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## A British Science News Service.

UNDER the auspices of the British Association and the British Science Guild, a conference was recently held to consider the advisability of establishing a science news service in Great Britain, and after discussion a small committee was appointed to carry the matter further. For some time such a service has existed in the United States, and the success achieved in that country encourages the belief that there is room in British newspapers also for accurate information on scientific subjects, narrated in such a manner as to be interesting to the average educated but unscientific reader. Matter which is suitable for the American reader is not necessarily suitable for the British: each nation has its own idiom and its characteristic outlook. But what American science can do for America, British science should be able to do, in its own appropriate way, for Britain. Already the *Morning Post* and one or two other British papers make a feature of admirable reports on scientific subjects, while a few specially gifted men of science are doing excellent work by furnishing the press with informative articles: but apart from these exceptional cases it is a commonplace that the great majority of newspapers fail to distinguish between science and magic in anything but name, that the space they allot to science, as distinct from sensational charlatanism, is negligible, and that such paragraphs as they do devote to scientific topics are for the most part meaningless and in many cases untrue. The sporadic efforts of a few gifted journalists are not adequate to meet the situation. What is needed is a systematic supply of news the accuracy of which shall be guaranteed by recognised scientific organisations, while its form renders it easily digestible by at least the better educated newspaper readers.

It is a curious fact that while it is considered socially disgraceful to be entirely ignorant of literature, a man's conception of the material universe he lives in may be that of a primitive savage, without his thereby incurring the smallest social stigma. Yet it is of vital importance to a modern State that its people should appreciate the value not only of the past achievements of science but also of its current enterprises. In his recent presidential address to the British Electrical and Allied Industries Research Association, Mr. Ll. B. Atkinson dwelt on the fact that Great Britain, which can claim credit for the fundamental discoveries in almost all the principal branches of science, has little or no vision of what could be achieved for it, in the material sense, by the adequate encouragement of scientific research: only by the cumulative effect of reiterated reminders, in the form of scientific news

items in the daily press, can the lay public be brought to recognise the untapped resources of command over Nature to which scientific research holds the key. The material advantages conferred by science are, however, to some minds its least valuable gifts. As a means of culture, as a perennial source of interest and wholesome enjoyment, scientific knowledge is a boon which the layman is entitled to share up to the limit of his mental capacity, and the specialist who makes discoveries is guilty of unsocial conduct if he fails to impart his good fortune, so far as is practicable, to the rest of the community to which he belongs. Moreover, if the results of research are of value, its methods are of far greater value. Scientific knowledge differs from unscientific in its quantitative character rather than in its essential nature. It is pursued more systematically, it depends on inferences which are more cautiously drawn, its propositions are held as having assigned degrees of probability rather than as being 'true,' it is characterised by more complete candour, and it is more resolutely guarded against the influence which habit and emotion exert on the judgment. Most of the administrative problems of the world could probably be solved by the application to them of similar standards of thought, and the more fully the general public comes to understand the methods of science, the better will it apply them in the conduct of its own affairs. The value of scientific method as an intellectual model and a mental discipline is at least as great as the value of its industrial achievements.

It must, of course, be recognised that scientific topics are not all equally suitable for popular consumption. The bulk of the matter to be supplied to the press would presumably consist of descriptive accounts of the results of research. Such subjects as the relation of animals and plants to man, or the phenomena observed during an eclipse, can with a little trouble be made interesting to readers of quite moderate education. Into the jam provided by such attractive items could be inserted, with tact and discretion, a reasonable proportion of pills in the shape of references to experimental methods (these would be of particular interest to skilled mechanics) and to reasoning processes. The rather disproportionate interest which the lay public takes in scientific hypotheses might also be gratified with safety, provided that the nature and use of a hypothesis be repeatedly explained. In all cases an attempt should be made to give the facts in true perspective, the relative degrees of probability attaching to various results being carefully distinguished, and the relation between observation and conclusion explained wherever possible.

There is already a keen demand for trustworthy information of the type described, and it is a demand which could be greatly increased by the provision of a suitable supply. Probably if there is one subject less suitable than the rest for popular exposition it is Einstein's theory of gravitation, yet when this was 'featured' by the *Times* some years ago, the public responded with a thirst for information which created an excellent market for popular books on the subject. If, then, the most esoteric subject that could possibly have been thought of met with such an enthusiastic popular reception, there can be no doubt as to the 'news value' of really suitable material. One or two of the higher grade of newspapers already find it worth while to provide accurate science news, and this fact, combined with the experience of the United States, indicates that a science news service need expect little difficulty in creating a market for its wares.

Doubt is sometimes expressed as to whether satisfactory popular exposition is seriously possible, and whether a scientific truth can ever pass into the mind of an unscientific reader without undergoing such distortion as to render it a fallacy. This objection might be sufficiently met by mentioning a few of the names which have made the Royal Institution famous, but the matter deserves somewhat closer attention. Newspaper readers are not a homogeneous class. Some will only be capable of following the simplest descriptive matter, but for the rest the improved teaching of science in schools is bringing into existence year by year a growing class of men who are quite familiar with the fundamental conceptions underlying modern science, and only need the stimulus of a daily news paragraph to enable them to resist the atrophy of their intellectual equipment.

Further, the difficulty of understanding scientific books and papers arises only in part from the intrinsic difficulty of their subject matter. It is beyond dispute that the published records of research are often extremely badly written. They abound in slovenly sentences giving rise to ambiguities which can be solved only by special knowledge on the part of the reader. They present ideas in a haphazard order which makes assimilation difficult. They omit to elucidate conceptions which are familiar to the author, but require explanation for the benefit of the less specialised reader. They fatigue the mind with the elaboration of minor details, and fail to focus attention on the really important parts of their subject matter.

The skilled scientific journalist, who mixes with the world in general sufficiently to understand his public, will avoid these faults. He will also know what to take for granted and what to explain, when to use a technical term and when to translate it. He will illustrate general principles by particular examples, and explain obscure conceptions by means of such analogies

as are helpful and not misleading. Above all, he will repeat his more important statements, varying their form and context, often enough to make sure of their being fairly grasped. Charles Darwin showed what can be done by a man who is himself clear-headed and takes the trouble to write simply, directly, and with a sympathetic regard for his reader's difficulties in comprehension. The "Origin of Species" consists largely of close and difficult reasoning, yet it is probably one of the most widely read and best appreciated books of its century. It should be the duty of any news service which may be instituted to provide day by day the kind of authentic yet digestible interpretation of science which such writers as Darwin have definitely shown to be attainable.

The committee which has been formed will be confronted with a number of difficult problems, which will have to be solved before success can be achieved. Perhaps one of the most difficult will be that of guarding the news against mutilation by unscientific sub-editors. On the other hand, there is little to be feared from the alleged hostility of the pioneer journalists who are already in the field. It is to the interest of all concerned to co-operate in creating an increased demand for science news, and it is therefore reasonable to hope that the parties in the case will agree to pool their assets, which are, on one side, experience and an established reputation, on the other, the prestige of scientific authority.

Without the willing assistance of scientific workers and institutions, no organisation for the preparation and distribution of science news can possibly be successful, and even with it, there is little hope that the agency would be self-supporting for several years. As regards finance, it may be mentioned that the American service pays for itself to the extent of about 60 per cent. of its expenses, the remaining 40 per cent. being provided by endowment. It has been estimated that a British service, selling news at standard rates, would need an endowment of at least 5000*l.* to ensure its being able to run for three years, at the end of which time it should be possible to decide whether the support secured was sufficient to justify the continuance of the service. One of the questions before the committee which has been set up is that of the possibility of raising this sum by contributions from public-spirited donors or other sources. It is unnecessary to discuss here the contrivance of machinery for obtaining and supplying news, but on the assumption that this and the other tasks confronting the committee can be successfully carried out, the scheme in its broad outline is one which must commend itself to every man of science who appreciates the significance of the discipline with which he is associated. C. W. H.

## The University of London.

*University Reform in London.* By Thomas Lloyd Humberstone. Pp. 192+4 plates. (London: George Allen and Unwin, Ltd., n.d.) 7*s.* 6*d.* net.

THE signing of the Locarno Pact and the settlement of the Boundary question in Ireland can scarcely have failed to raise hopes in sanguine minds that, in such days as these, even the University of London difficulties may at last meet with some satisfactory solution. A Departmental Committee of the Board of Education, appointed in 1924, is at work. It is sitting behind closed doors, but it is understood that evidence has been taken and that before long we may have the Report. It is certain that when the Report does come, it will be read with the utmost interest and examined with the closest scrutiny by all who are interested in British university education.

With this prospect before us there comes to hand in the most timely way a book that will be invaluable in supplying to all who seek it a compact and readable account of the history of the University of London. Mr. Humberstone calls his book "University Reform in London," and he writes not merely as a chronicler but as one imbued with a zeal and a policy for reform. In such circumstances, it is not easy for a writer to present an undistorted tale of history, but, though the reviewer differs from Mr. Humberstone on a number of questions, he has no single word of complaint to make of prejudice or distortion. On the contrary, he is grateful for an historical summary that is at once accurate and alive, far removed in style from the monotonous correctitude of the civil service essays in which so much of our authentic educational history is—perhaps necessarily—enshrined. One is impressed but not oppressed by what Mr. Wells calls the high sincerity of the writer; he has a literary gift, a light touch, and an engaging frankness that greatly help the march of his story. Where he is adding his own comments or expressing his own views, it is plain to the reader, and it is quite refreshing to have here and there some serious proposal stigmatised as preposterous. The size of the book, the print, and the three aircraft plates of Bloomsbury, South Kensington, and King's College, are admirable.

For an adequate appreciation of Mr. Humberstone's outlook, the reader must be referred to the book itself; it must suffice to say here that he expresses strong opinions about the restoration of the Royal College of Science at South Kensington (the "Imperial College" being left for technology), and he is strongly in favour of full development of Bloomsbury as a university quarter. On the whole his counsels are those of moderation, and he seems quite hopeful of harmonious

co-operation being achieved in the University without any subversive constitutional change.

The University of London is so complex, the individual knowledge and interests of those who criticise so varied and often so partial, that it appears less presumptuous to speak about it in the first person singular than to usurp an editorial "we," and in what follows that course will be taken.

I have had for nearly half a century a close interest in the University of London. As a student of chemistry at Owens College, Manchester, I became indebted to it as affording me the sole available means of obtaining a university degree. In early life I was thrown much among men with whom, in the days of religious tests at Oxford and Cambridge and the neglect of science there, the University of London stood for emancipation, freedom, and progress. It gave a university franchise to a vast section of the community suffering from a genuine grievance; it was subserving the development of the new universities that have arisen in our great cities; and it gave university privileges to women. It must be difficult for the younger generation to-day to understand the intensity of feeling which lay behind and still in a measure survives in the external-examining service of the London University. People have wondered how, for example, Convocation can ever have claimed so great a say in the University affairs; but it is easy enough for Victorians to understand—whether they approve it or not.

During the modern period of university development, the new universities in the provinces have, of course, been watching one another very closely, but they have been watching, not less closely, the University of London. What London does matters very much to them. There are two chief reasons for this. In the first place London seems from a distance to stand in more danger than any other university of coming into the toils of Government and bureaucratic control. In the second place, there is the possibility of London having ascribed to it duties or privileges of a metropolitanism and even an imperialism for its University, because London is the capital of England and the chief city of the Empire.

Of these questions I will only refer to the first, and on that little need be said in the columns of NATURE, for most of its readers will know how deep and intense in the English university world is the feeling that freedom and autonomy are beyond all else vital to a true university. They know that the possible encroachments of Government or other bureaucratic authority on university preserves even in England have called for constant vigilance. They know also the peculiar position the University of London has occupied in relation to the Government—or if they do not they will learn it from Mr. Humberstone's book.

Apart from the two special questions that I have named, there has naturally been great interest among those engaged in the newer universities in watching the efforts that have been made in London to achieve the stupendous task of welding into a genuine university the array of varied institutions which were providing studies of the university type. As a problem of organisation and administration, it is unique in magnitude and complexity, and in the purely educational aspect it is fraught with complications and difficulties of a quite peculiar kind. A smooth course of construction, a rapid achievement of unity, could not be expected by any reasonable person.

The University of London is bound, *ipso facto*, to be great in one sense, and it may easily be made great in external appearance by the aggregation of buildings and the creation of an imposing University quarter. But of course the real difficulty is to supply not the body but the soul to a University of London. We can conceive what might have been now if there had been in early times a true University of London, and if this University, growing up *pari passu* with the growth of London itself, had become scattered into such discrete and distant parts as those now comprised within the University. The parts would have had a genetic relationship, and there might well have been preserved among them, even within this modern community of more than ten million people, a reality and sense of University fellowship, a pride strengthened by time and tradition in being members of a great learned and humanising corporation in the metropolis of the Empire. We may conceive that in its specialist institutes and single schools, in its social amenities of clubs and parks, there might have been strong agencies for promoting a collective university spirit. But the University, even if in substance and action little more than a name, might have remained an august and genuine *Alma Mater*.

