas and compressed air, whilst a large two-pot recuperative furnace fired by oil has a capacity of two pots each of about 15 cwt. There are, in addition, a block of buildings devoted to the making of all sizes of clay pots, store rooms for the glass-making materials, a room for mixing, a machine room, smith's shop, compressor house, etc. Courses of instruction lead to the degree of B.Sc.Tech. and higher degrees. In addition, however, to the normal teaching work of the Department, a great deal of experimental work has been done for individual manufacturing firms, whilst since 1917 no fewer than 96 papers involving research have been published from the Department. The Department has no endowment, but the glass industry has been very appreciative of the work done and has contributed generously towards its maintenance.

MR. T. W. T. TUCKEY, who was in Japan at the time of the great earthquake, had an opportunity shortly afterwards of visiting both Tokyo and Yokohama, and gives the results of his observations in *Engineering* for November 30. The framework of the ordinary Japanese house is made of very light uprights secured, by tenons only, to other light horizontal members at the floor and ceiling. The floors and ceilings are wood, and the inside divisions are of wood and paper. When a severe shock causes the tenons to break, the structure closes up and pins down any occupants who do not escape quickly. The charcoal fires are also pinned and thus fires are started. It is almost inconceivable that up to August 31, 1923, such buildings were still being constructed in the capital city of Tokyo. Temples are also built of wood and have nothing but horizontal and vertical timbers in their construction; the timbers, however, are very massive, and such buildings stand up well against earthquakes and storms. In Tokyo, the first brick buildings of any importance were put up by the Government; nearly all these buildings survived the shock, though a few were burned. It will be remembered that the fires, started by the collapse of the more flimsy buildings, destroyed a large part of Tokyo. Tokyo station

building, three and four stories high and some hundreds of feet long, constructed of red brick, was not damaged by either earthquake or fire. Reinforced concrete buildings in Tokyo did not come off so well as the better-class brick buildings. Much of the brick facing has come away and there are cracks in the concrete. They are, however, probably the safest buildings for the inhabitants, and office buildings of this class have continued in use without interruption. The behaviour of steel frame buildings was peculiar; from a few feet above the ground the brickwork is cracked, and this continues for two or three stories. Above the third and up to the top (in some cases eight stories) no damage whatever is to be seen. The writer was nowhere able to find the slightest sign of failure of the foundations of any building, whether wrecked or standing.

THE report for 1922 of the director of the Bernice Pauahi Bishop Museum at Honolulu has recently been issued. It gives a summary of the various activities of the Museum officials in researches relating to the natural history of the Pacific Islands and the culture and folk-lore of the Hawaiians and other Polynesian people. A number of expeditions for systematic survey in anthropology, botany, and zoology have been undertaken in connexion with the Museum. The most important were the Whitney South Sea expedition, an expedition to Fanning Island, the exploration of Guam in the Ladrone Islands, and the Bayard Dominick expedition for the investigation of the origin, migration, and culture of the Oceanic people. Some interesting general conclusions have been reached by the members of the Dominick expedition with regard to the Polynesian population. There seem to be two basic elements. The first is Caucasian with physical characteristics approaching some Mongols, with tall stature, moderately long heads, relatively high narrow faces and noses, light brown skin, and straight or wavy black hair. The second element is the Indonesian typical of Celebes, with shorter stature, low broad faces, wavier hair and darker brown skin. A third element is found only in small numbers with very short heads, narrow faces, and light skin. The second type is characterised by a higher social and religious development than the first. The first type is universally distributed in the Pacific, but strongest in New Zealand and the Marquesas. The second type is prevalent in North and Central Polynesia. In the report Mr. J. F. Illingworth notes that the Hawaiian house-fly is not the same as that of Europe and the United States, but is a variety found on the western shores of the Pacific. As it is known that these flies follow man, and there were house-flies in Hawaii when Captain Cook arrived, the inference is drawn that the original immigrants and the flies came to Hawaii from the west.

APPLICATIONS are invited by the secretaries of the Royal Society for the Armourers and Brasiers' Company research fellowship in metallurgy, tenable in the first instance for two years, with a possible extension to five years. The research undertaken by the successful candidate must be connected with base metals and alloys, preferably those used in the ancient crafts of the Company of Armourers and Brasiers. The annual value of the fellowship is 500*l*. Applications must reach the secretaries of the Royal Society, Burlington House, W.1, by March 1 next.

WE have received the annual report of Livingstone College, Leyton, for 1922–23, being the thirty-first year of its existence. The College gives courses of instruction with the object of teaching missionaries how to care for their own health, and how to deal with the diseases of the people among whom they are working, when far from qualified medical aid. Altogether 752 students have passed through the College. Donations and subscriptions are requested to help carry on this useful work.

THE ninety-second annual meeting of the British Medical Association will be held on July 18-26, 1924, at Bradford, under the presidency of Mr. J. Basil Hall, consulting surgeon to the Royal Infirmary, Bradford. The presidential address will be delivered on July 22. The following presidents of sections have been appointed:—Medicine: Prof. A. J. Hall; Surgery: Sir Cuthbert Wallace; Obstetrics and Gynæcology: Mr. J. S. Fairbairn; Pathology and Bacteriology: Prof. C. H. Browning; Neurology and Psychological Medicine: Dr. T. G. Stewart; Ophthalmology: Dr. A. M. Ramsay; Public Medicine and Industrial Diseases: Mr. H. Jones; Diseases of Children: Dr. L. Findlay; Laryngology and Otology: Dr. W. J. Horne; Orthopædics: Mr. R. C. Elmslie; Medical Sociology: Mr. A. Manknell; Dermatology: Dr. J. MacL. H. MacLeod. The honorary local general secretary is Dr. W. N. West Watson (Victor Lodge, Manningham, Bradford).

THE Seismological Society of America has published a large Fault Map of the State of California (three sheets and a title-sheet) on the scale of 1 : 506,880, or close on one inch to eight miles. The topography is based on various official surveys, the hills being well brought out by a system of colour-shading. The sea-depths are shown by contours drawn at intervals of 100 fathoms. The known and probable faults, which mean so much in the moulding and instability of the continental edge, are marked by lines of various colours; these are broken where details are uncertain or inferred. A fault indicated as "active" is usually one along which an earthquake has occurred during historic time. The mind of the world has been once more riveted on the uncertainties of the Pacific ring, and this map, which must be mounted as one wall-sheet for its proper appreciation, will no doubt find a permanent place in colleges that respect geography. Prof. Bailey Willis has furnished a lucid description to accompany the sheets (Bull. Seism. Soc. America, vol. 13, No. 1, 1923).

A REPORT by the Meteorological Department of the Government of India for 1922–23 has just been issued under the superintendence of Mr. J. H. Field, the officiating Director-General of Observatories. The policy of Indianisation has been adopted, and the personnel for the thirteen posts of meteorologists has changed from 10 Europeans and 3 Indians in 1919 to

3 Europeans and 10 Indians in March 1923. A study of upper air movements in India is said to be laying the foundation for types of forecasting not hitherto possible from surface observations. The whole system of warnings for storms and cyclones over the sea and on land throughout India is the duty of the headquarters staff, and all is now done from Simla. Considerable retrenchment has been made during the year, which has involved the partial stoppage of Bombay, Madras, and Calcutta Daily Weather Reports, the issue being suspended during the seasons of least rainfall. Shipping at sea is supplied with the latest information regarding the weather by wireless bulletins. Upper air research shows that at heights of 4 miles and upwards the cold weather winds of northern India often reach a strength of 100 miles per hour or more, while calms prevail at the surface. At Agra the westerly components of upper air, at a height of about 4 miles, prevailing from the middle of September to the middle of October, show a close relationship with the precipitation in north-west India in the winter following. Departmental observatories for the year consist of 5 first class, 185 third class, 23 fourth class, and 24 fifth class. Rainfall observations are received from 2926 stations.

MESSRS. HAWKSLEY AND SONS, 83 Wigmore Street, W., have forwarded to us their catalogue of medico-diagnostic, physiological, anthropometrical, psychological, and chemical apparatus. Several forms and sizes of capillary pipettes for the accurate measurement of quantities from 0·005 c.c. to 1·0 c.c. are listed, as well as several types of hæmacytometers and hæmoglobinometers for the estimation of the number of corpuscles and amount of hæmoglobin in blood. Under blood analysis apparatus we find outfits for the estimation of calcium, urea, and sugar in the blood. Galton's finger-print outfit and whistle and many pieces of anthropometric and psychological apparatus are catalogued. Messrs. Hawksley are also agents for the microscopes and accessories of the Spencer Lens Co., New York.

IN the "Fauna of British India" Series the further volumes which the editor, Sir Arthur E. Shipley, with the assistance of Dr. Hugh Scott and with the sanction of the Secretary of State for India, has arranged for are: volumes on Butterflies (Lycænidæ and Hesperiidæ) by Mr. N. D. Riley; on the Ixodidæ and Argasidæ by Prof. G. H. F. Nuttall and Mr. C. Warburton; on Leeches by Mr. W. A. Harding and Prof. J. Percy Moore; on the Curculionidæ by Dr. G. A. K. Marshall; on the Carabidæ by Mr. H. E. Andrewes; on the Meloidæ by Mr. K. G. Blair; on the Erotylidæ and Endomychidæ by Mr. G. J. Arrow; on the Culicidæ by Capt. P. J. Barraud, Major S. R. Christophers, and Mr. F. W. Edwards; on the Chrysomelidæ (subfamilies Chrysomelinæ and Halticinæ) by Mr. S. Maulik; on the Scolytidæ and Platypodidæ by Lt.-Col. Winn Sampson; together with a revised edition of Mammalia by Mr. Martin A. C. Hinton and Mr. R. I. Pocock, and of Birds (6 vols.) by Mr. E. C. Stuart Baker.