To bring together the constituent parts, as they were at the inception of what is known as the teaching University of London, and to imbue them instantly with any of the spirit which has just been referred to, was certainly not to be expected. I confess to having considered the problem to be well-nigh hopeless and to have been inclined to think that the most likely solution of the University question in London would lie in the creation of several completely independent universities. This state of mind arose from my experiences and instincts as a university teacher and the apprehension I felt in observing how strong seemed the faith in some minds that a University of London was to be created by mere aggregation—by catching

and binding institutes and teachers into an examinational nexus, and by creating a machinery of organisation, co-ordination, and administration that together promised to make the life of a university teacher in London scarcely worth living.

I am happy to say that recent events have modified my opinion. The decision of King's College to remain where it is and to abide by limitations of space and numbers whilst making itself as good as it can be, was announced in June last in the *Times* by a letter from the Principal, Dr. Ernest Barker, which rang with a clear and arresting note. The Imperial College, under its new Rector, Sir Thomas Holland, has also apparently by a shrewd stroke reached a condition of contented life within the University circle. This trend of opinion and action seems to give good hope for the future. I am one of those who believe that a strong individual life of colleges must, in London as in Oxford and Cambridge, underlie any real strength of the university, and that it will be in keeping the official bonds within the university as light as possible that we may hope to see them grow strong. The *Lehrfreiheit*, of which perhaps we are rather tired of hearing, is after all a very serious aspiration, and equally serious are the susceptibilities of important public men, who give time and labour voluntarily to the management of individual colleges.

I believe that here, as in so many other corners of our educational world, the root of trouble is to be found in the false attributes which have been put upon university degrees. The apprehension that the freedom of a college will be associated with a laxity of academic standards is of course the natural view of the man in the street, but it is still felt also to some extent within the teaching world itself. People seem to forget how wide and influential an educated public opinion has arisen in the course of the last generation. It is perhaps more difficult in London than elsewhere to realise what an array of educational officials, what multitudes of headmasters and other teachers trained in the modern universities, are now watching all the universities and colleges, and how quick and effective is their detection of any shortcomings. Not much is said aloud, but there is a closeness of scrutiny and a silent appraisement in existence that make little of examination syllabuses or lists and go right to the heart of things. I am certain that the new universities in the provinces are sensible to-day of an intelligent and mute surveillance which is constantly and justly estimating their sterling value and letting it be known wherever such knowledge matters. I believe that the danger of London colleges under-bidding one another in their courses for a degree need in these days cause no anxiety. The question that will more and more be asked of London graduates will be, as it now is with the initiated, not whether they have an honours degree, but how, where, and by whom they were trained.

It was my fate to work for seventeen years in the bonds of a federal university wherein three colleges were acting together, linked closely in a degree system intended to preserve a uniform academic standard and a just classification of graduates. The condition was of course a great improvement on that of wholly external examination, and no doubt the teachers of the different colleges gained a good deal from intercourse and discussion in Boards of Studies and in their joint examining. But many of us felt the restrictions to be very serious, and in the following years of liberty the University of Leeds, and I think it is equally true of Manchester and Liverpool, has worked to more valid and really higher standards and has dispensed its honours with much greater justice. I see no reason why the disbanded colleges might not have obtained much, if not all, of this freedom and still have remained in name members of a Victoria University if there had been any strong practical or sentimental motive for such a union. But the case is of course different with the colleges and institutions in London. Here, there are both an obvious and compelling argument for inclusion under one university name and the geographical possibility of collective university action in the creation of special institutes and in bringing into common account the great and unique treasury of resources which London can contribute to university studies. The prospects for the teaching University of London appear to me to-day to have grown very sensibly brighter.

For the externally examining agency I can see a useful place if it be disentangled from the teaching university. Until the provision of universities in the country is completed, there will still be some developing colleges seeking the mark of a degree for qualified students. They had surely far better come to London, as of old, instead of trying to stir the new universities in the provinces to begin upon the work in which London is so well practised. Besides this there are, no doubt, and may be for a considerable time, a good many individual hard cases that are met by the externally examining system. But there is one thing that even the most devoted of the old guard of the external side of the University of London must now recognise; it is that the strength of opinion which has been steadily growing against completely external examining from top to bottom of our educational system, is now overwhelming, and that the external degree of London cannot escape the consequences.

The short preface which Mr. Wells contributes to

Mr. Humberstone's book is written in a vein of striking earnestness. Mr. Wells is of course one of the most distinguished beneficiaries of the old examining agency that bore the device of a university. The outlook which he now takes is, I think, very much the same as is taken in this article. If all of us who owe so much to the system that had its day and is ceasing to be, can readjust our loyalty as fairly as Mr. Wells has done to the system that must now succeed it, we should be doing a great good turn for a true University of London.

A. SMITHELLS.

## Industrial Distillation.

*Principles and Practice of Industrial Distillation.* By E. Hausbrand. Translated from the fourth, new and enlarged, German edition by Dr. E. Howard Tripp. Pp. xx+300. (London: Chapman and Hall, Ltd., 1925.) 21*s.* net.

THIS translation of Hausbrand's "Die Wirkungweise der Rektifier und Destillier Apparate" is a welcome addition to the comparatively small number of text-books on distillation which are available in the English language. As the original work has attained the rank of a standard treatise in the country of its origin, where it has reached the fourth edition, and as it is well known in other countries to those who can read German, it is rather surprising that a translation has not been attempted before now. As publication, however, although delayed, supplies an obvious want, there is no doubt that the book will find its way into the hands of many readers to whom it should prove of great service and interest.

Hausbrand's analysis of the various processes which occur in the distillation apparatus has the peculiar merit of avoiding any use of the calculus, and in this respect his presentation of the subject will appeal especially to those readers who are confounded by the integration which is so frequently employed by other writers. On the other hand his methods, although easily understood by the non-mathematical student, would appear to involve a great number of calculations. It is true that the results of such calculations for eleven of the best known mixtures are given in tabular form with great detail and for a variety of conditions such as are met with in practice, yet for other pairs of liquids than these, the necessary work would be both tedious and time-consuming compared with that required in the graphical integration which is such an important feature in other methods of analysis. Throughout by far the greater part of the book, the author has very wisely employed percentages by weight instead of the molecular percentages so much beloved of other writers. In the small section devoted to the calculations of the vapour composition curve, molecular fractions and percentages are employed quite correctly because they are essential, but their introduction into any analysis which purports to be of a more or less practical nature is not only confusing but also in the majority of cases quite unnecessary.

The extensive tables and accompanying graphs which form such an important feature in the book are very instructive when studied in connexion with the text. It must, however, be remembered that, as with all other methods of analysing distillation processes, it is necessary to assume that equilibrium conditions hold between a mixture and its evolved vapours. As such conditions do not exist in the working column, it is necessary to apply a correcting factor to the results obtained by using either Hausbrand's or any other method. This does not detract in any way from the great value of the book to all those engaged in practical or academic work connected with distillation. It does point to the need of establishing the relationship between the number of plates in a perfect and in a working column for different values of the reflux ratio and different initial and final concentrations of the mixture to be distilled.

There are some parts of the book where the author has preferred to calculate tables by first evolving somewhat fearsome formulæ, whereas a simple example would have saved time and trouble. For example, to arrive at the alcohol content of the residual liquid (Section 11, pp. 36 *et seq.*) several pages are devoted to evolving two equations by which the data given in Table 4 are calculated. The necessary calculations are, however, so brief and simple that the section seems redundant or, at least, could be severely compressed and explained by one example occupying a few lines. In some other directions similar remarks might be made. Viewed as a whole, the work is of considerable practical utility and contains a wealth of information which can be studied with advantage in connexion with plant on the works scale. In the first part of the book the underlying principles are explained, and in the second part is given the application of these fundamentals to the calculations of the required dimensions of fractionating columns. The work is a classic which has found great honour in its own country. In its English version it should be read by all those interested in the subject of distillation.

The translator, while remaining faithful to the sense of the original, has succeeded in his object of producing an English work free from the style and the long involved construction which are so peculiarly German and must considerably perplex those who are imperfectly acquainted with the language. The reviewer, having read the original, can appreciate the excellent way in

which the lengthy periods so common in German scientific and technical literature have been rendered into easy flowing English. The original work contained a great number of mistakes especially amongst the suffixes, but these have been carefully corrected. In the translation very few are to be found and none of importance; 0·35 instead of 9·35 in Table 4 would not lead any reader astray. On p. 12 on the bottom lines, "must rise with" would be more correctly translated as "must rise within" (*innerhalb*) or "as part of." All such criticisms are, however, of very slight weight. Printing, binding, etc., are excellent, and improvements on the original. C. ELLIOTT.

## Biology of Cancer.

*Tumors and Cancers: a Biological Study.* By Hastings Gilford. Pp. xii + 703. (London: Selwyn and Blount, Ltd., 1925.) 42*s.* net.

MR. HASTINGS GILFORD has approached his subject as a biological study, a point of view which has received comparatively little attention from those engaged in cancer research. In a very exhaustive survey, the author discusses the natural history of tumours and their relation to normal and abnormal growth and development. Development is considered as a cyclical movement, a progression followed by regression, and Mr. Gilford believes that cancer ensues when certain cells complete their developmental cycle prematurely and are roused into regressive activity by stimuli; it is thus essentially of intrinsic production and a disorder of development.

It is a little unfortunate that this book was published before the description by Gye and Barnard of their recent work in cancer research, to which at first sight Mr. Gilford appears to be in direct opposition. Had the book appeared a year later, more consideration might have been given to the possibility that micro-organisms could play a part in stimulating cells into regressive activity. In all diseases which are due, or probably due, to bacteria, there are two factors to be considered: they are the causal microbe and the relative immunity of the body. Lack of methods for better understanding of the latter has driven research in infective diseases into search for and study of the nature of the microbe, and it is only recently that predisposing causes have begun to be thoroughly investigated.

To some extent Mr. Gilford's book provides a review of the predisposing causes of cancer, and so far he is not at variance with other workers on the problem. Where he definitely departs from the trend of modern research is in considering the real source of cancer as essentially intrinsic. Tuberculosis is just as much a reaction of the body as is cancer, though we now know it to have an external cause, which, however, is negligible if the body is completely immune. The problem of cancer will not be solved until there is full understanding of the exciting causes as well as of the steps by which healthy cells change to form a malignant colony.

Mr. Gilford's view of cancer as essentially a developmental error leads him through an interesting survey of the sins of personal and racial life which predispose to such error. Thus he sees at the root of malignant disease our national state of "accelerated or premature senescence," and associates it with a spirit of diffidence and indifference in facing our social problems. While the cure of our political ailments and the removal of our personal errors of living may not eradicate cancer, nobody will fail to agree with him in his plea for a better form of civilisation and conformity to the rules which promote a higher standard of individual and national health.

## Our Bookshelf.

*Practical Physical and Colloid Chemistry: for Students of Medicine and Biology.* By Prof. Leonor Michaelis. Authorised Translation from the second German edition by T. R. Parsons. Pp. x + 195. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1925.) 7*s.* 6*d.* net.

THE English translation of this very useful book is to be cordially welcomed. Although it is intended for students of medicine and biology, and many of the examples in it are selected accordingly, the student of general colloid chemistry will derive considerable benefit from working through the greater number of the exercises. The very first chapter gives a much clearer account of the principles of serial experiments—which play so important a part in the study of electrolyte coagulation and of adsorption—than is to be found in the existing laboratory manuals. The application of these principles is thoroughly illustrated in the subsequent exercises on electrolyte coagulation and on the Hofmeister series. The author, in common with all European authors, appears to be quite convinced of the reality of the anion effect, in spite of J. Loeb's criticisms, and, following Wo. Ostwald's example, demonstrates it with hæmoglobin instead of the usual egg or serum albumin. The chapters on the determination of hydrogen ion concentrations are excellent, and a student who has mastered the one entitled "Units and nomenclature" ought to have no illusions on the accuracy of statements like "*p*H 4·3 to 4·6," and should be able to state either offhand in gram-ions per litre. Viscosity is treated somewhat briefly, and some exercises on sols other than that of gelatin would have been instructive. On the other hand, the sections on surface activity and on adsorption—on which subjects the author has done much original work—contain a number of very ingenious experiments not to be found in other manuals.

The translation is unusually good, and it is a pleasure to read an English rendering of a German text in which no hyphenated nouns and compound adjectives have been allowed to intrude. The translator might, however, have considered it part of his functions to restore a victim of the German mania for phonetic spelling like "Tindall" to its correct form, and even in these degenerate days he should have given the participle of *adjuware* its proper termination instead of making it "adjuvent."

*Principles of Genetics: an Elementary Text, with Problems.* By Prof. Edmund W. Sinnott and L. C. Dunn. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xviii+431. (New York: McGraw-Hill Book Co. Inc., London: McGraw-Hill Publishing Co. Ltd., 1925.) 17*s.* 6*d.* net.