THE latest catalogue (New Series, No. 10) of Messrs. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, should, we think, be very useful to librarians and others, it being a classified list of some 840 serials and transactions of scientific societies on sale by them. The catalogue is conveniently arranged under the headings: British Isles—Transactions of societies and other scientific periodicals; British Isles—Proceedings of local societies; Dominions and Colonies—scientific serials, etc.; United States of America—scientific serials, etc.; and foreign countries—scientific serials, etc.

Our Astronomical Column.

THE JANUARY SHOWER OF METEORS.—This display of meteors is of greater importance than is supposed. It sometimes furnishes a rather brilliant exhibition of a conspicuous character, being more brilliant than the average and traversing longer paths. The radiant point is situated at about 230° +53° in the region barren of bright stars lying on the borders of the constellations Boötes, Draco, and Hercules.

The shower has occasionally been so abundant as to furnish one or two meteors per minute. In the evening hours, from the latitude of England, the radiant point is situated at a low altitude in the northern sky, and it is generally in the few hours preceding sunrise that the display attains its greatest strength. Unusually rich returns of these meteors were witnessed in the early evening hours of January 3, 1918 and 1922, and we may expect another plentiful exhibition of its meteors on the morning of January 4 next between about 4 and 6 A.M. The moon will not offer any obstruction on that date, as it will be 26 days old and visible as a very narrow crescent only.

Should the weather be clear on the morning of January 4, all the conditions are promising for a meteoric spectacle of very interesting character, and it will be important to observe it carefully through the night in order to determine the hourly number of meteors visible and the time when it reaches a maximum.

THE AXIS OF MARS.—*Popular Astronomy* (November) contains an interesting study by Prof. W. H. Pickering of the position of the axis of Mars. He notes that the method used by Lowell of observing the polar caps is subject to a systematic error. The edge of the cap has a sensible diurnal shift: the white deposit melts on the noon side of the cap, and forms again on the opposite side. Accordingly a new determination was made, based on a large number of small well-defined markings spread over the disc. Incidentally the conclusion was reached that a large number of the Martian spots have a sensible annual shift, easily explicable on the view that they are vegetation phenomena. This, however, can be eliminated from the discussion. Prof. Pickering's final value for the obliquity of the Martian equator to its orbit is 24° 14′, a degree greater than Lowell's. He gives for the co-ordinates of the point to which the N. pole is directed—

$$\text{R.A.} = 20^h\ 58^m\ 6^s + 1{\cdot}56^s\ (t\text{—}1918)$$
$$\text{N. Decl.} = 52^\circ\ 12'\ 50'' + 12{\cdot}6''\ (t\text{—}1918).$$

The equinox of the planet is shifted back 7·16° from 87·89° to 80·73°. This has the effect of increasing the Martian date by 14 days. The method employed seems to give this determination more weight than any other that is based on markings on the disc.

Research Items.

THE CAVE OF MACPELAH.—In the concluding issue for the year of *Ancient Egypt*, Sir Flinders Petrie discusses the probable position of the double cave below the Herodian monument which is described in the lately published "Hebron, le Haram el Khalil," by Père Vincent and Captain Mackay. Owing to the fanaticism of the present Arab population, the authors of this work were not allowed access to the subterranean parts. Our knowledge of these is derived from an account, written in A.D. 1136, of an examination of them in A.D. 1119 by the monks. Sir Flinders Petrie's conclusion is that the double cave probably lies to the S.E. rather than to the N.E. of the basilica-like chamber to which the monks penetrated. A point of interest in connexion with the superstructure is that while the internal proportions indicate the Jewish foot as the unit, those of the exterior conform to the Roman foot, the design being based on the fact that the two units can be worked together on a ratio of 10 : 11 in the length or 11·5 : 12·5 in the breadth.

ROCK PAINTINGS IN PAPUA.—Dr. W. Mersh Strong has published in the December number of *Man* photographs and tracings of a number of rock paintings from the Central District of Papua. They were found on a prominent whitish rock, and were executed in a single monochrome red, apparently a preparation of iron oxide. The designs included a cassowary, a figure of a man, a scroll pattern, a double chevron with pendent lines, possibly a tortoise, a man's face, a crescent, and a hand. There is nothing to indicate their age except that they are covered with a slight film, probably of calcium carbonate derived from the trickling of water. The present natives have no knowledge as to who did them. Dr. Strong is of the opinion that the face design suggests the face *motif* of the Papuan Gulf, but points out that this culture has its centre some two or three hundred miles west of Port Moresby and scarcely comes within a hundred miles of that area. He also refers to the paintings of canoes and men in red monochrome seen by Seligman in the Marshall-Bennet Islands.

THE COPPER ESKIMO.—Two further instalments of the Report of the Canadian Arctic Expedition 1913–1918 have just been issued; these are "The Physical Characteristics of the Copper Eskimo," by D. Jenness, and "The Osteology of the Western and Central Eskimo," by John Cameron, being parts B and C of volume xii. The measurements given by Mr. Jenness were, for the most part, taken at Coronation Gulf, where the expedition spent two years. Mr. Jenness concludes that there is strong support for Boas's view that Indian admixture in Alaska has increased the stature and produced a marked tendency towards brachycephaly; and that while the Copper Eskimo show more resemblance to the Eastern Eskimo than to the Alaskan, they differ from most other Eskimo in that the head is slightly longer and broader, although the cephalic index is virtually the same as among the pure-blooded tribes to the eastward. It is interesting to note that Mr. Jenness finds no evidence to support Dr. Stefansson's theory of European admixture among the Copper Eskimo. Of the features principally relied upon by Dr. Stefansson, Mr. Jenness holds that the proportion of face breadth to head breadth is illusory, and the blue or grey tinge of the eye is pathological in origin and common elsewhere.

CAUSAL ORGANISM OF POTATO BLACKLEG.—As the result of a study of twelve strains of the potato blackleg parasite, including the four "species" originally described as the cause of the disease, H. M. Jennison concludes, in a paper published in the Annals of the Missouri Botanical Garden, vol. x. No. 1, February 1923, that the blackleg disease of Irish potatoes in North America and Europe is caused by a Schizomycete which should bear the name *Bacillus atrosepticus* van Hall. The following names are to be considered only as synonyms: *Bacillus phytophthorus* Appel, *B. solanisaprus* Harrison, *B. melanogenes* Pethybridge and Murphy. The pathogen infects the stems and the tubers of the potato. Virulence of the parasite, as tested by artificial inoculation, appears to be dependent upon a rather delicate balance of temperature and water relations, and upon the sugar content of the tissues inoculated.

CYTOLOGY OF MUTATION.—Prof. R. R. Gates has an important paper in the *Annals of Botany*, vol. xxxvii. No. 148, October 1923, under the title "The Trisomic Mutations of Œnothera," in which he describes the occurrence in the F_1 generation of the cross *Œnothera rubricalyx* × *Œ. Hewettii* of a mutant with fifteen chromosomes, and discusses in connexion therewith the whole question of the chromosome mechanism associated with such types of mutant. In Œnothera, relatively few mutants are found with fourteen chromosomes; these may be accounted for in terms either of crossing over or of double "non-disjunction." "Non-disjunction" has been called in to explain the existence of the relatively frequent trisomic mutations (with 15 or 16 chromosomes). It is assumed that on segregation two chromosomes of a pair, instead of separating to different gametes, both go into one cell; thus in a pollen tetrad two pollen grains will be found with eight chromosomes each instead of seven. When, as in the mutation now described by Prof. Gates, two precisely similar mutants appear in a small culture, it would seem probable that both such pollen grains have functioned, so that the male parent is responsible for the extra pair of chromosomes. Inevitably in discussing such a problem the question arises as to what extent the seven pairs of chromosomes in Œnothera may be regarded as individually distinct. Prof. Gates discusses the question in a tentative manner, directing attention to recent statements by Hance (1918) and Van Overeem (1922), who conclude that these seven pairs are distinct and form a graded series. Prof. Gates is evidently of opinion that this conclusion is not yet sufficiently soundly based upon observation and experiment, but that the cytological complexities of the problem well deserve further exploration.

DISTRIBUTION OF HERRING SHOALS.—The report of the Dove Marine Laboratory, Cullercoats, for 1922–23 contains an interesting paper by Mr. B. Storrow on the distribution of herring shoals. Evidence is given in favour of the view that the failure of the industry in 1921 was due, in part, to a migration of young North Sea herrings in the preceding winter. Late in 1920 these fish divided into two sections, one of which migrated northwards towards the Orkneys and Shetland, and the other southwards. The northern group thereby passed into an area favourable to growth, and grew rapidly. The southern section grew much less rapidly. If this be so, the herring industry in any particular locality should depend upon whether the herring caught are migrants from a region of rapid or of slow growth, rather than upon the existence of a particular year class. The author is inclined to the view that migrations, which may in some cases depend upon the "activity" of Atlantic

water, prohibit the existence of different herring races in the North Sea.

EUCALYPTUS OILS AS GERMICIDES.—Messrs. A. R. Penfold and R. Grant give an account of an investigation of the germicidal values, determined as Rideal-Walker carbolic acid coefficients, of the principal commercial eucalyptus oils and of their active constituents (Journ. and Proc. Roy. Soc. of N.S. Wales, vol. lvii., 1923, p. 80). Standard suspensions of 1 per cent. of the crude oils and their pure constituents were made in 7½ per cent. resin soap solution. Of the oils of ten species of Eucalyptus, that of *E. radiata* was the strongest and gave a coefficient of 10-12, the active principle being piperitol. Of active principles, australol, geraniol, citral, and piperitol gave coefficients of 22·5, 21, 19·5, and 13 respectively. The interesting observation is made that a lower coefficient is given by the dilution (with water) of a concentrated preparation than by a dilute preparation of the same strength, probably because the dilution of a concentrated emulsion upsets the emulsion.

RED DISCOLORATION ON DRIED SALTED FISH.—The condition known as "pink" is one to which dried salted fish is liable, and is characterised by the appearance of pink patches on the surface. It is dealt with in Special Report No. 18 of the Food Investigation Board by Dr. P. C. Cloake. These pink patches are caused by the growth of chromogenic micro-organisms of at least two species—one a red sarcina, the other a curiously polymorphic form which may be a bacillus. These organisms may be cultivated on such media as salted fish agar, provided they contain a high percentage of salt, *e.g.* 15 per cent., at a temperature of 24° C. The source of these organisms has been traced to the salt used in curing when this is of marine origin; rock salt seems to be free from them. Sterilisation of the salt at 120° C. for 30 minutes suffices to destroy the organisms.

A SUGGESTED INDICATOR FOR PETROLEUM.—In the Journal of the Royal Society of Western Australia, vol. 9, p. 8 (1923), A. Farquharson describes an occurrence of the hydrocarbon impsonite, infilling the vesicles of a basalt that underlies a limestone variously regarded as of Cambrian or Lower Carboniferous age. Specimens have been collected from various points in the Ord Valley near Kimberley, West Australia, and these were sent to the office of the Geological Survey in the first instance as possibly oil-bearing shales. The author points out that the occurrence is of sufficient magnitude to have a bearing on the search for petroleum in the district. We need not share his view (p. 17) that oil would be unlikely to occur if the rocks were of Cambrian age, since seepage from a distance is always possible, and the highly vesicular character of the basalt may have provided a favourable storehouse on the way. As E. H. Cunningham Craig remarks, migrating petroleum will make its appearance in "the most porous rock available."

CLIMATIC CHANGES AND WEATHER NORMALS.—The U.S. *Monthly Weather Review* for August contains an article by Prof. C. F. Marvin, Chief of the U.S. Weather Bureau, on the above subject. The discussion is introduced by a question, "Is the climate changing?" and justifies the answer of "Yes" or "No" to this inquiry. Geological records are said to leave no question as to the great changes the vast lapse of time has occasioned in the past, while there is said to be no conclusive evidence of notable permanent changes during thousands of years of human history. The author believes that long-time fluctuations of climatic conditions have occurred, and that minor surgings of the seasons to and fro take place for such periods as 50 to 100 years. Reference is made to the somewhat general deep-seated conviction that, to many, weather conditions at the present time differ from corresponding conditions within their memory. The prime object of the discussion is to establish a method of completing a broken record of observations, say of temperature or rainfall, so as to lengthen out to the utmost a series of observations and thus to secure long-period normals of observations to aid in obtaining proof of secular changes if such are obtainable. A method is suggested for completing the individual values for missing years which is practically a system of drawing lots from the values of all the years for which observations exist, and so on for all the years for which means are required. This system scarcely seems likely to commend itself to all workers. Considerable importance is attached by the author to the use of accumulated sums of departures from a normal base and exhibiting the same as a graph.

PHOTOELECTRIC CELLS FOR MEASUREMENTS OF TIME.—In the *Comptes rendus* of the Paris Academy of Sciences, November 5, 1923, Messrs. G. Ferrie, R. Jouart, and K. Mesny describe methods employed to amplify the current from a photoelectric cell, so that the amplified current can be used to record the passage of a pendulum through a certain point of its path. The anode of the photoelectric cell was joined to the grid of a special triode valve, and the filament of the valve to the positive of a battery, the negative of which was connected to the deposit of alkali metal in the cell; a constant high potential difference was applied between the anode plate and the filament of the valve. When the cell was illuminated, the grid was charged negatively, and the current of the valve was diminished. In this way a variation of current, 10,000 times as great as the original photoelectric current, can be obtained; and, by attaching to a pendulum a screen, provided with a slit, through which light from an electric lamp can pass, measurements of the time of vibration can be made with considerable accuracy. With a more complicated arrangement of valves, an amplification of the order 10^6 was obtained and it was possible to determine the period of the pendulum within one-thousandth of a second. The authors hope to be able to adapt the method for recording the passage of stars across the central line of a meridian telescope.

VELOCITY DISTRIBUTION OF ELECTRONS FROM INCANDESCENT OXIDES.—The velocity distribution of the electrons ejected from incandescent substances has been investigated by the integral method, not attempting to separate out the electrons moving at or near a definite velocity, but deducing the distribution law from observations which included all the different velocities present; Richardson used also the differential method. All the observers have found that Maxwell's probability law for the distribution of the velocities is correct in the case only of clean metal surfaces. In the *Zeitschrift für Physik*, November 15, 1923, Herr M. Rössiger describes experiments, using the differential method, in which the electrons pass through a longitudinal slit, parallel to the axis of the cylindrical anode; this is coaxial with a straight, incandescent platinum wire which forms the cathode and is coated with oxides of calcium, barium, or strontium. There is an outer cylinder, coaxial with the first, and electrically connected with

it; in this is a slit, parallel to that in the surface of the inner cylinder, while outside this slit, and insulated from the cylinder, is a collecting plate, which receives the electrons which pass through both slits. The inner cylinder can be rotated about its axis; so that the angle ϕ between the planes passing through either slit and the cathode wire can be varied, and measured by means of a reflecting mirror. A solenoid is wound round the cylindrical glass containing vessel, so that a magnetic field can be produced in the direction of the axis of the cylinders, deflecting electrons with a certain velocity which pass through the first slit, so that they pass through the second when ϕ has the correct value. Maxwell's law is still found to hold.

MAGNETIC SURVEY OF THE BALKANS.—Heft 10, Bd. 131, Abt. IIa, Math. Nat. Kl. of the Sitzungsberichte of the Vienna Akademie der Wissenschaften contains a paper by Mr. A. Schedler, which gives the results of a magnetic survey carried out during 1918 in the Balkans. Results are given for 27 stations, varying in latitude from 44° 49′ to 40° 55′ N., and in longitude from 18° 32′ to 21° 55′ E. Attached to the paper are six charts. The first and the last indicate the geographical positions of the stations, and the geological features of a magnetically disturbed region. The four intermediate charts give curves of equal values of magnetic declination, inclination, horizontal force, and total force respectively for the epoch January 1, 1918. Through an oversight, the values of the force are printed as angles in the charts. For example, 0·4444 C.G.S. is printed as 44° 44′. It is interesting to note that the dip observations were taken with an English dip circle, Dover No. 1.

INVERTED FLIGHT IN AEROPLANES.—A paper of considerable interest to practical aviators, as well as to workers in the dynamics of aeroplane flight, was read recently before the Royal Aeronautical Society by Squadron Leader R. M. Hill. The paper is entitled "The Manœuvres of Inverted Flight," and is based upon extensive experimental flights executed by Mr. Hill and others. The object of the experiments was threefold. The immediate aim was to examine the causes of fatal accidents that often occur in aerobatics on an unstable aeroplane, when the aeroplane assumes an inverted position and the pilot fails to right the machine. Subsidiary aims were to find the magnitudes of the loads in inverted flight, and to examine the behaviour in inverted flight of machines with different stability characteristics. An account is given of the ways in which inverted flight can be obtained, namely, by means of the half loop and the half roll, and details of the manœuvres are given for particular aeroplanes, such as the Sopwith "Camel," the "Camel" modified so as to increase its longitudinal stability, the "Snipe," the "Bat Bantam," and the S.E.5A. The use of the controls in inverted flight and the return to normal flight are similarly discussed. Mr. Hill considers the belting arrangements to be of supreme importance, especially in unstable fighting machines; pilots often fail to use the controls because they cannot reach them. Steady inverted flight is possible on all types of machines investigated; but whereas the longitudinally stable machine tends to right itself, the longitudinally unstable machine has no such self-righting properties: there is, however, no real difficulty in recovering from the inverted flight. The longitudinally unstable machine is also liable to get into an inverted spin, but here again the pilot can recover if he knows the use of the controls in such positions. Inverted loops were also investigated. Mr. Hill suggests that "the best compromise between safety and extreme manœuvrability is to be found in an aeroplane which, though preferably stable throughout the major part of its range of flying speeds with elevators free, must definitely be stable with them fixed."

SILICATE OF SODA FOR THE TREATMENT OF CONCRETE ROADS.—Silicate of soda is now being more and more used in Great Britain for the surface treatment of concrete, following on the extensive and very satisfactory experience recorded in America. In fact, new uses for silica of soda are being found almost every day, and this material looks like rivalling sulphuric acid, soap, or soda ash as a ready test, according to the amount consumed, for the civilisation of a community. The chemical reactions that result from the application of a dilute solution of silicate of soda to concrete, say the surface of a road, are very complicated, but seem to include the combination of the silicate with the free hydrated lime liberated in the setting of cement to give a lime silicate, which forms a hard compound. At any rate, the nett result is the formation of an intensely hard outer skin—in which all the pores have been completely filled up—strongly resistant to abrasion and dusting, and largely waterproof. It is essential, however, that the silicate of soda be sprayed over the road in the form of a very dilute solution, say 1 of the liquid neutral silicate to 4 of water, whilst the silicate of soda must be prepared for the specific purpose, with a fairly high ratio of silicate to soda. As is well known, very many grades are supplied, from a low-ratio product containing 1·60 molecules silica to 1·00 molecules soda (Na_2O) to a very high-ratio grade with over 4·0 molecules silica. The right brand to use is a matter of experience and research on the part of the firms supplying the product, but the results, under proper conditions, are remarkable, and constitute a factor of national importance in the upkeep of roads.