THIS book is intended to be used by first-year students taking an introductory course in genetics, and appears to be well adapted for the purpose. It is pleasantly and clearly written, the numerous illustrations are well executed, and the authors have succeeded in obtaining a fair proportion which are not already over familiar. An innovation in this class of book is the introduction at the end of each chapter of a number of "Questions for Discussion," of "Problems," and of what are termed "Reference Assignments." Of these, the problems are on the whole excellent, and, to the student who conscientiously works through them, should provide a good test as to whether he has fully grasped the subject matter on which they are set. They should also prove useful to the teacher. The reference assignments are perhaps intended for more advanced students, for many of them seem too difficult for elementary ones.

If, as is likely, a second edition of the book is called for, the authors should pay a little more attention to their historical sketch, and to the crude diagram on p. 6. Genetics is here shown emerging from the "Dark Ages" with the discovery of spermatozoa by Hamm in 1677, as though the names of Harvey and de Graaf had no significance for students of this science. Nor was the function of the sperm discovered by Spallanzani about 1700, for at that time he was not even born. To Camerarius too should be given some credit in the discovery of the process of fertilisation in plants. And why should not Buffon and Erasmus Darwin be mentioned in connexion with theories of evolution? The dates after some of the names evidently refer to a famous publication such as Darwin, 1859, Mendel, 1865; but why should 1779 be assigned to Knight, who was then a young man of twenty years with nothing particular to his credit? We agree that a brief historical sketch might well be both interesting and illuminating, but to be of any real service, it must be more accurate and more comprehensive than what is given here.

*Graphical Methods of Plotting from Air Photographs.* By Lieut.-Col. L. N. F. I. King. Pp. 92. (London: H.M. Stationery Office, 1925.) 3*s.* net.

THE rapid development of aerial navigation has opened the door to a number of new subsidiary possibilities, not the least of which is the mapping and surveying of large areas from air photographs. Generally speaking, the problem is twofold. It is concerned in the first place with the scientific conditions under which the photographs are to be taken and the scientific machinery, camera, lens, plates, etc., for effecting this. In the second place, it is concerned with the principles and methods that have to be devised for the accurate interpretation of these photographs in terms of an exact geometry of the landscape. The present collection of notes deals with the second aspect of the question, not as a dogmatic treatise on the subject—it is too early for that—but as a record of graphical processes that may be utilised in the analysis and synthesis of such photographs and the geometrical principles upon which such processes depend. It is not claimed that for this purpose graphical methods are necessarily superior to other possible methods of a mechanical or a photographic nature, but that many cases must occur both in peace and war where individual and tilted photographs must be made to yield their secrets, and the graphical processes described in this work will do it.

There are many parts of this interesting subject that might with advantage be incorporated into a course on perspective and descriptive geometry, and teachers of this subject would do well to examine this little book. One word of criticism. One does not require to be a purist to object to the word "photo," especially when it alternates with "photograph," so that no new significance is attached to it. Its frequent appearance on every page of this Government publication does not convert it into the King's English.

*Chemistry to the Time of Dalton.* By E. J. Holmyard. (Chapters in the History of Science, 3.) (The World's Manuals.) Pp. 128. (London: Oxford University Press, 1925.) 2*s.* 6*d.* net.

To the majority, perhaps the vast majority, of trained chemists, the history of their subject is practically a closed book, partly because they lack the historical sense, but also because they have been repelled by the manner in which the subject has been presented. To write a readable history of chemistry that will appeal to the practically-minded is no easy task; alchemy, with its lure of gold, has always a certain fascination, but the symbolical writings of its devotees are painfully dull to all except the specialist; and the long-drawn-out controversies of later times on views that are now held to be mainly erroneous are no less wearisome. To those who have passed through the mill, or have been arrested at its threshold, Mr. Holmyard's little book will be heartily welcomed as a successful attempt to present in bold outline a history of the development of ideas which have played a great part in the elaboration of modern chemistry, notably those on the constitution of matter and on the nature of combustion; and the author's original work on the gropings of the early Muslims will add a spice of novelty to what is usually regarded as dull and indigestible. Specialists will naturally ask for a more detailed treatment than that here presented, but they also will read with pleasure and profit this valuable introduction to the subject. The book is well written, profusely illustrated, and remarkably cheap.

## 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 Loculus of Archimedes.

IN the course of study, of a totally different subject, I recently came across reference to a pastime of the ancient Greeks and Romans, which was of the same nature as the Chinese puzzle, or Tangram, though more elaborate. Curiosity being excited, the scattered references were hunted up, and it was found possible to reconstruct this puzzle with practical certainty, though I have not been able to discover that this has previously been done. From the manner in which this has been received, by those who have seen it, the subject appears to be of sufficient general interest for the result to be placed on record.

To this puzzle the Romans applied the name of *loculus Archimedius*, the first word meaning a small receptacle divided into compartments, the second referring to the name of the reputed inventor. The Greek name is uncertain; the lexicons give it as *ostomachia*, but the only authority quoted is the Latin writer, Ausonius, and this is the form usually adopted by the editors of the printed texts, though the word is sometimes given as *stomachia*. The question of the choice between these two forms was discussed at length by Prof. J. L. Heiberg, in 1907 (Hermes, *Zeitsch. f. class. Philol.*, **12**, p. 240), who concluded that the first named, usual, form is a mistaken emendation of the editors, and that the other is the correct one; it is also the form found in a palimpsest, deciphered by him in 1906, and the only known occurrence of the word in a Greek manuscript. If ostomachia is correct the interpretation would be a battle or struggle of bones, while stomachia, or stomachion, would mean the thing that drives one wild.

The descriptions of the Latin writers, being in each case a parenthesis, in illustration of a very different subject, are naturally incomplete, but they show that the puzzle consisted of fourteen pieces of ebony or ivory, mostly in the form of triangles of various kinds and descriptions, with some pieces of a larger number of sides, which were combined to form pictures of fearsome elephants and barking dogs, of ships, castles, and many other objects, but, adds Ausonius, though the compositions of the skilled are wonderful, the efforts of the novice are ridiculous. To this all that can be added is that the whole set was contained in a *forma quadrata*, an expression which, like its English equivalent, square, in geometry implies equality of the four sides, but, in literary or colloquial language, need mean no more than a rectangle.

These descriptions, though they give a good general idea of the puzzle, are no help to a reconstruction of it; of this the first information became generally available in the publication, by H. Suter, of the text and translation of two Arabic manuscripts, preserved in Berlin (*Abh. z. Geschichte d. Mathematik*, 9, 1899, pp. 493-499). The Arabic text is itself a translation from the Greek and is entitled the book of Archimedes on the division of the Stomachion into fourteen parts; it contains a description of the construction, followed by a demonstration of the relation of the area of each separate part to the whole. The translation is illustrated by a figure, reproduced in Fig. 1, which appears to be a reconstruction by the translator, as no mention is made of any figure appearing in the manuscript, and two similar manuscripts, in the India Office and Bodleian libraries, are both wanting in the figure, for which a space is left. The construction may be briefly described: the figure ABGD, drawn as a square but described in the Arabic as a parallelogram, is divided into two equal parts by the line EZ, parallel to AB; the diagonals AG, BZ, ZG are drawn; AL is bisected in M, and BM joined; BE is bisected in H, from which HT is drawn parallel to AB, and HK as part of the line joining HA; ZG is bisected in C, and DG in N, and EC, CN are drawn; finally CO is drawn in continuation of BC; the whole figure being thus divided into fourteen parts.

This interpretation appears to have been accepted by scholars as a representation of the loculus, but an examination throws doubt on this conclusion. First there is the practical difficulty that it gives a number of very acute angles, which would not only need skilled and careful workmanship to produce, but the razor edges resulting, in one only just over 11°, would be too brittle to stand usage, and would rapidly become damaged. Secondly, a comparison of the translation with the Arabic text shows that while,

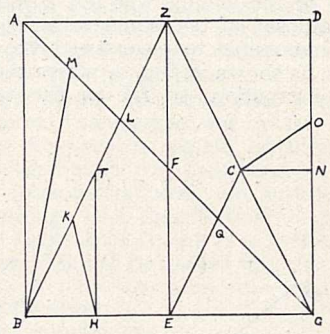


FIG. 1.

in the former, the outer figure AG is described as a square, and the two halves AE, ED as rectangles, the latter consistently uses the same word, which means no more than a parallelogram; and in this the Arabic is logically correct, for it treats the subject as an exercise in pure geometry, and the construction, together with the subsequent discussion, is equally applicable to any parallelogram, irrespective of the magnitude of the sides or angles.

These doubts have been largely cleared up by the discovery, in 1906, by Prof. J. L. Heiberg, of Copenhagen, that a palimpsest, preserved in Constantinople, was overwritten on a copy of the works of Archimedes, which has not only yielded very important additions to the previously known body of his writings, but also contains, at the end, part of a book of the Stomachion, the existence of which had been unknown. This fragment was first published in 1913, in the second edition of the works of Archimedes, edited by Prof. Heiberg for the Teubner Classical Library (vol. 2, p. 416 ff.). The opening paragraph of this fragment says that as the thing called the Stomachion presents examples of the method of transposition of figures, he thinks it well to treat of these and to show how it is divided and how the parts resemble each other, so that, in forming them into pictures, one may see how the angles may be combined to form two right angles, and whether two sides, which appear to lie in a straight line, do so, or depart slightly from it; though a picture is not necessarily to be rejected on account of a small gap resulting from this. It is evident from this

summary that the complete book would have made a very interesting treatise on the game, but only two short passages remain. The first, following immediately on the introduction, demonstrates that the angle AMB (Fig. 2) must be an obtuse one, and the second, following on a gap, is part of the description of a construction, similar, so far as it goes, to that

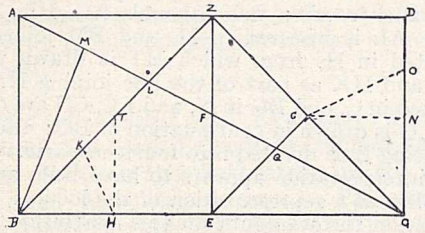


FIG. 2.

described in the Arabic manuscript, with the instructive addition that, after the first division of the whole figure into two equal halves, each half is a square.

From these passages two conclusions may be drawn: that the pastime was really an invention of Archimedes, and not merely fathered on him, and that the initial figure of the loculus was not a square, but a rectangle composed of two squares, set side by side. This makes it possible to reconstruct the pattern of the divisions, as shown in Fig. 2, where the firm lines show the construction, so far as the text of the palimpsest goes, and the dotted lines the completion, taken from the Arabic text. I have, however, made one departure from the Arabic, in drawing the triangle OCN, which appears necessary if the thing is to be used in the manner described, and not as a mere exercise in geometry.

If Fig. 2 is examined it will be seen that the angles are either right angles, or the angles made by the diagonal of a square, or those made by the diagonal of a rectangle twice as long as it is broad, or the sum or difference of some two of these, so that there are many possible combinations by which either two or four right angles can be built up. Also, for length of side, we have the whole, half or quarter of AB, the half, third or sixth of BZ, and the third or sixth of AG, so that there are a number of sides which can be matched with each other, either singly or in combination. To this there are two exceptions: the line BM cannot be matched with any other side or combination of sides, nor can the angles at B and M be matched with any others to complete either two or four right angles, but the other sides of the two triangles, based on this line, and the angle between them can readily be matched, as can the combined triangle ABL. The other exception is the triangle OCN, and this is a very different case; if drawn according to the Arabic construction, with CO as a continuation of BC, it would have the angles of the diagonal of a rectangle of sides three by one, and the common side CO, the two sides NO, OD, and the four angles at O and C would none of them be matched with any other sides or angles. If, however, DN is bisected in O, we have a construction more in tenor with the rest, and get a triangle with angles of the diagonal of a two by one rectangle, though the length of the side CO, being one quarter of AG, would still be impossible to match with any other side. For these reasons it seems probable that, whatever may have been the original construction, designed as an exercise in geometry, the modification would soon have been introduced when it was adopted as a pastime, for, so far as may be judged from a slight experience, it is a marked improvement.

However this may be, it seems clear that, with this possible, though not probable, exception, we have, in Fig. 2, the actual pattern of the pieces forming the loculus mentioned in Latin literature. As examples of what can be done with it I may give a few ridiculous efforts of a novice (Fig. 3); the elephant (i), the ship (ii) and the two figure studies, which I owe to Sir Richard Paget, of the Pied Piper (iii) and the Pundit (iv) will give some indication of the wide range of subjects which can be depicted, in a somewhat cubist style it is true. The last-named figure, it may be noticed, contains one of those small gaps, which, the palimpsest expressly declares, need not involve the rejection of the figure. In each case the whole fourteen pieces are employed, this being, presumably, of the essence of the game; it happens at times that a satisfactory figure may be built up, with one or two pieces to spare, and then the fitting in of these superfluous pieces becomes the thing that drives one wild.