TESTS ON BOILER MATERIAL.—The annual memorandum by Mr. C. E. Stromeyer, Chief Engineer to the Manchester Steam Users' Association, covering the year 1922, contains several interesting matters. Tests have been made on the material of some old wrought-iron boilers, one of which was sixty-nine years old, and a comparison with the tests of the original material shows that wrought iron does not lose tenacity appreciably with age. The furnace plates show a reduction of ductility, but not of tenacity. Mr. Stromeyer again directs attention to the effect of nitrogen on mild steel, and urges that the effect of a high proportion of this element, such as is found in Bessemer steel, requires more thorough investigation. A table of failures of mild-steel plates, bolts, stays, and rivets is given, 22 in number, and in every case the sum of $5N+P$ is greater than 0·08 per cent., the upper limit previously fixed by the author. A case for inquiry has been made out, and it is to be desired that analyses for nitrogen should be made more frequently, until its alleged harmfulness has been confirmed or disproved. The tests on riveted joints in old boilers show that the strength of a double-riveted seam in a boiler is greater than that found when the seam is cut out and the joint tested in a machine, so that the engineering practice of crediting the joints with their full strength is justified. An interesting section on dished and flat-end plates of boilers deals with the behaviour of cracks, which in some cases do not spread, but relieve the stress, so that some boilers mentioned worked for years in a cracked condition. This is traced to a very finely laminated structure in the outer layers of the plates.

The Jubilee Celebrations of the French Physical Society.

IT was in 1873 that the Société Française de Physique came into being, and the first volume of the Proceedings of the Society contains a report by Lissajous on the preliminary steps that were taken. The statutes include one by which any discussion " étrangère à la physique " is prohibited. Whether the French physicist of fifty years ago was a keen politician we do not know, but it seems to have been desirable to provide against extraneous matters more rigorously than is our wont in Great Britain.

A glance at the first list of members reveals a number of very well-known names, such as the Becquerels, Berthelot, Bouty, Cornu, Jamin, Joubert, Koenig, Lippmann, Lissajous, Mascart, Sainte-Claire Deville, and Violle. The first president was Fizeau, and the following eight successive presidents were Bertin, Jamin, Quet, E. Becquerel, Blavier, Berthelot, Mascart, and Cornu. The first honorary member was the elder Becquerel. In 1876 there were five honorary members, including Regnault and Sir William Thomson ; and in 1878 the names of Fizeau and Joule were added.

In the early part of this month, the founding of the Society was celebrated by a number of meetings. Apart from these there has been the Exhibition, which has hitherto been held by the Society at Easter, but has this year been combined with a Wireless Exhibition. It has been on an unusually large scale, as may be realised when it is said that the Grand Palais in the Champs Élysées, in which the annual Automobile Show is held, was used for the purpose. The Exhibition was excellent from many points of view, and was characterised by many demonstrations, more or less popular, which were very attractive.

The anniversary lectures were given at the Sorbonne, the first on Saturday, December 8, by Col. Robert, on the relations of physical and technical aeronautics.

On Monday morning, December 10, an attraction of another kind presented itself in the general meeting of the International Union of Physics. The chair was taken by M. Brillouin with Prof. H. Abraham as general secretary. The business was largely formal, the main item being the adoption of the statutes. After some discussion as to whether the value of the franc for the contributing countries should be taken in the French or Swiss currency, the former was adopted, notwithstanding the reduction in the contributions by so doing. The date of the next meeting of the Union was fixed for the year 1925, the normal three years' interval being reduced, and the question of an international congress will then be decided. A somewhat pious resolution was adopted on the desirability of authors supplying abstracts to their papers, such abstracts being left in the hands of the editor of the journal concerned for final revision. The meeting was followed by a luncheon.

On Monday evening a lecture was given by Prof. H. A. Lorentz on the old and new mechanics. The motion resulting from the impact of two balls was considered, and generalised equations were obtained which were applicable to two observers in relative motion. This was followed by the gravitational deflexion of light, and a discussion of the quantum theory and kindred subjects. The address was a model of lucidity, and at its conclusion Prof. Lorentz received quite an ovation from a crowded audience.

On Tuesday, December 11, Lord Rayleigh gave an interesting account of his investigations on iridescent colours in Nature. He dealt successively with the colours observed in light reflected from potassium chlorate crystals, mother-of-pearl, Labrador felspar, and scarabee. This work was described recently in a series of papers read before the Royal Society.

At the conclusion of the lecture Prof. Volterra presented, on the behalf of the Accademia dei Lincei, two volumes of the collected works of Volta. Other volumes are in preparation.

Wednesday, December 12, was marked by a banquet at which the delegates were royally entertained. The chair was occupied by the Under Secretary of State for Public Instruction. M. Picard (president of the Société Française de Physique) welcomed the foreign delegates, and responses were made by Prof. Volterra, Prof. Lorentz, Lord Rayleigh, Prof. Störmer, and Prof. Knudsen.

The culminating point in the celebrations came on Thursday afternoon, when the chair was taken by the President of the Republic in the large amphitheatre of the Sorbonne. There were also present the Ministers of Commerce, of Public Instruction, and of Public Works. After speeches by M. Picard and M. Brylinski (president of the French Electrotechnical Committee), Prof. Lorentz presented the addresses which had been brought by the delegates. These were numerous, and, in the alphabetical order of the countries from which they came, were from the following societies : L'Académie Royale de Belgique, La Société Scientifique de Bruxelles, L'Académie Royale de Danemark, L'Institut d'Égypte, L'Académie des Sciences de Madrid, Bureau of Standards, Carnegie Institution of Washington, L'Académie des Sciences de Finland, Royal Society, Royal Institution, Physical Society of London, Röntgen Society, Accademia dei Lincei, Accademia di Torino, La Section de Physique du Conseil National de Recherches du Japon, Le Ministère de l'Instruction Publique du Grand Duché de Luxembourg, La Société de Physique de Christiania, L'Académie Royale des Sciences d'Amsterdam, La Société Hollandaise des Sciences de Haarlem, L'Académie de Cracovie, La Société Polonaise de Physique, La Société Suisse de Physique, La Société de Physique et d'Histoire Naturelle de Genève, La Société Zurichoise de Physique et l'École Polytechnique fédérale de l'Université de Zurich, L'Union des Mathématiciens et des Physiciens tchecoslovaques à Prague.

After this part of the ceremony came a speech by M. Bérard (Minister of Public Instruction), followed by remarks by the President of the Republic. The latter with his ministers then withdrew, and we settled down to a discourse by Prof. C. Fabry on the domain of radiations. The programme was interspersed throughout by a selection of music rendered by the celebrated band of the Garde Républicaine.

The magnificent amphitheatre of the Sorbonne, in which these proceedings were held, seats about 3000 people, and gave rise to some reflections, possibly not only on the part of the present writer. Where is such a theatre to be found among our educational institutions in London ? Unfortunately, nowhere ; and if we had such a theatre, would an audience of, say, 2500 people come on such an occasion, and listen to an address (unillustrated) on the difficulties experienced in exploring the field of radiation, from the longest waves, as used in wireless telegraphy, to the shortest, as shown by X-rays ? We doubt it, even if the Prince of Wales were present. The value of science is obviously recognised more fully in Paris than in London.

Lectures by Prof. Störmer on the aurora borealis, on Friday, December 14, and by Prof. Knudsen on the mechanism of evaporation and condensation, on Saturday, brought to a close these very interesting and very successful celebrations.

Virus Diseases of Plants.

AN interesting discussion upon "Virus Diseases of Plants" was held during the meeting of the British Association at Liverpool between the Sections of Botany and Agriculture. These obscure maladies, which are of great economic importance, affect a great variety of cultivated plants and have lately received much attention from plant pathologists. Formerly these diseases were attributed to general physiological degradation, notably in the potato, but since they have been shown to be markedly infectious, they are usually considered to be caused by organisms of ultramicroscopic size, which are disseminated largely by means of insects.

The discussion was opened by Dr. Paul Murphy, who first described the symptoms of these diseases in general and compared them briefly with certain diseases of animals of somewhat similar type. He then dealt specifically with the "leaf-roll" and "mosaic" diseases of potatoes, both of which cause enormous losses in yield. In discussing "leaf-roll" of potatoes, Dr. Murphy maintained that the abnormal accumulation of starch in the leaves, which led to rolling, preceded the degeneration of the phloem, which is also a marked symptom of this disease. In potato "mosaic," characterised first by a mottling of the foliage and later by marked degradation of the whole plant, he stated that this disease sometimes masked other "virus" diseases of the potato such as "stipple-streak" and "crinkle." He had also demonstrated that certain varieties might act as "carriers" of this disease, in which the symptoms remained dormant, although infection could still be spread from these plants. As instancing the rapidity with which degeneration caused by such diseases might occur, Dr. Murphy said that on a farm at Ottawa potatoes had been grown healthily for seventeen years, but that, after this period, marked degeneration set in during the course of a single season, which had affected all potatoes subsequently grown on that farm. He considered, however, that there still remained a certain reduction in yield attributable to non-pathogenic causes when the same healthy stock was grown in different but apparently suitable localities.

Prof. H. M. Quanjer, of Wageningen, Holland, who has made a special study of these diseases in the potato, then gave an account of his own researches on these maladies. In regard to "leaf-roll" he combated the view of Dr. Murphy that the seat of the disturbance lay in the abnormal accumulation of starch in the leaves, maintaining that the primary effect of disease was the necrosis of the phloem consequent upon the entry of the "virus" through insect agency. He pointed out that infection by aphides during May and June first resulted in rolling of the upper leaves during August. Prof. Quanjer claimed that the real seat of these "virus" diseases was the phloem, and suggested therefore that they should be called "phloem diseases" rather than "virus" diseases, although he admitted there was no visible degeneration of the phloem in "mosaic" diseases. In this connexion also it must be conceded that there are other diseases of phloem tissues which do not fall into the category of "virus" diseases. Prof. Quanjer emphasised the rôle played by insects, especially aphides, in the dissemination of these diseases, but pointed out that in some "mosaic" diseases transmission was possible through mechanical abrasion of the leaf hairs.

Dr. W. B. Brierley exhibited lantern slides which showed in a striking manner, by reference to American statistics, the losses caused by these diseases in crop plants. With regard to sugar-cane "mosaic," he stated that varieties resistant to the disease had recently been discovered which would probably prove the salvation of the cane industry in certain districts.

Mr. T. Whitehead classified "virus" plant diseases into four categories, of which the following are examples:

(1) Infectious chlorosis, which is transmissible only by grafting.

(2) Spike disease of the sandal-wood tree, in which there is neither abnormal starch accumulation nor phloem necrosis.

(3) Leaf-roll of potatoes, in which abnormal starch accumulation accompanies phloem necrosis. This disease is transmissible by insects, but not by expressed sap alone.

(4) Potato mosaic, in which there is neither accumulation of starch nor phloem necrosis, although the sugar content may be unusually high.

This disease is transmissible by the sap alone, without insect agency. Mr. Whitehead appealed for more accurate methods in diagnosing this group of diseases, and gave striking evidence for the transmission of potato "leaf-roll" through the soil. He suggested that these diseases could be best controlled by raising resistant varieties and by establishing special beds of potatoes for seed purposes, which could be rogued effectively and lifted early.

Mr. Holmes Smith expressed the view that leaf-roll was by far the most serious of the "virus" diseases of the potato in this country. Unfortunately manurial treatment had no effect upon it, although this was somewhat beneficial in potato mosaic.

Dr. R. N. Salaman pointed out that although this year he had taken the trouble to spray his seedling potatoes, planted in old garden soil, with nicotine at frequent intervals in order to control aphides, infection by mosaic and leaf-roll had been more serious than ever before, although seedlings planted in remote plots in other crops had remained healthy. *Solanum nigrum* appeared to be of no importance as a "carrier" of these diseases. Dr. Salaman expressed the view that "virus" diseases of the potato were probably not congenital, and that susceptibility to leaf-roll was transmitted independently of susceptibility to mosaic disease.

F. T. BROOKS.

Australian Railway Development: a Study in Political Geography.

MR. O. H. T. RISHBETH read a paper on this subject to Section E (Geography) of the British Association at Liverpool. Railway systems typify the humanised as opposed to the purely physical environment, and in so far as they reflect the higher social and political mentality of the people, contribute most useful data for the human geographer. In Europe the system of national states, with their semi-geographical basis, was evolved before the railway era. The railway systems superimposed on a well-defined national background share the intense individualisation of the continent. Europeans brought to Australia this tradition of individualism and exclusiveness.

Mr. Rishbeth maintained that Australia is a clear-cut geographical unity and that its interstate bound-

aries are mathematical and artificial: with one or two exceptions they have no geographical meaning. The early settlements around the island-continent were separated by long stretches of inhospitable coast and still more difficult interior. From these various centres the human settlement developed on old-world lines. This is expressed in the various state railway systems, each planned without reference to those of adjoining states.

The geographical and economic unity of the island was overlooked until a much later date, but the commonwealth feeling or spirit is now making rapid headway and is reflected in the new and newly planned railway lines. These lines are projected to bind together and not to separate the various states. All major Australian railway schemes are essentially commonwealth propositions in that they involve the interests of more than one state. A sketch map was shown to indicate the economic areas, independent of political divisions, which may be regarded as the hinterlands of different stretches of sea coast. On this map it is possible to forecast, with tolerable certainty, the main outlines of the completed Australian railway system. Briefly, this entails an outer ring of which the elements already exist; an inner circle; fragments of a radial system cutting across both circles and joining hinterlands with their appropriate ports; certain overland lines from north to south and east to west. These systems when fully built will unify the continent and overrule the artificiality of the original states.

Structure of Greenland.

WE have recently received, though the work is dated 1920, volume 53 of the "Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft,"[1] containing an account of the Swiss trans-Greenland Expedition of 1912–13. Between southern Greenland at about lat. 64°, where the country was crossed by Nansen in 1888, and Peary's routes of 1892–95 through 80° N., the interior of Greenland remained unknown for an interval of more than 1000 miles. In order to determine the structure along one line through this gap a Swiss expedition under Prof. de Quervain in 1912 traversed Greenland from the western coast in lat. 69° 46′ opposite Disko to the eastern coast in lat. 66°. The journey on the inland ice was begun on June 20. The summit of the ice-cap was crossed on July 8, and its eastern margin was reached on July 21. The party, with dog-drawn sledges, averaged 22 kilometres a day. Meanwhile the western party under Prof. Mercanton investigated the open country on the western edge of the ice-cap to the east of Disko Island.

The new traverse of Greenland confirms the general accuracy of Nansen's profile, though, as he crossed the country where the ice-cap is narrower but rises to a greater height, his gradients were steeper than those found by the Swiss party. Doubt is thrown as to the distance inland reached by von Nordenskjöld in 1883. The expedition, however, supports his view that cryoconite consists in part of meteoritic material. Nordenskjöld's conclusion has generally been rejected and the material explained as dust blown on to the ice from the nearest rocks. Part of the cryoconite collected by the Swiss expedition is regarded as derived from local diorite, but it contains spherules of magnetite which Prof. Mercanton regards as possibly of extra-terrestrial origin. In this view he supports the conclusions of Wulfing and of Swinne (1919). In the absence, however, of proved nickel, the meteoritic origin of the magnetite may still be regarded as open to doubt.

The western party made careful measurements of the ice movements, and found it to vary from less than a centimetre a day on the ice front to 2⅓ metres. It is shown that the bare land in west-central Greenland was once covered by the ice-sheet, and Prof. Mercanton supports the view that, with the exception of some of the high southern mountains, the whole of Greenland was once buried under an ice-cap. His account and photographs show the powerful disruptive effect of frost on bare rocks in the neighbourhood of ice. The larger part of the volume is occupied by the meteorological observations and results, including the records of some pilot-balloons.

The last chapter describes the collection of Eskimo skulls, and its author, Dr. Hoessly, rejects the view that the Eskimo reached Greenland from Europe across the Faroes and Iceland; he regards the Eskimo as the most primitive section of the Mongolian race. The volume is well illustrated by four plates of maps and sections, nine plates, and numerous figures in the text.

[1] "Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft" (Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles) Band 53. Pp. xx+402+54. (Basel, Genf und Lyon: Georg und Co., 1920.)

Building Materials made of Waste Materials.[1]

By Prof. A. P. LAURIE.

WE have in Great Britain large accumulations of blast furnace slag, of cinders, and clinker, and in the neighbourhood of Edinburgh of burnt shale, the residue from the stills of the oil industry. There are three ways in which these materials can be utilised—for the production of bricks, for the production of cement, and as aggregate mixed with Portland cement or plaster of Paris. The general method adopted for the production of bricks is known as the sand lime process. Briefly, this process consists of mixing the aggregate with a certain proportion of lime and water, squeezing it into a brick under a pressure of some two hundred tons to the area of the brick and then steaming under high pressure or in open steaming chambers. Bricks are now being manufactured by this process from sand, blast furnace slag, granulated by being run while hot into water, clinker, town refuse, slate dust, and burnt shale.

Cement is being manufactured by two of the Scottish steel companies from blast furnace slag granulated, mixed with lime, and then raised to a high temperature so as to form a clinker in the same way as ordinary Portland cement was manufactured. This cement, known in Germany as iron cement, can be sold in this condition, or can be finally ground with a mixture of a certain proportion of raw blast furnace slag.

The uses of these materials as an aggregate opens the question of how far it is possible to reduce the content of Portland cement and, at the same time, get sufficient strength for building purposes. The objection to the usual building slab made of cement is that, in order to be able to remove it from the machine as soon as made, the content of water has to be kept low and, consequently, the crushing strength of the finished slab is also low. Two interesting methods of getting over this difficulty are the Crozite method, in which the cement bricks were sliced off from the bottom of a column of cement and aggregate, and the method used by the Triangular Construction Company, in which a heavy compression is put upon the bottom and top of the slab at the

[1] Substance of a lecture delivered at the Royal Academy of Arts, London, on Wednesday, November 21.

moment of completion. It has been possible in the case of the slabs made by the Triangular Construction Company to reduce the amount of cement to one to twelve of aggregate, and the manufacture of cement bricks by the Crozite process is being carried on in a large scale in America.