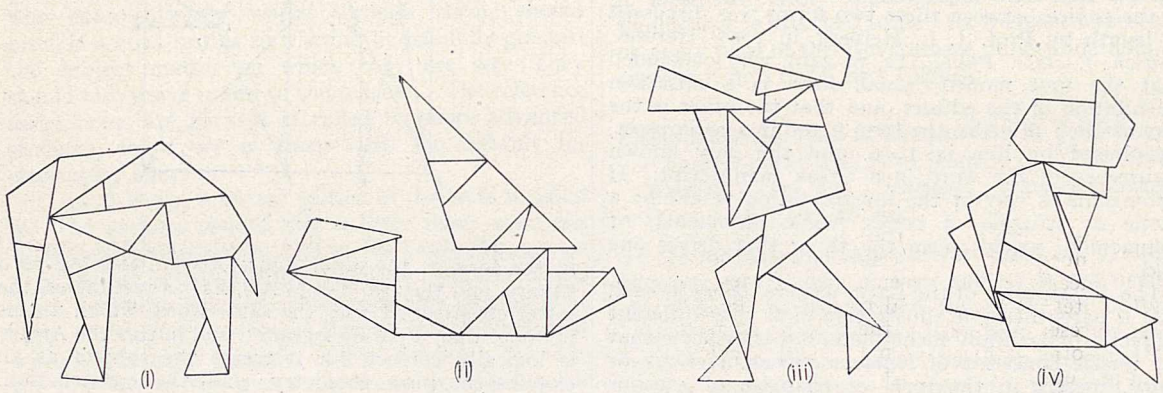


FIG. 3.

R. D. OLDHAM.

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### Use of an Artificial Horizon in Photographic Measurements of Buildings or other Structures.

IT is sometimes required to know whether certain lines intended to be vertical or horizontal in buildings or other structures are really so, and if not, by how much they deviate from these directions. All such measures can, of course, be made by a theodolite or level, but when many details have to be examined this is a long process.

A photographic method, however, which I made use of during the construction of the Tower Bridge, and elsewhere, compresses in a few negatives information which it would take weeks to acquire by direct instrumental observation on the spot.

This method, which I have had occasion to use again recently, consists in photographing the object to be measured, together with its image in an artificial horizon. If the lens used is free from spherical aberration and the plates are suitable, each negative will yield all the information which could be obtained from a theodolite of the same focal length.

Collodion plates give the best results. In all gelatine emulsion plates the coarseness of the grain is against the use of high power in the analysis of the image, and the more sensitive the plate the coarser the grain.

If $a_1$ $a_2$, etc., are points in the direct image and $a'_1$ $a'_2$, etc., corresponding points in the reflection, then straight lines joining $a_1$ $a'_1$, $a_2$ $a'_2$ are true verticals, and the straight line through their bisections is a true level, and indicates the line in which the plane of the artificial horizon cuts the object photographed.

Measurements made on the plate, therefore, will indicate how much out of 'plumb' any line may be, and also the angular altitudes of any points (above the plane of the artificial horizon) as well as their azimuths. Photographs of this kind might in many cases be substituted with advantage for plane-table work.

The only adjustment which must be made with any degree of accuracy is the levelling of the camera, that is, ensuring the verticality of the photographic plate. If the plate makes an angle $\alpha$ with the vertical, the images of true vertical lines will converge to a point on the plan of the plate distant from the centre by a quantity proportional to cot $\alpha$, and the image of a line joining the direct and reflected image of a point the azimuth of which is $\beta$ and altitude $\gamma$ makes an angle $\tan \alpha \tan \beta \tan \gamma$ with the true vertical. If $\alpha$ is small (a quarter of a degree or less) the error introduced is for most purposes negligible.

It is unnecessary to describe in detail the reduction of the measurements taken from the negatives, but a few notes on the general result may be of interest at the present time when there seems to be a widely spread notion that modern forms of traffic have an injurious effect on adjacent buildings.

Those who are acquainted with the subject do not require to be reminded that such disturbance of the ground as is caused by traffic has no effect on the stability of buildings, but the belief to the contrary is still common, and cracks and subsidences due to very different agencies are often imputed to 'vibration.'

Such experience as I have had leads me to believe that it is rare to find any building, whether old or new, in which lines intended to be vertical are not measurably out of 'plumb.' In what may be called domestic architecture—cottages and small houses—the errors sometimes approach 1°. For large buildings and factory chimneys, which have presumably been built under some sort of supervision, the inclinations to the vertical are much smaller, often only a few minutes of arc. In mining districts (in which I have not yet had any experience) the effects of subsidence would probably give much larger angles.

In the few old churches to which the method has been applied, I have not found more than 10′ or 12′ deviation from the perpendicular in the towers. For the interior columns, however, this is sometimes exceeded.

Referring to a few particular buildings, I could find no error in the verticality of the western towers of Westminster Abbey or in the Clock Tower of the Houses of Parliament.

The top of Salisbury spire is about 13 inches to the south of the position it should occupy, and the columns which carry its weight have been bent inwards by the thrust of the vaulting of the aisles. Their maximum horizontal displacement is only about 4 inches, but the effect as seen from the west end of the nave is conspicuous. There is, so far as I know, no evidence as to whether the bending took place at the time of the completion of the spire or later. Something of the same kind happened at Wells, and the inverted arches in that cathedral were introduced as a safeguard.

It is not uncommon to find that foundations have sunk locally as the load placed on them increased, and that building on the sunk foundation has been continued in a more or less true vertical direction, thus introducing a 'kink' in what should have been a straight line. The east end of the church in Smith Square, Westminster, is a good example of this. In St. Paul's Cathedral also there is similar evidence of a local sinkage of foundation during construction, but this cannot be seen from any ordinary point of view.

It would be worth while to obtain, for future reference, a regular series of artificial-horizon photographs of the principal existing buildings both at home and abroad, and these would be particularly interesting for earthquake and mining countries and also for towns built on pile foundations.

I expect it would be found that where buildings have remained unchanged for a few years after completion they would remain unchanged for centuries, provided that the conditions of the ground about the foundations were not interfered with as regards drainage and distribution of pressure, and that where subsidence occurs it is in these directions that the cause should be looked for.

A. MALLOCK.

9 Baring Crescent,
Exeter, January 16.

## Acidity of the Medium and Root Production in Coleus.

IN order to test the effect which the reaction of the medium has upon root-production by cuttings, experiments have been made during the summers of 1924 and 1925 with Coleus. It is the practice at the Royal Botanic Garden, Edinburgh, to root in cocoa-nut fibre cuttings which require heat. It was found that the fibre gave a reaction of *p*H 4·5-4·7, and was very strongly buffered, large additions of acid or alkali being necessary to shift the *p*H appreciably. (The testing was done with the B.D.H. Capillator, the brown colour of the water squeezed from the fibre causing little trouble in the capillary tube.) In view of this marked buffer action, it is not possible to use this natural fibre for experiment, though it is excellent in practice, being of a light texture and holding a good amount of water without becoming sodden. An artificial medium, comparable to the natural fibre in physical state, of which the reaction can be controlled, has yet to be found. Sand, cotton-wool, and glass-wool, with water, and water alone were tried; only the last proved satisfactory. Experiments were accordingly made with tap-water, adjusted to the required *p*H by the addition of traces of hydrochloric or sulphuric acids or of sodium carbonate, the normal *p*H of the water being about 7·3. While these results cannot be directly transferred to the case of fibre, owing to the great differences in oxygen supply, they are at least suggestive.

The cuttings were made at random from plants of

a form of *Coleus Blumei*. They were placed in large, carefully cleaned gas-jars, with about two inches of water. The water was changed as often as the indicator showed a marked departure from the initial *p*H—at least once in 24 hours. (All the solutions became more acid, owing to respiratory carbon dioxide: this was proved to be the chief source of acidity by the ease with which a current of carbon dioxide-free air restored the initial *p*H. The following indicators were used: thymol blue, phenol red, brom-phenol blue, di-ethyl red, methyl orange, brom-cresol green. At the dilutions used they were not toxic to the plant in seven days.) The cuttings were thus fully turgid, and no time was lost through preliminary flagging. At the end of the experiment (after seven or fourteen days) the roots of each batch were cut off, and roots and cuttings weighed separately after being dried to constant weight at 100° C. The weight of root corresponding to 1 gram of cutting was taken for comparison.

It was found that rooting would only take place between *p*H 4·0 and *p*H 9·2. Below *p*H 4·0 the ends in contact with the water quickly became soft and died. Within these limits *p*H 7·0-7·2 was the most favourable for root production; and *p*H 4·5 was more favourable than *p*H 9·2. The results for one experiment were:

| | | | | | |
|---|---|---|---|---|---|
| *p*H 4·5 : 1 | gm. cutting | corresponds | to | 0·05540 | gm. root. |
| *p*H 7·2 : 1 | ,, | ,, | ,, | 0·08138 | ,, |
| *p*H 9·2 : 1 | ,, | ,, | ,, | 0·04318 | ,, |

Even without weighing, the batch at about *p*H 7·0 was easily seen to be ahead: the roots appeared from one to three days earlier and were usually longer than the others.

The condition of the carbohydrate reserves had a marked influence on the rooting. Two lots of the same form of Coleus were used, one growing in full light and the other in a shaded house. The first had brightly coloured leaves and short red internodes, and the reserves were largely starch, with traces of reducing sugars. The second plant had larger and paler leaves, and longer internodes with no red colour, and the chief reserve was reducing sugar. The 'starch' plants produced more roots and produced them more quickly than the 'sugar' plants, regardless of the reaction of the medium. In all cases there was a basipetal concentration of reserves in the cutting after a few days.

The *p*H values of the tissues of the stem were examined by placing thick sections of fresh material (first washed in neutral water) in dilute solutions of di-ethyl red, methyl red, brom-cresol green, brom-cresol purple. They were found to be as follows: pith 5·2, xylem 4·4, cambium 5·8-6·0, phloem parenchyma, 5·8-6·2, cortex 5·2.

In fibre the cut end of the stem shows an intense reaction with Sudan III., indicating that the cut cells are blocked with fatty substances, and a basal meristem forms callus to a depth of three or four cells. In water the cut end stains only slightly or not at all with Sudan III., and callus formation is inhibited, but in spite of this rooting goes on freely.

These results indicate that the free admission of air is one of the most favourable aspects of the fibre, and suggest that (for this plant at least), given equal supplies of oxygen, a reaction of the medium near neutrality would be preferable.

These experiments are being continued on quantitative lines, in the hope of ascertaining more exactly the optimum reaction of the medium for this plant.

E. PHILIP SMITH.

Laboratory of Plant Physiology,
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Edinburgh.

## Genes and Linkage Groups in Genetics.

IN making a final reply to Prof. Huxley on the subject of linkage and genes, I should like to say that I resent very strongly his accusation that I refuse to keep to the point which he has raised. I may remind Prof. Huxley that he began the discussion by attacking my review in NATURE of Haecker's "Pluripotenz"; that he asked me for my views on the nature of linkage groups and unit-factors; and that when I answered him as briefly and clearly as possible, he replied by giving a lengthy exposition of the well-known 'results' of the Morgan school of Mendelians.

Prof. Huxley knows perfectly well that I could not deal with such an exposition without examining critically the evidence on which the 'ratios' were based, the value of the mathematical formulæ, and above all, the criteria for discriminating unit-factors, and that to accomplish all these things would be altogether impossible within the ambit of a letter to NATURE. All I could do was to indicate my general scepticism as to the value and soundness of Morgan's methods and to attempt to give my reasons for regarding the whole method of 'factorial analysis' as a futile way of attempting to solve the problems of heredity and mutation. Of course, I never denied that segregation of paternal and maternal characters occurs when a 'mutant' is crossed with the type, and in the "glad confident morning" of Mendelism twenty years ago, it appeared as if it would be an easy task to analyse this segregation into 'factors.' The attempts at this analysis, continued during the present somewhat overclouded afternoon of the theory, have led to such absurd and impossible results that they have induced many besides myself to regard the whole analysis as radically unsound in principle.

By a singular coincidence I have just received from Prof. R. Woltereck a copy of a paper which he has written on the gene for the 'eyeless' mutation in Drosophila (Zur neuen Genetik: II. Einiges über die Augenmutanten von Drosophila und besonders über die Mutation "eyeless," *Die Erde*, vol. 3, Heft 9, 1925). In this paper Prof. Woltereck examines all the work that has been done on this so-called gene. He points out what enormous individual variations are classed together under the head of the single 'unit-factor'; he states that to endeavour to account for these variations by introducing additional unit-factors only obscures the question by bringing in further 'unknowns' into the problem; and he concludes by observing that the only satisfactory way of dealing with the problem is a physiological one, which he enunciates in language almost identical with my own. He says that there is a normal grade of developmental energy in every animal which expresses itself in the typical development of every organ (thus the ommatidia of the Drosophila eye increase to a certain number and then stop); that in the eyeless mutants this energy encounters an increased amount of resistance varying in amount from individual to individual, due to the condition of the 'internal environment.' I should have preferred to say that the developmental energy had suffered different degrees of weakening, but that is a minor point.