Many waste products such as sawdust, disintegrated wood, and ordinary cheap aggregates such as clinker can be utilised in slabs made from plaster of Paris. There are large and easily available deposits of gypsum in Great Britain, but the industry has never been developed on the enormous scale found in America, where all kinds of materials required by the builder have been turned out made from plaster of Paris as the cement.

University and Educational Intelligence.

THE *University Bulletin* issued by the Association of University Teachers has hitherto been confined mainly to a record of the activities of the Association, which have been concerned largely with questions of remuneration and other conditions of tenure of university posts. In the November issue an effort is made to widen its circle of readers. Lord Gorell contributes an article dealing with three subjects: (1) expected developments of the functions of the Teachers' Registration Council with the view of the establishment of teaching as one of the unified learned professions; (2) the financial needs of universities; and (3) the projected Imperial Education Bureau. Prof. Arthur Thomson's thoughtful and arresting essay on the essentials of education deserves a wider circulation than the *Bulletin* can hope to give it. Here is a biologist dealing with the ignorance of young Scotland as faithfully as Prof. Burnet in his Romanes lecture dealt with the same subject from the point of view of the humanist. Over the familiar initials M. E. S. appears a plea for large capital grants to universities as recommended by the Royal Commission of 1870 on Scientific Instruction and the Advancement of Science. Prof. Sandbach tells of a committee having been appointed by the A.U.T. to consider and report on the subject of co-operation between libraries, possibly on the lines of the German central information bureau and general card catalogue, for the benefit of research workers in Great Britain and Ireland. There is also a contribution from Melbourne on the perils of inbreeding and localism in universities in the Overseas Dominions.

THE North of Scotland and the Edinburgh and East of Scotland Colleges of Agriculture append to their calendars for 1923–24 lists of appointments gained by their students. They illustrate the Scottish propensity, referred to in Mr. Rudyard Kipling's recent rectorial address, for "raiding the world in all departments of life—and government." The lists include posts in England (53), Canada, the United States, South America, the West Indies, Australia, New Zealand, South, West, East, and Central Africa, the Sudan, Egypt, Cyprus, Hungary, India, Burma, Ceylon, Straits Settlements, Malay States, Java, Sumatra, Borneo, Fiji, and Hawaii: only 60 out of the 280 were in Scotland. The director of studies of the North of Scotland College reports that in 1922–23 a record number of students (27) obtained the degree in agriculture. Both colleges do a large amount of "county extension" work in addition to the instruction and research carried on at their headquarters and at college and experimental stations. The northern college report records 67,096 attendances and 2929 classes and lecture meetings and 11,840 visits to farms and crofts for instruction and advice. A scheme of rural science to be taught in conjunction with school gardening was introduced into several schools and proved efficacious "in creating an interest in school gardening which is lacking at present."

RHODES Scholars in residence at Oxford in 1922–23 numbered 273, namely, 125 from the British Empire and 148 from the United States. Of these, 57 were taking natural science and medicine, 10 economics, and 6 mathematics. Sixty-eight Rhodes scholars were successful in the final honour schools examinations, namely, first class 14 (United States 8, Canada 2, Australia 2, New Zealand 1, South Africa 1); second class 31 (United States 16, others 15); third and fourth classes 23 (United States 11, others 12). The Ph.D. degree was awarded to 7 (all from the United States), the B.Sc. or B.Litt. to 17, and the B.C.L. to 18. Among other academic distinctions obtained by Rhodes scholars may be mentioned the Christopher Welch scholarship in biology and the James Hall Foundation essay prize, both won by Americans, the Francis Gotch memorial prize won by a scholar from New Brunswick, the David Syme research prize (Melbourne) won by a scholar from Victoria, the Bourse des Œuvres françaises à l'étranger (tenable for one year in a university in France) awarded to a New South Wales scholar, two demonstratorships and a tutorial fellowship at Oxford awarded to two Australians and a South African, and a Rockefeller Medical research fellowship, tenable in the United States, to which an Australian scholar was elected. In athletics distinctions were won by 11 scholars from the United States, 10 from Australasia, 6 from Canada, and 4 from South Africa.

A NOTABLE citizen of Bolton, Lancashire, Mr. J. P. Thomasson, made known to the School Board of the Borough in 1876 his intention to allot the sum of 750*l.* annually for a period of ten years, in order to assist scholars from the elementary schools to proceed to higher schools before becoming pupil teachers. His purpose was to secure a body of teachers in elementary schools efficiently educated and properly trained for their duties. The School Board felt that the full benefit to be derived from the scholarships would not be realised if they were restricted to those entering upon the profession of teacher, and Mr. Thomasson consented to enlarge the scope of the scheme so as to encourage pupils from the elementary schools to continue their education at higher schools and to encourage suitable pupils to become teachers. The scheme provided fees, books, railway fares, and a grant towards maintenance. Mr. Thomasson died in 1904, and Mrs. Thomasson intimated her willingness to continue the benefaction for a further period. Meantime the School Board ceased to act and the Town Council became the Education Authority. The scheme was enlarged in its scope, and provision was made for scholarships for boys and girls between 16 and 17 years of age who had been in attendance at secondary schools in Bolton to continue their education in such schools, for leaving scholarships of the annual value of 150*l.* tenable for three years at a university and for a post-graduate scholarship at a foreign university of the annual value of 200*l.* tenable for two years. The scheme has now come to an end. During the 46 years of its existence under varying conditions there have been awarded 122 major exhibitions, 427 minor scholarships, 36 scholarships in respect of continued education at secondary schools, 18 university scholarships, and one post-graduate scholarship. The total sum received from Mr. and Mrs. Thomasson amounts to 26,438*l.*, and the examination expenses, etc., to only 1718*l.* during the whole period, testifying to the fact that the scheme has been most economically administered.

Societies and Academies.

LONDON.

Geological Society, December 5.—Prof. A. C. Seward, president; and, afterwards, Dr. G. T. Prior, in the chair.—The following communications were read: C. W. **Osman**: The geology of the northern border of Dartmoor, between Whiddon Down and Butterdon Down. The Lower Carboniferous rocks may be divided into a Lower Aluminous and a Calcareous Series. The latter commences with grey shales above the Lower Aluminous series, without any physical feature, and contains a volcanic band, generally in a fragmentary condition, mixed with ash, slate, and other fragments, and impregnated with chert; but, at East Underdown, the rock is more solid, and is a quartzless keratophyre. The corresponding mixed igneous rocks of the north-western Dartmoor border, which have been variously described, are altered keratophyres. Above the volcanic band are two limestone-areas: one on the west, near Whiddon Down, and, separated by quartzose rocks, another limestone-area at Drewsteignton. Throughout the length of border considered, the top of the Calcareous Series is formed of grey shales, with hard rock-bands which pass upwards into the Upper Aluminous Series. The granite south of the Carboniferous border-rocks shows three separate intrusions, all from the same magma, but showing sufficient differences to separate them.—D. J. **Farquharson**: The geology of southern Guernsey. With the possible exception of some dykes of doubtful Palæozoic age, the whole of Guernsey consists of pre-Cambrian rocks—gneisses and schists in the south; unfossiliferous shales and grits at Pleinmont; and a series of intrusions in the north, which range from hornblende-gabbro through diorites and tonalites to granites with their accompanying dykes. These dykes not only pierce the last-named suite, but also the gneisses and grits of the south.

PARIS.

Academy of Sciences, November 26.—M. Albin Haller in the chair.—E. L. **Bouvier**: *Ormiscodes gregatus*, a moth the larvæ of which group together to build complex pouches. A description of the building habits of a new species of Ormiscodes found by M. Grisol in the neighbourhood of San Fernando d'Apure, Venezuela. The pouch is built in common, and may contain 10 to 12 cocoons. The name *Ormiscodes gregatus* is proposed for the species.—G. **Friedel**: The black inclusions contained in Cape diamonds. These inclusions have been regarded as graphite, but without clear proof. E. Cohen has shown in a large diamond of 80 carats that the inclusion was a flattened crystal of oligist, and has concluded that many inclusions, if not all, are oligist. The author regards these conclusions as too sweeping, and shows that in the case of a diamond in the University Museum at Strasbourg the inclusion was certainly not oligist, but was very probably graphite.—M. Aimé Cotton was elected a member of the section of general physics in the place of the late J. Violle.—Harald **Bohr**: The approximation of nearly periodic functions by trigonometrical summation.—Pierre **Humbert**: The confluences of Clausen's series.—Léon **Pomey**: Linear integro-differential equations with several variables.—René **Lagrange**: Systems connected with linear differential equations.—Paul **Sonnier**: Thin rectangular plates with edges resting on a fixed surface.—Ernest **Esclangon**: Gliding flight without motive power.—C. E. **Guye**: The motion of the gas in the electromagnetic rotation of the electric discharge. In the case where the action of the positive ions is alone concerned in imparting a movement of rotation to the gas, the observed velocity V can be put in the form