As Prof. Huxley still seems to be in doubt as to my meaning, let me state again that I regard a linkage group as caused by a definite form of constitutional weakness, or as I should term it germ-weakness, the linked genes being "outward and visible signs" of this weakness. A good example of a definite type of germ-weakness is afforded by amniotic pressure in the developing vertebrate. This,

differing from case to case in its intensity, duration and period of onset, can manifest itself in the most varied groups of 'factors' showing different degrees of 'linkage.' Prof. Huxley says that he does not know what I mean by calling a unit-factor a 'change.' A unit-factor can only be defined and has always been defined by *its deviation from the type*: that is what I meant by calling it a change.

Prof. Huxley refers to the attempts of Stresemann to account for specific differences between birds on the basis of supposititious mendelising mutations. Stresemann is not the only Mendelian who has attempted this futile task: no good systematist known to me will have anything to say to it, and if readers of NATURE wish to convince themselves of the utter bankruptcy of all such efforts, I recommend them to read the latest and most elaborate of them by Goldschmidt ("Untersuchungen zur Genetik der geographischen Variation," *Arch. f. mikr. Anat. u. Entw.-Mech.*, vol. 101, 1924), in which he deals with the geographical races of *Lymantria dispar*. After trying in vain to account for his results by assuming (*pace* Prof. Huxley) Mendelian factors, he is driven back to the assumption of maternal and paternal (!) cytoplasmic influences, and even then does not arrive at a satisfactory solution. He thinks it could perhaps be done by assuming 'modifying factors' (Morgan's patent), but deems such a procedure beneath his dignity. Really, when Prof. Huxley says that Mendelian factors are not 'assumed' one doubts if he realises the meaning of words.

The central fact of biology is adaptation: its central problem is the origin of this adaptation, and until Prof. Huxley recognises this he will continue to flounder in a quagmire of imaginary 'factors,' the number of which will require continual augmentation, as Nature exhibits herself more and more unwilling to be comprised within the narrow formulæ of the geneticists. Really, the top-heavy structure already evolved in the imagination of these gentlemen reminds us of nothing so much as the Ptolemaic conception of the heavens "with cycle and epicycle scribbled o'er," which preceded the views of Kepler and Galileo.

E. W. MACBRIDE.
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THE purpose of my letter published in NATURE of January 16, p. 86, was to support, by an example, Prof. MacBride's view that mutations that appear together have some common developmental cause. From Prof. Huxley's letter it seems that the term 'linkage-group' is to be used only if this cause be unknown, when the hypothesis that the characters are associated because their factors are in the same chromosome is less easily disproved.

C. TATE REGAN.

### The Palæolithic Drawing of a Horse from Sherborne, Dorset.

IN NATURE of February 13, p. 233, Mr. C. J. Bayzand describes how his leg was pulled by certain boys of Sherborne School (for whose conduct, on their behalf, I wish to apologise to him) with respect to the finding of this inscribed bone.

As I probably know most about the circumstances of the find, I may be allowed to state the facts.

In, if I remember rightly, September 1911, among the new boys who visited the school museum for the first time were A. Cortesi and P. C. Grove, who asked where they could obtain fossils like those in the museum. I directed them to a certain quarry where, as it was being worked, they could find ammonites, etc. In this quarry, on a heap of broken stone, which the workmen told me had come from the opening to an adjacent fissure, still visible, where the rock was much broken, Cortesi, in the presence of Grove (who died in the War), picked up, among other things, a bone, which he handed to the latter, asking if it was a fossil. Grove said "No"; but in giving it back he noticed a drawing upon it. So Cortesi took it to his boarding-house, where in the evening it was examined and thought little of; but when Cortesi was about to throw it into the fire he was stopped by Jefferson (then a boy who had been a year in the school), as stated by him in a recent letter to the headmaster, which I am permitted to send for publication. The bone was accordingly brought to me for inspection, and afterwards given to the school museum by Cortesi.

That two new boys should have made such a discovery was, as any public school boy will understand, not looked upon favourably by many of the older boys, and very soon sides had been taken, for and against, and as "fama viret eundo," the latter party soon changed the locality of the find to a town refuse heap, and would-be recruits were shown how Cortesi must have drawn it, though this was not very effective, for he could not draw "for nuts," as boys say, and the Town Council of Sherborne burned their refuse and do not allow inhabitants to keep horse bones on their premises till they are as brittle as this one.

Eighteen months *later* the quarrymen broke into a narrow cave forming the lower part of the same fissure, and it was then evident that the heap on which the bone was found was composed of the debris from the quarrying away, some years before, of the entrance to this cave, which pointing south-west was situated near the summit of a short narrow valley, now dry from the working back of some of the Somerset streams draining the low land between Sherborne and Glastonbury and the Mendips, and in which, lower down, we have discovered remains of the mammoth and woolly rhinoceros.

Cortesi was always very jealous for his find to be attributed to himself alone, so it is improbable that any one else at Sherborne drew it, and he certainly could not himself. As a hoax on a master, a new boy in a public school, with all his troubles before him and without for some years any privacy, would scarcely think of hoaxing masters he knew nothing about; in fact, Cortesi's letter to the headmaster disposes of anything of that kind.

I have done my best to unravel the mystery of its production, if it is a 'fake,' and I have come to the conclusion, which I hope Prof. Sollas will accept, that it was not manufactured at Sherborne School. Like Mr. Bayzand, I always felt its similarity to Sir W. Boyd Dawkins' Creswell Crag specimen must raise doubts; but since I, as in duty bound, submitted it to the inspection of the members of the Geological Society, my doubts have been somewhat allayed and I have placed my trust and confidence in them, seeing that I am not in a position to be able to express an opinion myself. May I therefore, in conclusion, ask some member of that learned society to explain how they got over this difficulty of similarity to the Creswell Crag inscribed bone?

R. ELLIOT STEEL.
Stalbridge, Dorset,
February 18.

*Copy of Part of the Letter of Mr. E. A. Ross Jefferson.*

17 Kensington Palace Mansions,
De Vere Gardens, W.8,
12.2.26.

DEAR HEADMASTER—Perhaps I may be able to throw some light on the "Palæolithic Bone." Cortesi

showed it to me when he was about to throw it in the day-room fire, and I told him not to be such an Ass; as I had been reading about the Palæolithic Period, and saw at once that the bone was a real find.

I told him to show it to Bob Steel, which he did; and for that reason it is in the museum to-day.

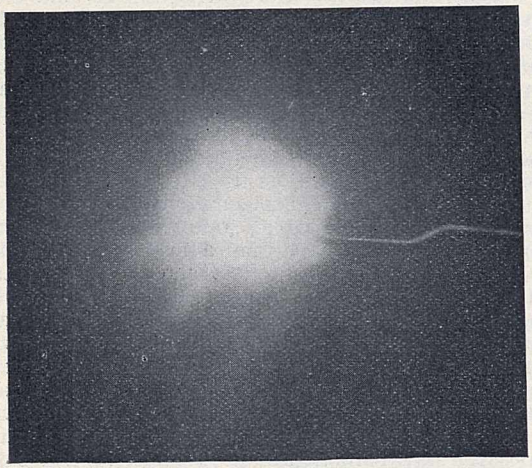
. . . . . .

The idea of the bone not being genuine was a rumour started by that arch-humourist, Mr. X.—Yours sincerely, E. A. ROSS JEFFERSON.

### A Single Electrode Arc.

THE accompanying photographs (Fig. 1) represent a somewhat extraordinary manifestation—a single electrode arc. The discharge is produced by the application of alternating voltage of the order of 5 kv. at frequencies higher than about 10,000,000

(a) Copper



(b) Molybdenum

FIG. 1.

cycles to an electrode consisting of a short length of wire. It may occur spontaneously if the wire is sufficiently thin (0·1 millimetre); with a thicker electrode it must be started by touching the end of the wire with a glass rod, which is then withdrawn. The discharge has the appearance of a flame or arc having one or more tongues up to 15 centimetres long and is coloured faintly by the electrode material.

If the arc is drawn from the end of the wire it forms a globule of molten metal from which it burns until the temperature of adjacent portions of the wire and/or the diameter of the globule indicate that it should move elsewhere. This movement has just taken place in the photograph (Fig. 1 (*a*), copper electrode) in which the molten globule can be seen. In general the movement of the flame is controlled by the melting of the wire. Under the conditions of the experiment the arc consumed about half a kilowatt.

Presumably the production of the arc depends on the frequency being so high that ions of one sign are not wholly collected by the electrode during one half cycle, and that de-ionisation is small during the period when the potential is changing sign.

N. RYLAND DAVIS.
C. R. BURCH.

Research Laboratories,
Metropolitan-Vickers Electrical Company, Ltd.,
Trafford Park, Manchester, January 23.

### The Herrings of the Eastern Part of the English Channel.

DURING the great East Anglian herring fishery which takes place during October, November, and part of December, almost all of the fish taken are either spawning or are in the condition which just precedes spawning.

It has been shown that the main areas in which eggs are deposited are near Smith's Knoll L.V., near the Gabbard L.V., and also in the neighbourhood of the Sandettie L.V., and, with the exception of the latter place, that the spawning fish are in the minority. This must mean, then, that there is some other area in which spawning takes place.

In 1923 and 1924 an attempt was made to locate these fish after their disappearance from the Southern Bight in December. Herrings were obtained from Brighton in the winter of 1923–4, and from Swanage in 1924–5, but, on examination, it was shown that they were of a very different type from those of the southern North Sea. These fish, according to the maturity observations, belonged to a shoal which spawned in December-January, but the nature of their annual growth as shown by their scales proved without doubt that they were not fish which had migrated from the North Sea.

In the paper recently published by the Ministry of Agriculture and Fisheries, I have pointed out that there are two groups of herrings in the southern North Sea, and these are classified according to their first year's growth as calculated from the first winter ring on their scales. One group was found to be approximately 8 cm. at the end of its first year, and the second 10 cm. This difference is probably due mainly to the difference in the time of year in which they were spawned.

The fish from the English coast of the Channel were found to be approximately 12 cm. at the end of their first year, and, age for age, were larger than those of the North Sea. The fact that these fish were found in two successive years along the southern English coast made it appear at first very doubtful that the remainder of the East Anglian herrings migrated into the Channel to complete the spawning. It was known that there was a fishery along the French coast during December and January, and also that after this period it was possible with suitable gear to obtain larval herrings in the neighbourhood of Cap d'Antifer; so with this information an investigation was carried

out at Boulogne in January this year, with the view of establishing the identity of these herrings.

Below I give an outline of the results obtained.

Fish which were actually spawning, and also some which were newly spent, were obtained, and an examination of their scales was made. Here is the age composition of one of the samples of spawning fish :

| Age (years) . . | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|
| No. . . . . | 20 | 64 | 17 | 32 | 8 | — | — | 3 | Total 144 |

There are, it will be seen, two main groups, the four-year-olds and the six-year-olds. From the scales of the '4' group I have calculated the length of the fish to the end of each year of their life, and the averages of $l_1$, $l_2$, $l_3$ are found to be 8·55, 16·42, and 20·88 cm. respectively, which, according to the work already published, classes them as southern North Sea herrings.

The peak at '6' is of different composition. Here, without calculation, it is possible to detect two different kinds of growth in the scales—the large Channel type of $l_1$, and the smaller southern North Sea type—so it is safe to say that while North Sea fish are found spawning along the French coast in winter, there are also Channel fish in the shoal which are spawning at the same time.

W. C. HODGSON.

Fisheries Laboratory,
Lowestoft,
February 2.

## Domestic Heating.

I FULLY agree with Mr. Gheury de Bray in the letter on this subject in NATURE of February 6 : open fires in a house are immeasurably preferable to electric or gas fires.

For some time past I have studied not only the microscopic structure of coal, but also its vital effects, and I am absolutely convinced, and desire clearly to enunciate, that it is sociologically most important as well as scientifically interesting that the valuable vital effects of a glowing coal fire should be realised. A glowing coal fire gives out something subtle, yet intensely 'nourishing' to the system, 'nourishing' in a way that vitamins and ultra-violet rays are 'nourishing.' Whatever this stimulating influence may be, it is either absent or very weak in radiation from anthracite stoves or gas and electric fires. Hence, for health, a brightly glowing coal fire should be present in every nursery, and in the chief living-room in every house.

Further than this, the curative powers of such a fire are great. An illustration may emphasise this. After a very severe illness, when I had been at death's door, and still suffered with a high temperature and intense weakness, I insisted, to the horrified amazement of the hospital nursing sisters in charge of me, on being lifted from my bed and, protected by screens from draughts, lying naked before a specially prepared brightly glowing coal fire for half an hour. So rapid were the beneficial effects, that in fifteen or twenty minutes even the nurse in charge recognised them as indicated by the steadying and rate of the pulse, the temperature, and a marked improvement in the feel and appearance of the skin, to say nothing of the sense of returning health and increased vitality to which the patient alone could testify. The regular use of the coal fire in this way greatly contributed to my rapid recovery and returned vitality. When overtired or threatened with a cold in the head, whenever possible, I use the same measure, always with beneficial results. This is not due simply to the airing of the skin (most valuable also in its way), as the effect does not result from stripping in a room equally warmed by plated hot pipes and electricity.

At present, when so many homes are being built regardless of the value of the coal fire, or with improperly constructed coal fires, it is important that the plain common-sense man and woman should not allow their common sense to be crushed out of them by pseudo-science which professes that the substitutes offered by gas or electricity are equally effective. The question of fires seems to me at present to be parallel to that of the 'scientific' provision of substitutes like margarine for butter some years ago, when farm women and servants were laughed at by scientists for preferring real butter to margarine, and have since been proved by profounder scientists to be quite right, butter containing vitamins absent in margarine.

What the 'nourishing' substance in a brightly glowing coal fire is, I do not yet know, but it will be found out some day. There are many extraordinarily interesting and subtle points about the composition of coal which are not yet fully investigated. For example, the vitrain bands in an ordinary banded bituminous house coal affect a photographic plate in the dark so as to imprint themselves as a clear image upon it (see Stopes, *Phil. Trans. Roy. Soc.*, 1919, p. 470).

Our race is being weakened by innumerable interferences with our natural physiological processes, and therefore, in the interests of the race, of the health and happiness of the individual, as well as in the name of science, may I emphasise the immense importance of not flouting the natural instinct of the British people to use bright *coal fires*.

MARIE C. STOPES.

Givons Grove,
Leatherhead, Surrey,
February 15.

## Conservation of Momentum and the Doppler Principle.

SINCE on the relativity theory mass and energy are related by the equation $Mc^2 = W$, the different energy states of an atom may be thought of as being different mass states of the atom. For example, on the quantum theory when an atom changes from an energy state $W_p$ to an energy state $W_q$, a quantum $h\nu$ is radiated such that $h\nu = W_p - W_q$ ($W_p$ being supposed greater than $W_q$), and hence $h\nu$ may be supposed to be produced by a loss of mass in the atom as a whole. We shall therefore consider an atom to have a mass $M_p$ before the emission of a quantum $h\nu$ and a mass $M_q$ after the emission. Each of these masses consists of the rest masses of the various parts of the atom together with the mass due to the kinetic and potential energies of the various parts. Further, although parts of the atom may be moving relatively to each other, we shall suppose that $M_p$ and $M_q$ are the rest masses of the atom as a whole in the two states.

Let us now consider the case where an atom of rest mass $M_p$ is travelling in the direction $\theta$ with respect to the $OX$ axis with velocity $\beta_p c$. At a certain instant of time the mass $M_p$ changes to mass $M_q$ and a quantum $h\nu$ is emitted in the $OX$ direction, the atom of rest mass $M_q$ then moving with a velocity $\beta_q c$ in the direction $\phi$. The principle of conservation of energy requires

$$\frac{M_p c^2}{\sqrt{1-\beta_p{}^2}} = h\nu + \frac{M_q{}^2 c^2}{\sqrt{1-\beta_q{}^2}}, \quad . \quad . \quad (1)$$

while the principle of conservation of momentum requires

$$\frac{M_p\beta_p c\cos\theta}{\sqrt{1-\beta_p^2}} = \frac{h\nu}{c} + \frac{M_q\beta_q c\cos\phi}{\sqrt{1-\beta_q^2}}, \quad . \quad . \quad (2)$$

and

$$\frac{M_p\beta_p c\sin\theta}{\sqrt{1-\beta_p^2}} = \frac{M_q\beta_q c\sin\phi}{\sqrt{1-\beta_q^2}}. \quad . \quad . \quad (3)$$

Solving for $h\nu$ we find

$$h\nu = \frac{(M_p^2 - M_q^2)c^2}{2M_p}\cdot\frac{\sqrt{1-\beta_p^2}}{1-\beta_p\cos\theta}. \quad . \quad . \quad (4)$$

Now, if $\beta_p c$, the velocity of the atom before the emission of the quantum, is zero, then the quantum emitted is $h\nu_o$, where

$$h\nu_o = (M_p^2 - M_q^2)c^2/2M_p, \quad . \quad . \quad (5)$$

so that equation (4) may be written

$$\nu = \nu_o\sqrt{1-\beta_p^2}/(1-\beta_p\cos\theta). \quad . \quad . \quad (6)$$

If $\beta_p$ is small, then writing $\beta_p = v/c$ we have

$$\nu = \nu_o \times c/(c - v\cos\theta), \quad . \quad . \quad . \quad (7)$$

the formula for the Doppler principle. It seems therefore that the Doppler principle may be deduced without recourse to a wave theory.

If $\beta_p = 0$, we may solve for the velocity of recoil $\beta_q c$ and find

$$\beta_q c = c(M_p^2 - M_q^2)/(M_p^2 + M^2{}_q) = 2M_p h\nu_o/(M_p^2 + M_q^2)c. \quad (8)$$

For light of about 4000 Å.U. emitted by the hydrogen atom:

$\beta_q c = 100$ cm./sec., while $(M_p - M_q) = 5 \times 10^{-33}$ gm.

G. E. M. JAUNCEY.

Washington University,
St. Louis, U.S.A.,
January 22.

### An Australian Fossil Jelly-fish.

QUITE recently a remarkable discovery of a fossil jelly-fish has been made in the fine-grained blue mudstone of the lower part of the Silurian at Brunswick, Victoria. It was in the same locality, but at a higher horizon, that another unique discovery was made about twenty-four years ago, of an exquisitely preserved crinoid, *Helicocrinus plumosus*, of which the entire organism was found, including the coiled distal end of the column.

The present fossil occurrence is unique for Australia, so far as I am aware, and the only other related form is a Discophyllum (*D. peltatum*) figured and described by James Hall in 1847, from the Hudson River Series, below Troy, New York.

It is especially noteworthy that our basal Melbournian stage of the Silurian comes, in point of geological time, immediately after the American sediments, so that these two widely separated occurrences practically agree both in morphological affinity and in age.

The Victorian Silurian jelly-fish is shown in strong relief on the two halves of a slab. The umbrella is radiately ribbed and concentrically frilled. The genital pockets are distinct and there is a zone of comparatively short tentacles more or less clearly marked.

Notwithstanding the paucity of definitely preserved skeletons of invertebrates, such as mollusca and arthropods, in the Victorian mudstone, very much original structure has been retained in fossils that would not, in the ordinary way, be regarded as good museum specimens. From similar fine-grained mudstones in Victoria, the soft gill-plumes of the Serpula-like Trachyderma have already been described, in which even the eyes are still visible as carbonised spots. There is little doubt that a careful and prolonged search amongst these supposed unfossiliferous mudstones would result in many thrilling discoveries, and it is fortunate that the above fossil fell into the hands of so careful a collector as its discoverer, Mr. R. Evans.

FREDK. CHAPMAN.

National Museum, Melbourne,
January 12.

### Measurement of Radiation Intensities by Photographic Methods.

DR. HOUSTOUN, referring in NATURE of January 30, p. 159, to Dr. Toy's note on the above, deprecates the use of 'neutral' absorbing screens, and recommends that the intensity of a beam of radiation be reduced by increasing the distance between source and screen and applying the inverse-square law. In view of the simplicity of action and ease of calibration of neutral screens or wedges, it is surprising that at this stage in the development of photometry, a method possessing so many disadvantages as that suggested by Dr. Houstoun should be seriously considered. If large variations in the intensity of radiation are required, say of the order of 2000 to 1, any instrument depending on the direct application of the inverse-square law must necessarily be extremely cumbrous. Further, the effect of reflected radiation from adjacent surfaces is difficult to eliminate, and the necessary correction for the absorption of the intervening medium detracts from the apparent simplicity of the method.

The 'neutral' wedge, on the other hand, provides an accurate and compact means of altering the radiation intensity throughout a very wide range. Wedges can be obtained which are practically neutral over a large portion of the visible spectrum. Even if the absorption varies with wave-length, as it does, for example, in the ultra-violet, the wedge is easily calibrated in its actual position in the apparatus, so that its lack of neutrality is not really detrimental to its use. Again, the wedge produces a continuous change of intensity, whereas any method depending upon the inverse-square law can in practice only change the intensity by finite amounts. Optical wedges have been used here in many different types of researches and have proved both convenient and accurate.

I. O. GRIFFITH.

Clarendon Laboratory,
Oxford.

### What is a Beam of Light?

PROF. GILBERT LEWIS'S views (NATURE, February 13, p. 236) stretch far, but will he, or any one else, begin at the first stage?

As any group of incandescent atoms must be at every variety of phase of distance, why does any beam of light behave as if it all started from an identic single phase? How can interference appear if two streams of waves moving at every phase interact? There cannot be lamination of space at a wave-length apart, as wave-lengths are varied, and incandescence is the same in all directions.

Another difficulty; in a bundle of waves vibrating in all azimuths, how does polarisation separate the whole light into two parts vibrating at right angles? A selective action might only transmit waves nearly in the same plane, but polarising appears to take all light up to 45° from its plane. Is every separate vibration, or quantum, or corpuscle split into two components?

To the outer layman it looks as if the clearing of these fundamental questions would be a useful preliminary to further theories.

F. P.

# The Species Problem and Evolution.

By O. W. RICHARDS and G. C. ROBSON.

## I.

THE object of these articles is to describe and discuss some of the chief attributes of closely allied species in so far as they may cast some light on the process of evolution. The method by which the latter has been brought about is still a matter for discussion, and one of the chief lines of inquiry to which great importance is attached to-day is the intensive study of the early stages of specific divergence. Darwin and the biologists of last century did not, of course, neglect this question; but within the last twenty-five years much has been discovered concerning animal ecology, genetics, and the intensive study of distribution, so that a review of the evolutionary position from these points of view may be of service. The problem will be here discussed principally from the zoological point of view; but some attempt will be made to indicate to what extent the method of evolution in plants is likely to differ from that in animals.

In the course of this discussion it will be seen that no absolute criterion of species can be given. Such distinctions have been sought in structural differences or in some special type of sterility. With regard to the latter criterion, sterility between many forms is well known, but it is uncertain whether there is a special type which can be called specific. Structural discontinuity has been supposed to be a good criterion of species; but the number of characters in which such discontinuity may occur and the degree of discontinuity itself are variable.

In any genus, when the taxonomically described species are compared one with another, it is found that the latter differ in a variable number of structural characters and that no fixed amount can be proposed by which they must differ in order to be called species rather than varieties. Structural discontinuity between such species is sometimes very evident within the limits of a single area; but it frequently becomes much less marked when a complete range of such forms is investigated. In the majority of cases specific distinction is based on the examination of a few characters only which are selected for convenience, and, as a result, the actual amount of difference between species is often doubtful in a particular case. However, in spite of the lack of an absolute criterion, the majority of forms recognised as species by taxonomists represent within broad limits a certain grade of divergence in structure and habit, and are frequently sterile, when crossed.

Some palæontologists have shown that certain forms occurring in successive strata are continuously connected by 'intermediates,' and have thought that the species concept, as it is employed by zoologists, is inapplicable to series of forms in which only the lineage of single characters can be traced. In the first case our knowledge of the relationship of different specimens must be confused by the effects of the environmental conditions which they have experienced; while the second phenomenon has not been shown to be widely spread, and in many groups species may remain well defined over long periods of time.

### SPECIFIC CHARACTERS.

Specific differentiation may show itself in several ways, namely, in (1) structure, (2) physiological activities, (3) reproduction, (4) habitat-preference, (5) food, (6) special types of behaviour. When species differ in habits or structure it is probable that they differ physiologically as well, though it is difficult to show a correlation between such differences and any particular physiological process. The result is, therefore, that in practice species are distinguished by differences in their habits and structure because it is not yet possible to do so by reference to their more fundamental properties. The term physiological difference is here used in the narrow sense of difference in metabolism.

1. STRUCTURE. — Constant structural differences between species occur in all organisms from the simplest to the most complex with the exception of the Bacteria, in which, according to the present view, the physiological differences are those which can be best employed for the recognition of species. In the Spirochaeta structural and physiological characters seem to be of equal importance. A comparison between the species or races of Bacteria and those of higher organisms is of doubtful value because of the more rapid multiplication of the former. In the higher plants, structural characters may show a remarkable amount of plasticity; among animals, some, such as the corals and particular genera of other groups, are equally plastic. Not enough is yet known to enable us to say whether the degree of plasticity is a real difference between animals and plants. If such a difference exists it is more likely to occur between motile and sessile organisms.

When closely allied species in various phyla are examined, it seems to result on the whole that no particular organ or system is especially differentiated. The differences that occur usually consist of slight divergencies in size, proportion, and colour and in the number of individual parts, such as the cusps of teeth or 'ornamental' bosses and lines on shells. On the other hand, in certain groups there is no doubt that secondary sexual characters stand out as being affected; though in some these are scarcely differentiated at all, for example in the Polychaeta, the Lamellibranchia, and some Prosobranchiate gastropods.

Of those forms which show such differences, some exhibit them in the organs connected with copulation, for example many of the Platyhelmia, a large proportion of the Arthropoda, Pulmonate gastropods, and many groups of mammals; while in birds other secondary sexual characters are affected. No other generalisation as to the structural characters which distinguish closely allied forms can be made; but the following points are worthy of attention. Species often differ in the frequency with which certain characters occur together; thus the common limpet (*Patella vulgata*) differs from the "flither" or low-water limpet (*Patella athletica*), with which it has many features in common, in that it possesses more frequently a broad shell and a grey foot, while the flither usually has a narrow shell and an orange-yellow foot. Many allied

forms differ in total body size, though if their sizes were plotted graphically the frequency curves would overlap considerably.