$$V = \frac{\epsilon H}{12\pi\sigma^2 M m}\left[1 + \frac{3N}{M - N}\right],$$

where ϵ is the charge of the ion supposed equal to that of the electron, H the magnetic field producing the rotation, σ and m the radius and mass of the molecule or positive ion, M the total number of molecules, ionised or not, and N the number of positive ions contained in unit volume of the discharge. This expression allows the approximate deduction of N.—R. **Mesny** and P. **David**: Very short waves in wireless telegraphy. With very short wave-lengths it is possible to utilise parabolic mirrors so as to direct the bundle of radiations. The short waves are produced by an arrangement of two symmetrical triodes: waves of wave-length of 1·6 metres can be produced, and telephonic communications have been produced with these at a distance of two kilometres without using mirrors.—Paul **Woog**: The resistance to rupture, lateral compression and equilibrium, of monomolecular layers of various substances in thin films on water.—René **Audubret**: The influence of polarisation on photo-voltaic effects. The mechanism of the phenomenon. The results of the experiments described can be expressed in terms of the Nernst theory by saying that light acts on the electrodes by modifying the solution tension of metals, with an intensity and sense connected with the state of polarisation of the plate.—J. **Pouget** and D. **Chouchak**: The radioactivity of the mineral waters of Algeria.—A. **Lassieur**: An arrangement for electrolysis with graded potentials. The method of Sand and of A. Fischer is modified by replacing the potentiometer measurement by a millivoltmeter and a high resistance.—Camille **Matignon**: A new reaction for the preparation of strontium. Strontia is heated in an iron tube with silicon and the strontium condensed in the cool part of the tube.—M. **Faillebin**: The hydrogenation of certain ketones in the presence of pure or impure platinum black.—A. **Daucet**: The action of xanthydrol on semicarbazide, the substituted semicarbazides, the semicarbazones and benzoylhydrazine. The monoxanthylsemicarbazide is shown to possess the constitution $NH_2.NH.CO.NH.CH(C_6H_7)_2O$, the hydrazine radicle remaining free and capable of combining with aldehydes and ketones in the usual manner.—P. **Gaubert**: The optical properties of graphite and graphitic oxide. The index of refraction of graphite is between 1·93 and 2·07; the crystal is optically negative.—David **Rotman-Roman**: Contributions to the lithology of the Yemen; deep rocks and non-differentiated lode-bearing rocks.—Albert **Michel-Lévy**: Some eruptive rocks from the neighbourhood of Toulon (Var).—Léon **Bertrand** and Léonce **Joleaud**: The relations between the crystalline and sedimentary formations in the western part of Madagascar, between Betsiboka and Tsiribihina.—R. **Dongier**: Magnetic measurements carried out in Dauphiné, Savoie, and Bresse.—Beaulard **de Lenaizan**: The earthquake of November 19, 1923. This shock was recorded on the barograph at Montpellier at 3.40 A.M.—Lucien **Daniel**: New researches on the migration of inulin in grafts of Compositeæ.—A. **Guilliermond**: New observations on the evolution of the chondriome in the embryonic sac of the Liliaceæ.—P. **Lecomte du Noüy**: Meaning of the maximum fall of surface tension of the blood serum.—L. **Mercier** and Raymond **Poisson**: Contribution to the study of the atrophy of the wings and muscles of flight in the Forficulidæ.—Alain **Caillas**: The composition of propolis of bees. Propolis, or bee glue, contains 70 per cent. of resins and 30 per cent. of wax.—Louis **Boutan**: The two zones of external

epithelium of the mantle and their influence on the quality of the pearls in molluscs.—L. **Fage** and R. **Legendre**: The nuptial dances of some species of Nereis.—Boris **Ephrussi**: The action of a high temperature on the mitosis of segmentation of the eggs of the sea urchin.—Nicola Alberto **Barbieri**: Presence of the retina and absence of the optic nerves in anencephalic monsters.—R. **Bazin**: Certain coincidences of malignant neoplasms and their delay in appearance.—E. **Lesné**, L. **de Gennes**, and Ch. O. **Guillaumin**: Study of phosphating in cases of rickets and its variations under the influence of ultraviolet rays.—E. **Wollman** and J. A. **Graves**: Alexic hæmolysis and proteolysis.

CAPE TOWN.

Royal Society of South Africa, October 17.—Dr. A. Ogg, president, in the chair.—K. H. **Barnard**: An example of adaptation in a South African isopod Crustacean. One of the most interesting inhabitants of the empty tubes of the reef-building polychaet worm, *Sabellaria capensis*, is an isopod Crustacean, allied to Eisothistos. This animal has evolved an elongate worm-like shape in strong contrast to the other members of the Isopoda. The "tail-fan" on the other hand is greatly enlarged, and when fully expanded fits the mouth of the worm-tube exactly.—S. H. **Haughton** and A. W. **Rogers**: The volcanic rocks south of Zuurberg. In the divisions of Steytlerville, Uitenhage, and Alexandria, the rocks extend through an area about 100 miles in length from east to west along the northern boundary fault of the Cretaceous beds and are continued southwards round the western end of the Cretaceous area, following it again towards the east on its southern side for 23 miles. The folded belt of rocks belonging to the Cape system and lower part of the Karroo system forms an incomplete "frame" defined by faults on the north, west, and partly on the south, within which there is a sunken area. This area consists of Cretaceous rocks lying unconformably upon an uneven surface of marls, sandstones, sandy tuffs, breccias, and basalts. This latter post-Ecca, pre-Cretaceous formation forms a syncline of post-Uitenhage date, and is unaffected by the intense folding and cleavage of the surrounding region. It can probably be correlated with part of the Stormberg series.—A. V. **Duthie**: Studies in the morphology of *Selaginella pumila*. Part III. The embryo. The megaspores of *Selaginella pumila*, which are shed towards the end of the year, lie dormant on the soil during the summer months and germinate after the early winter rains. Intra-sporal embryos can endure prolonged drying without losing their vitality. The embryo has a prominent foot with large haustorial cells which project into the non-septate storage cavity of the megaspore. The cotyledons do not develop simultaneously, nor are they strictly opposite each other. The first dichotomy of the axis, which takes place at the level of the cotyledons, gives rise to two branches, one of which grows erect; the other develops into a very short horizontal rhizome with branches alternately right and left. The number of cones found on adult plants varied from 1 to 160. The sporophytes are greatly modified by conditions of environment. *S. pumila* possesses a number of characters which are very suggestive of the tree-like Lycopods of the Palæozoic. Its closest relative is the Australian species, *S. Preissiana*.—J. R. **Sutton**: On the genesis of diamond. The various known forms of diamond are attributable to growth only. Crystallisation was not necessarily at a high temperature, and may have been preceded by a condition of plasticity in the carbon. Diamond was deposited from a carbon solvent within cavities, the contour of which determined its final form and habit, in a solid or solidifying matrix.—J. S. v. d. **Lingen**: On the action of some fluorescent antiseptics in the dark. (Preliminary note.)

BRUSSELS.

Royal Academy of Belgium, January 6.—M. Aug. Lameere in the chair.—El. and Em. **Marchal**: The "Homothallism" of some Ascomycetes. In cultures of single spores the following Ascomycetes produce normally fertile perithecia: *Hypocopra fimicola, H. macrospora, Sordaria tetraspora, Philocopra setosa, P. curvicolla, Sporormia intermedia, Choetomium elatum*. Hence these species should be considered as "homothallic."—V. Van **Straelen** and M. E. **Denaeyer**: The fossil eggs of the Upper Cretacean of Rognac in Provence. These fossils have been submitted to a palæontological and mineralogical study. It is not possible to determine with precision the origin of the eggs, but they present more analogies with birds' eggs than with those of reptiles.—P. **Bruylants** and J. **Gevaert**: Contribution to the study of the reaction between organo-magnesium compounds and nitriles. Vinyl-acetic nitrile. Vinyl-acetonitrile with ethylmagnesium bromide gives dipropenyl, two isomers of crotonitrile, and two polymers of the latter.—P. **Bruylants**: The action of organo-magnesium compounds on glutaric nitrile.

February 3.—M. Ch. J. de la Vallée-Poussin in the chair.—Clément **Servais**: A group of three tetrahedra.—C. de la **Vallée-Poussin**: The movement of a heavy homogeneous solid of revolution fixed by a point on its axis.—Th. **de Donder**: The physical interpretation of general relativity.—Lucien **Godeaux**: Cyclic involutions of fourth order belonging to a surface of genus one.

March 3.—M. Ch. J. de la Vallée-Poussin in the chair.—Th. **de Donder**: The physical interpretation of general relativity.—Marcel **Winants**: Intersecants and tangentials.—Victor **Van Straelen**: The systematic position of some decapod Crustacea of the Cretacean epoch.

April 7.—M. Ch. J. de la Vallée-Poussin in the chair.—Th. **de Donder**: Remarks on the Einstein gravific.—P. **Stroobant**: (1) The National Astronomical Committee. An account of the work carried out during the years 1921 and 1922. (2) National Committee of Geodesy and Geophysics. An account of the work done in 1921 and 1922.—Jean **Morelle**: The cytoplasmic constituents in the pancreas and their rôle in secretion.—Laure **Willem**: Researches on the aerial respiration of the Amphibia.

May 8.—M. Léon Fredericq in the chair.—G. **Cesaro**: The equiorientation and similitude of the ellipse of inertia and Steiner's ellipse in the triangle. The Steiner ellipsoids and ellipsoid of inertia of the tetrahedron.—P. **Fourmarier**: The presence of oolitic pebbles in the Tertiary gravels of Cokaifagne (Sart-lez-Spa).—H. **Philippot**: The comparison of time by wireless telegraphy in 1922. A detailed study of the results obtained over one year at the Observatories of Algiers, Edinburgh, Greenwich, and Uccle on the observations of the time signals sent daily from Paris by wireless telegraphy.

June 2.—M. Ch. J. de la Vallée-Poussin in the chair.—P. **Fourmarier**: The supposed glacial phenomena of the Baraque Michel. The author concludes that it is improbable that the plateau of the Baraque Michel has been covered by a glacier.—Laure **Willem**: Aerial respiration in the Amphibia (2).