It has been pointed out frequently that allied species tend to throw parallel variations; but it is equally true that one of two closely allied forms may be distinguished by its ability to throw some particular variant, for example, the fly *Dorniphora abdominalis* always has two antero-dorsal bristles on the hind tibia, while *D. florea* may have two or three (Lundbeck, 1922). Furthermore, species may be polymorphic in one part of their range and not in another, so that their races may differ in the ability to produce certain variants.

Colour differences between species are often held to be of great importance, but many cases are known in which such differences do not obtain, and it is uncertain whether colour is markedly affected at the onset of divergence. Some colour differences, for example melanism, constitute special problems which cannot readily be explained.

2. PHYSIOLOGICAL DIFFERENCES.—Differences between species of the same genus have been reported in many activities and properties which we define as physiological and biochemical; for example, in actual metabolic processes and their products (including special secretions such as venoms), in the fertilisation reaction, and in the behaviour of grafts. In a wide sense physiological distinction is ultimately implied in all differences of structure and habit. If we consider measurable differences in metabolism only, it is very difficult to say whether a physiological differentiation parallel to that of structure is at all universal. The study of such processes is usually limited to different genera, and the differences between species are not often considered. Furthermore, when species of the same genus are examined, no allowance is made for individual idiosyncrasy, sexual and seasonal difference, and other factors important from the taxonomic point of view. There remains, however, some evidence which suggests that taxonomic species may be as clearly differentiated in their metabolic activities and products as in their structure; for example, in carbon dioxide output, certain properties of hæmoglobin, amount of blood-sugar, starches of plants, and the precipitin reaction of vertebrate blood. The data on most of these points, however, require investigation from the taxonomic point of view, and there is furthermore a real need for the study of the physiological differentia of closely allied species.

3. REPRODUCTION.—The phenomena to be considered here include (*a*) breeding season, (*b*) mating habits, (*c*) coitus, (*d*) sterility, and may be considered in two ways, first as criteria of species and secondly as means of isolation. The latter will be more fully considered in a later section.

(*a*) *Breeding Season.*—In those parts of the world where there is marked seasonal change in physical conditions, the breeding period of animals and plants is more or less determined by such change, but within the somewhat wide limits of the general breeding period allied species may breed at different times. These differences may be absolute so that such forms cannot interbreed, or the two breeding seasons may have a larger or smaller amount of overlap. Some species, however, breed throughout the year even in temperate regions, while some allied forms breed at the same time of the year. We do not think there is at present enough evidence to determine whether differences in the breeding season are frequent in closely allied species.

(*b*) *Mating Habits.*—There are two main divisions of this subject—differences in mating-place and differences in mating-behaviour. Neither of these exist in many animals (*e.g.* sessile forms), and in others there is no definite mating-place as distinct from the general habitat.

*Mating-Place.*—In many cases physical conditions, such as light and temperature, control mating to a considerable extent, and it is quite possible that allied species may be isolated by definite requirements. Very little exact evidence, however, is available on this point. Many species choose particular mating-places which may or may not coincide with the nesting site. Thus Kemp (1915) records that while in *Palæmon malcolmsi* the male probably fertilises the female in fresh water outside the Chilka lake, in *P. rudis* the male accompanies the female into the lake. Both these species perform their migration when the lake is full of fresh water, while a third species, *P. lamarrei*, migrates into it in the brackish season. Comparable cases occur in fishes and birds. When the choice of mating-place involves migration the latter may take place from one particular area to another, so that allied forms are separated throughout the year; or it may take place from an area in which many species live together to a special area. In particular cases this choice of breeding-area may lead to isolation; though how often this results is uncertain.

*Mating-Behaviour.*—The complex behaviour that often occurs in this connexion may be divided into (1) expressions of excitement, (2) incitement and suggestion, and (3) various types of preliminary manipulation of the female. The second may include either specially developed ceremonies, for example the display by spiders of a special coloured patch, or the abortive use of behaviour included in (3); for example, in many insects the male will jump on the female's back long before coitus. Instances of specific differentiation may be found in all these types, but it is possible that it may be more marked in the second. When differences occur they are often as diagnostic as structural characters.

(*c*) *Copulation.*—The mechanics of coitus involve a complicated adjustment of the musculature and skeletal parts. Differentiation of the latter may be very frequent in intromittent and receptor organs and in parts developed for clasping. Connected perhaps with structural differences are differences in posture and the duration of coitus.

(*d*) *Sterility.*—The sterility which occurs when two species are crossed has often been supposed to be a special characteristic of such crosses. The incidence of sterility is, however, capricious, and no absolute correlation between it and structural divergence can be shown. There is, therefore, a danger of arguing in a circle as to the relationship of species, according as one or the other criterion is used. At present it is only the structural criterion which can be employed satisfactorily; for by this method the degree of sterility and other phenomena difficult of interpretation can be referred to a standard more easily fixed.

The capricious incidence of sterility was known to such an early worker as Kölreuter, and was further

emphasised by Darwin and later workers. While sterility is well substantiated among species-crosses in general, the evidence is at present insufficient to decide whether *closely allied* forms are usually sterile. Various forms (for example, species of Drosophila and Poecilopsis), which must be regarded as very closely allied, show a high degree of sterility when crossed. On the other hand, fertility of varying degree may occur between structurally distinct forms which have even been placed in different genera, *e.g.* the mallard and pintail (Philipps 1915); *Xiphophorus strigatus* and *Platypoecilius maculatus* (Gerscheler 1914). In the Teleost crosses made by Newman (1916) one effected between different orders was as successful as that between species of the same genus. Thus it is evident that sterility does not necessarily precede structural divergence and is probably produced in many cases as the sequel to a certain degree of general differentiation. This view is substantiated by the occurrence of many degrees of sterility, of which the following are some examples :—

1. Absolute sterility. (*Poecilopsis isabellæ* and *lapponaria*, Harrison.)
2. $F^1$ produced but with disturbed sex ratio, low vitality, or other abnormality. (Lymantria, Goldschmidt; certain Bistoninæ, Harrison.)
3. $F^1$ normal but sterile. (Mule.)
4. $F^2$ produced but weak. (*Drepana curvatula* and *falcataria*, Standfuss.)
5. $F^2$ healthy. (Antirrhinum, Baur; Bistoninæ, Harrison.)

Between most of the categories no definite distinction can be drawn; as, for example, two forms can only logically be called absolutely sterile if the sperm is unable to enter the egg, yet in practice they will be called sterile if the embryos are produced but die in early stages. If the embryos live a little longer they will be regarded as a sickly $F^1$. In addition to the categories listed above, it is sometimes found that the result of a cross between species depends on which of them provides the male and which the female.

In discussing sterility there is a danger of identifying phenomena which are only apparently similar (cf. Bateson 1912) and also of confusing sterility produced by unnatural condition with that due to genetic incompatibility. It is sometimes found that crosses at first unsuccessful are, under different conditions, quite fertile.

4. HABITAT-PREFERENCE.—In plants the habitat depends mainly on the physical and chemical factors of the environment, but in many animals an active search for more or less diverse foods determines the exact habitat almost as much as the other factors. Thus two species occurring in one plant habitat, but seeking diverse foods, may be exposed to very different conditions of competition and experience a certain measure of isolation.

Closely allied species of animals and plants may be found in different geographical areas or in habitats differentiated within the same area, and, so far as animals at least are concerned, our knowledge of their distribution is largely founded on the former. The importance of such geographical isolation is, however, uncertain unless at the same time the actual habits and mode of life are known. No two habitats in different countries perhaps can be identical, at any rate in the conditions of competition; yet conditions may be sufficiently similar for the amount of divergence attributable to them to be unimportant.

The occurrence amongst the majority of animals of specific differences in habitat between close allies is not easy to show at present. The geographical range of species may be known, but even in the commonest forms the number of plant-habitats, for example, in which they occur may be very uncertain. Amongst the forms of which the distribution is satisfactorily known, some species occur in the same habitat as their close allies, and some occur in separate ones. The common view that allied species always occur in separate habitats is by no means true. In many mammals the separation seems to be fairly complete; but this is not the case in some insects and Mollusca. When a species occurs in a particular habitat, it is often not restricted to it by a general adaptation but by a reaction to a particular factor. A habitat is usually defined by many factors, and the occurrence of a species in a particular habitat may be determined by different factors in different parts of its range. Structural modifications shown to be adapted to particular habitats or modes of life seem to be more characteristic of genera or groups of higher rank than of species. Thus, when allied species do occur in different habitats, it may not be because of any simple difference in them which could be the result of a single variation.

5. DIFFERENCES IN FOOD.—When animals live on organic débris or on food in solution, it is obviously impossible to say whether there is any difference of diet between species. When the feeding habits are more specialised, the food eaten by any species may consist of the members of a single species or genus, or of a larger range of forms. Differences in diet are not easily detected unless the range of foods is small; for when the diet is more varied a difference between allied species may relate only to a few components of the diet. In the latter case, the food-habits are rarely known well enough to differentiate species. Among insects there are many closely allied vegetarian forms which can be distinguished by the food-plant, though it is probable that such cases are not frequent in the rest of the animal kingdom. With a few exceptions, there is very little satisfactory evidence as to differences between closely allied species in this respect. When parasites are limited to specific hosts their distribution is probably determined by many factors besides food.

6. MISCELLANEOUS DIFFERENCES.—Many differences in habit between species will be recalled which are not considered in the previous discussion. The following are a few well-authenticated examples in closely allied forms. In the moths of the genus Nepticula, the larvæ of which are leaf-miners, the species are sometimes distinguished by the shape of the mine and sometimes by the way in which the larvæ dispose of their dung (Tutt 1899). G. T. Lyle (1925) records differences in closely allied species of Apanteles in the method of making cocoons. Closely allied forms of birds may differ in the degree of their timidity towards man (for example, the British and Continental robins) and in their alarm notes (meadow and tree pipits). Such cases show that habits just as structure are liable to differ specifically.

(*To be continued.*)

## Stresses in Buildings.

By Prof. E. G. COKER, F.R.S.

THE range and variety of the problems connected with the provision of safe and suitable buildings and structures have recently been brought to the attention of the British public in many ways, notably by a lack of housing accommodation, the insecurity of Waterloo Bridge, and the dangerous state of St. Paul's Cathedral. During the post-War period, the provision of new materials and improved methods of construction have also engaged the attention of eminent architects, engineers, and firms of constructors. Commercial buildings are in the main proceeding apace, where great capital interests are involved, as in Regent Street, London, or where private munificence is supplying the urgent needs of hospitals and educational institutions. New technical problems are in consequence arising, and will no doubt continue to present themselves under a condition of affairs in which methods of construction are rapidly changing and new materials are being pressed into service.

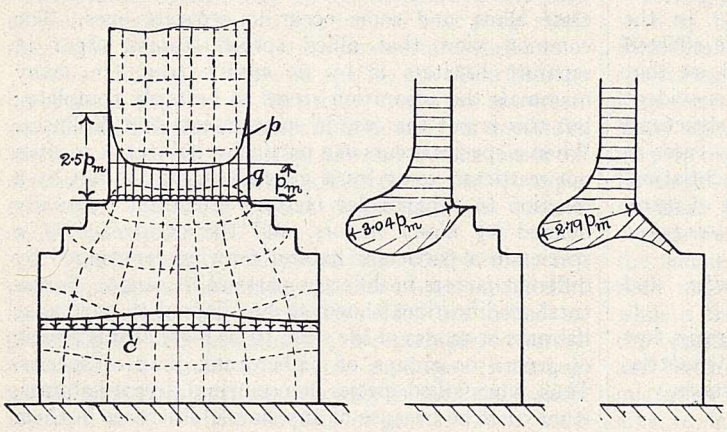



FIG. 1.—Stress distribution and lines of principal stress at the base of a wall.

Some elementary problems of this kind presented themselves recently during the partial completion of the engineering wing of University College, London, upon foundations built thirty years ago. These difficulties were dealt with successfully as they arose, but the absence of definite data in existing literature led to an experimental investigation on transparent models,[1] in which stress is measured by the temporary double refraction produced by load. One of these primary problems is the stress at the junction of a main wall with an enlarged base spread out in the usual fashion shown by Fig. 1, *a*, to afford a safe load on the earth below it.