July 7.—M. Ch. J. de la Vallée-Poussin in the chair.—Jean **Massart**: Researches on the lower organisms. (VIII.) Reflexes in Polyporus.—Cl. **Servais**: The

geometry of the triangle and the tetrahedron.—Francis **Meunier**: The electrolytic overvoltage of hydrogen. A short account of the present knowledge of the phenomena of overvoltage, with an experimental study of the overvoltage of hydrogen on platinum, lead, molybdenum, and tungsten. It has been found that the magnitude of the cathode surface is without influence, the overvoltage increasing as the concentration of the electrolyte diminishes. The fluorine ion, added in small proportions, reduces the overvoltage.—A. **d'Hooghe**: The mechanism of the reduction of oxide of zinc.

August 4.—M. Ch. de la Vallée-Poussin in the chair.—Th. **de Donder**: The fundamental formula of the new gravific.—P. **Fourmarier**: The southern extension of the gap of Theux.—Fréd. **Swarts**: The catalytic hydrogenation of organic compounds containing fluorine. Meta-trifluorcresol treated with hydrogen in the presence of platinum black gives trifluormethyl-cyclo-hexanol, trifluormethyl-cyclohexane, and water. The velocity of the reaction was studied.—Edouard **Herzen**: A simple method of obtaining the stationary orbits of Bohr in the hydrogen spectrum.—L. **Godeaux**: The cyclic involutions of the fourth order belonging to a surface of genus one (2).—G. **Lemaitre**: A property of the Hamiltonians of a multiplier.—Laure **Willem**: Researches on the aerial respiration of the Amphibia (3).

Official Publications Received.

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 7, No. 3: A Preliminary Note on the Decomposition of Calcium Cyanamide in South Indian Soils. By Dr. Roland V. Norris, B. Viswanath, and C. V. Ramaswami Ayyar. Pp. 55-75. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 12 annas; 1s.

Bulletin of the American Museum of Natural History. Vol. 48, Art. 17: New Fossil Mammals from the Pliocene of Sze-Chuan, China. By W. D. Matthew and Walter Granger. Pp. 563-598. Vol. 48, Art. 18: The Problem of the Uintatherium Molars. By Horace Elmer Wood. Pp. 599-604. (New York.)

Department of Agriculture, Madras. Bulletin No. 84: A Soil Survey of the Periyar Tract. By Dr. Roland V. Norris, M. R. Ramaswami Sivan, and S. Kasinatha Ayyar. Pp. 6+10 maps. (Madras: Government Press.) 1.14 rupees.

Meteorology in Mysore for 1922: Being the Results of Observations at Bangalore, Mysore, Hassan, and Chitaldrug. Thirtieth Annual Report, by C. Seshachar. Pp. iii+15. (Bangalore: Government Press.)

Mysore Government: Meteorological Department. Report of Rainfall Registration in Mysore for 1922. By C. Seshachar. Pp. xvii+35. (Bangalore: Government Press.)

Publications of the South African Institute for Medical Research. No. 16: On the Effects of Cold on the Vitality of certain Cysticerci and Echinococci in Meat kept under Commercial Conditions of Freezing in Johannesburg. By Dr. Annie Porter. Pp. 49. (Johannesburg.) 5s.

The Indian Forest Records. Vol. 9, Part 9: Note on the Work of Extraction of Broad Gauge Sleepers from Nepal. By J. V. Collier. Pp. 349-357+15 plates. (Delhi: Government Central Press.) 1.11 rupees.

Geological Survey, Canada. Index to Separate Reports 1906-1910 and Summary Reports 1905-1916. Compiled by F. J. Nicolas. Pp. 305. (Ottawa: F. A. Acland.)

Canada. Department of Mines: Geological Survey. Summary Report, 1922, Part B. Pp. 135B. Summary Report, 1922, Part C. Pp. 91C. (Ottawa: F. A. Acland.)

Tide Levels and Datum Planes on the Pacific Coast of Canada; from Determinations by the Tidal and Current Survey up to the Year 1923. (Published by the Department of Marine and Fisheries.) Pp. 68. (Ottawa: F. A. Acland.)

Transactions of the Astronomical Observatory of Yale University. Vol. 3, Part 2: Trial of the Loomis Memorial Telescope for Stellar Photometry; with Determinations of the Light Curves of the RR Ceti ($1^h\ 27^m$) and of VV Orionis ($5^h\ 28^m$). Pp. 51-80. (New Haven.)

The South-Eastern Naturalist: Being the Twenty-eighth Volume of Transactions of the South-Eastern Union of Scientific Societies, including the Proceedings at the Twenty-eighth Annual Congress, held at Maidstone, 1923. Edited by Edward A. Martin. Pp. lxxxii+94+8 plates. (London.) 5s. net.

International Geodetic and Geophysical Union (Union Géodésique et Géophysique Internationale): Section of Terrestrial Magnetism and Electricity. Bulletin No. 3: Transactions of Rome Meeting, May, 1922. Edited by Louis A. Bauer. Pp. vii+181. (Baltimore, Md.: Johns Hopkins Press.) 3.50 dollars.

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 13, No. 1, December. Pp. 318. (Plymouth.) 10s. net.

Bulletin of the National Research Council. Vol. 6, Part 5, No. 36: Catalogue of Published Bibliographies in Geology, 1896-1920. Compiled by Edward B. Mathews. Pp. 228. (Washington, D.C.: National Academy of Sciences.) 2.50 dollars.

Nineteenth Report, State Entomologist of Minnesota to the Governor By A. G. Ruggles. Pp. 151. (St. Paul, Minn.: Agricultural Experiment Station, University Farm.)

Annuaire pour l'an 1924, publié par le Bureau des Longitudes. Pp. viii+658+A9+B26+C17+D10+E26+F72. (Paris: Gauthier-Villars et Cie.) 6 francs.

Diary of Societies.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Concerning the Nature of Things: The Nature of Gases (Juvenile Lectures (2)).

MONDAY, DECEMBER 31.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Mrs. Charles Hose: Boat Journeys in Sarawak (Lecture for Young People).

TUESDAY, JANUARY 1.

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College), at 2.30.—Sir W. Henry Hadow: The Claims of Scholarship (Presidential Address).

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Concerning the Nature of Things: The Nature of Liquids (Juvenile Lectures (3)).

MONTESSORI SOCIETY (at University College), at 6.—Miss Barbara Low: The Value of Psycho-Analysis to the Educator.

WEDNESDAY, JANUARY 2.

ROYAL SOCIETY OF ARTS, at 3.—Prof. W. A. Bone: Fire and Explosions (Dr. Mann Juvenile Lectures (1)).

SCHOOL NATURE STUDY UNION (at University College), at 3.—Sir Richard Gregory: The Sun and Stars.

PHYSICAL SOCIETY OF LONDON AND OPTICAL SOCIETY (Annual Exhibition, at the Imperial College of Science and Technology), 3 to 6 and 7 to 10.—At 4.—H. B. Grylls: The Heape and Grylls Rapid Cinema Machine.—At 8.—Sir Richard Paget, Bart.: The Nature and Artificial Reproduction of Human Speech (Vowel Sounds).

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—D. Fitzwilliams: A Scientific Method of Removing Foreign Bodies.—A. G. T. Fisher: The Pathology and Treatment of Internal Derangements of the Knee-joint.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—R. H. Barfield: Some Experiments on the Screening of Radio Receiving Apparatus.

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7.30.—B. K. Das: The Habits of some Indian Fishes.

THURSDAY, JANUARY 3.

GEOGRAPHICAL ASSOCIATION (at Birkbeck College), at 9.30 A.M.—L. MacD. Robison: Ceylon.—At 11.30 A.M.—Sir Richard Gregory: British Climate in Historic Times (Presidential Address).—At 2.—Joint Conference with the Royal Meteorological Society and the Science Masters' Association. Subjects for Discussion: The Place of Meteorological Observations in the School Course—The Teaching of Meteorology and Climatology in Schools.—At 5.30.—Prof. E. de Martonne: A Study of Transylvania.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Concerning the Nature of Things: The Nature of Crystals—the Diamond (Juvenile Lectures (4)).

PHYSICAL SOCIETY OF LONDON AND OPTICAL SOCIETY (Annual Exhibition, at Imperial College of Science and Technology), 3 to 6 and 7 to 10.—At 4.—Sir Richard Paget, Bart: The Nature and Artificial Reproduction of Human Speech (Vowel Sounds).—At 8.—H. B. Grylls: The Heape and Grylls Rapid Cinema Machine.

INCORPORATED BRITISH ASSOCIATION FOR PHYSICAL TRAINING (at University College), at 5.30.—Major H. J. Selby: The Mental, Moral, and Physical Health of a Nation.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. S. P. Smith: Railway Electrification in Foreign Countries.

FRIDAY, JANUARY 4.

GEOGRAPHICAL ASSOCIATION (at Birkbeck College), at 10.30 A.M.—Conference on The Teaching of Railway Geography.—At 2.30.—Annual Business Meeting.

EUGENICS EDUCATION SOCIETY AND LING ASSOCIATION (at University College), at 3.—Mrs. Hodson: The Teaching of Hygiene and Racial Progress.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Mrs. Julia Henshaw: Camping in the Kootenay, British Columbia (Lecture for Young People).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Pictorial Group Meeting.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—L. Manico: Economy of Fuel by Removal of Soot from Boiler Tubes.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. S. Boyanus: Russian and English Phonetics.

SATURDAY, JANUARY 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Concerning the Nature of Things: The Nature of Crystals—Ice and Snow (Juvenile Lectures (5)).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Sir David Prain: Gilbert White and Moral History.