It is at once apparent that, at the first sudden enlargement in such a wall, the stress at the angles must be extremely great, as experiments show, but for experimental purposes it is necessary to avoid an excessive concentration of stress at such places in order to measure the distribution. All such angles were, therefore, completed by a small circular arc in this case of radius $b/24$, where $b$ is the breadth of the wall. With this modified arrangement, it was found that the stress at the horizontal cross section due to a mean vertical stress $p_m$ rose to approximately 2·5 $p_m$ at the junction with the wall, but is even greater at a point on the circular fillet just below this where it rose to 3·04 $p_m$ (Fig. 1, *b*). The general vertical distribution $p$ over this cross section is also accompanied by a variable cross stress $q$ as indicated, while at $C$, well below the change of section, the tendency of the stress is to concentrate towards the centre, as my colleague, Prof. Filon, had already shown, mathematically, must be the case. It will also be noted from Fig. 1, *a*, that in the wall the tendency is exactly opposite. Monolithic walls are not usually constructed with stepped footings, but are connected to the base by sloping sides such as may be obtained when the projecting angles, Fig. 1, *a*, are removed, as in Fig. 1, *c*. This is found to result in a diminution of the maximum stress at the face of the wall to 2·79 $p_m$.

Another problem of frequent occurrence is the stress effect due to a line of window openings, and represented here by two rectangular openings with rounded angles, Fig. 2, in a wall of limited width, such as might occur with some modifications and many more windows in a monolithic concrete wall of a building. The stress distribution here shows that at the cross section $AB$, the central part of the wall is under practically uniform stress, while the side walls are under nearly uniformly varying stress with maximum values at the window openings, accompanied by great local concentrations of stress at the rounded angles, and variable tension along the upper and lower boundaries of the window openings. This latter stress is unsuitable for masonry, brickwork, or concrete to bear, unless reinforced by steel, or, as in a high building, dealt with by a steel framework, which transmits the main load to the

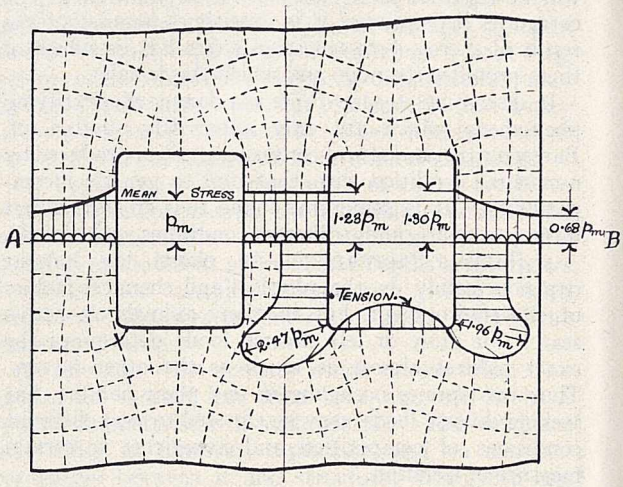



FIG. 2.—Stress distribution and lines of principal stress due to window openings.

[1] For a description of the experiments, see the issue of February 6 of the *Journal of the Royal Institute of British Architects*.

foundations, leaving the walls a mere protecting cover of no structural importance.

Structural weakness in a building may also be produced by an excess of material placed there from purely artistic considerations, and a good example of

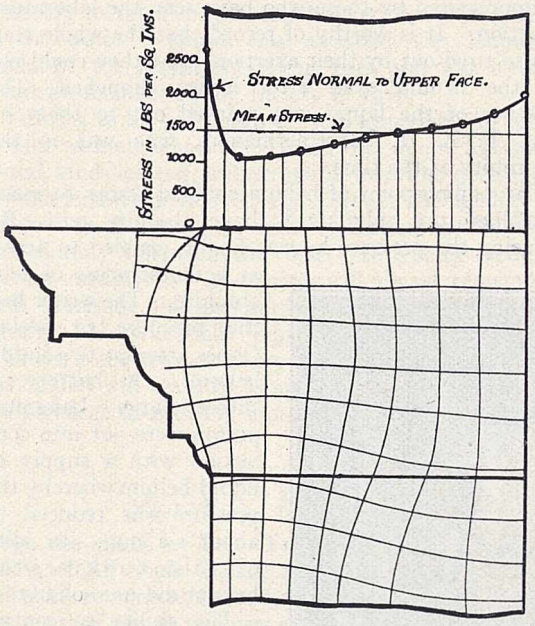



FIG. 3.—Stress effect of a cornice.

this is an ornamental cornice, Fig. 3, such as may be found in, say, a Gothic cathedral structure. The effect of the projecting part is to cause a considerable change in the vertical directions of the lines of stress, as Fig. 3 indicates. Such lines are also found in the free projecting part and direct attention to the stress there. An examination of the stress across the horizontal joints shows that there is a great local increase of load at the face of the wall, which in this case causes an increase of stress of about 75 per cent. of the mean stress at this face, and is also approximately the same at the outermost point of the lower joint. It may happen, therefore, due to sinking of the foundations at one place, that a good deal of extra load may be thrown on another part of a wall, and the extra stress on a cornice may then rise to so great a value that the material at the face is crushed locally and cracks develop, which ultimately lead to the cornice falling down, as occasionally happens. The reason for this concentration of stress is not difficult to understand, if it is remembered that, in a simple rectangular block of masonry with plane joints and without projections, the compression stress is uniformly distributed, and the two horizontal faces approach one another by a small definite amount.

The effect of a projection such as a cornice is to resist alterations of the form of the block, more especially in its own neighbourhood, and in consequence the plane surfaces of the joints deform into slightly curved surfaces resulting in a higher stress developing at the ends and more especially at the face of the wall.

This example is one of many instances in construction where an addition of material causes increased stress, which must be taken into account where architectural or other requirements compel the use of excess of material in disadvantageous positions. Experiment in this case shows that some slight improvement in stress conditions is obtained when the cornice is itself of much less depth than the masonry block.

## Obituary.

### PROF. A. PEROT.

THE death of Prof. Alfred Perot on November 28, 1925, was a serious loss to French science. Perot was born at Nancy in 1863, and after completing his studies at the École Polytechnique at Paris, returned in 1884 to the University of his native town, where he undertook research upon the density of saturated vapours, obtaining experimental confirmation of the thermodynamic formulæ. In 1884 he commenced teaching at the University of Marseilles, where he also undertook investigations on the properties of dielectrics, and on Hertzian waves, and ultimately became associated with Charles Fabry in a series of researches on optical interference, particularly between plane parallel semi-silvered surfaces. The methods developed by Perot and Fabry have formed the basis for the precise determination of the values of the reference lines in the international system of wave-lengths now universally employed.

In 1901 Perot was entrusted with the task of organising a "Laboratoire d'Essais" in connexion with the Conservatoire des Arts et Métiers. While engaged on this task he continued his association with Fabry, and with the further collaboration of the late Dr. R. Benoit, then director of the Bureau International des Poids et Mesures, carried out by new methods a fundamental determination of the value of the metre in terms of the wave-length of the cadium red line, the result of which confirmed with truly remarkable precision the earlier determination of Michelson and Benoit. This determination remains the recognised standard of departure for wave-length values to the present time.

In 1908 Perot left the Laboratoire d'Essais to become professor at the École Polytechnique, and physical astronomer of the Observatory of Meudon, resuming his spectroscopic studies, particularly with respect to very small displacements of lines in the solar spectrum due to various causes. He continued to occupy himself with questions of measures and units, and succeeded M. B. Violle as president of the Commission de Métrologie Usuelle, in connexion with the French weights and measures service. He also took an active part, as president of the Special Commission de Refonte des Règles, in the preparation of the new French law on the subject (1923) whereby the definitions of the metric system were extended and amplified (for example, by the introduction of a system of units based on the metre, tonne and second [M] [T] [S]), with the view of increasing their applicability to the ordinary transactions of commerce and industry.

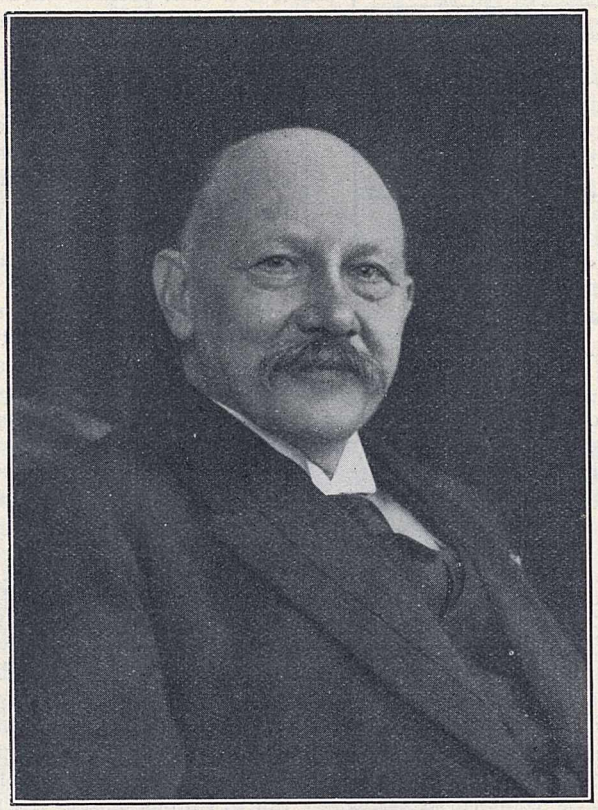
Perot was not only a sound theoretician and skilled experimenter, but also an excellent mechanic, who was well able to construct with his own hands the very delicate apparatus used in some of his investigations. During the War his time was mainly devoted to confidential researches connected therewith.

J. E. S.

## PROF. H. KAMERLINGH ONNES, FOR. MEM. R.S.

PROF. HEIKE KAMERLINGH ONNES, whose death on February 21 will be widely regretted, was born on September 21, 1853, in Groningen. As a youth he attended a school in that town, of which J. M. Van Bemmelen, who later became professor at Leyden, and whose name will always be remembered in connexion with colloid chemistry, was principal.

In 1870 Onnes became a student at the University of Groningen, and from 1871 until 1873 he worked under Bunsen and Kirchhoff at Heidelberg. He remained in Groningen until 1878. His doctoral dissertation was entitled "New Considerations on the Axial Changes of the Earth," and was marked by the combination of theory and accurate experiment which is characteristic of all his later works. In 1881 he became influenced by the theories of Van der Waals and wrote an important paper in which he deduced the law of corresponding states from considerations of statistical mechanics.



HEIKE KAMERLINGH ONNES.

In the following year Onnes became professor at Leyden. In his inaugural address he insisted that the laws of physics could be determined by accurate experiment alone. His motto "From measurement to knowledge" was then stated for the first time, and his remarks upon the necessity of the then recently designed pumps of Cailletet and Pictet for the attainment of low temperatures were almost prophetic. It was about this time that Onnes planned his cryogenic programme, which has since made his name famous throughout the world. In 1894 he published his first paper on the design and equipment of the Leyden laboratories, and in his inaugural address in 1894 he laid down the importance of accurate measurements at very low temperatures.

The formation of the cryogenic laboratory at Leyden was only made possible by the extraordinary energy and tenacity, combined with organising talents of a very high degree, which Onnes brought to bear on this subject. As a preliminary it was necessary for him to train mechanics and glass-blowers, and as a result of many years of patient work he obtained an organisation which is still unique. In 1904 Onnes was able to control large supplies of liquid air. By 1906 he had developed the technique of the liquefaction of hydrogen on a large scale. In 1908 he attained the triumph of his career by liquefying helium. This feat, taking into consideration the limited supplies of helium and the difficulty in obtaining it in those days, was little short of superhuman.

The amount of careful organisation and planning necessary before the experiments were started can only be appreciated by those who have seen the laboratory in action. It is worthy of record that the whole staff was so tired out by their exertions that they could not see the helium even after it was liquefied. The presence of the liquid was pointed out to them by Prof. F. A. H. Schreinermakers, who was in the laboratory at the time.

The boiling-point of helium enabled Onnes to reach a temperature only 4·22° above absolute zero. By reducing the pressure he was finally enabled to arrive at a temperature of 0·9° absolute. The writer had the privilege of seeing Onnes attempt to solidify helium. A battery of fifteen large Langmuir pumps were put into connexion with a supply of liquid helium whereby the pressure was reduced to about 0·2 mm.; in spite of this, however, the helium did not solidify.

The ability to control really low temperatures enabled Onnes to make the astonishing discovery of supra-conductivity. It had always been assumed that the conductivity of a metal would run out to nil at the absolute zero. Onnes discovered that quite a number of substances showed a sharp discontinuity in their conductivity curves at a temperature of about 4° or 5° absolute. Typical examples are lead and cadmium. He passed a current of 1000 am./sq.mm. through a conductor under these conditions without being able to detect the slightest change of E.M.F.

Onnes's work is well summarised in the volume presented to him on the occasion of the fortieth anniversary of his holding the chair at the University of Leyden. Most of his work was published in the *Proceedings of the Physical Laboratory of Leyden*, and it is due to the comparative inaccessibility of this publication that Onnes's work is not so widely known as it should be.

It is impossible, within the limits of a brief notice, to give more than an idea of the scope and range of his activities. The division of the above-mentioned work into thermodynamic, magnetic, optical, magneto-optical, radioactive and electric sub-sections, in each of which he published numerous papers, is an indication of the magnitude of his work.

In later life Onnes received the fullest recognition

of his great talents. His own country awarded him a Commandership in the Order of the Lion of the Netherlands. Similar decorations were conferred upon him by the Governments of Poland and Norway. In 1913 he received a Nobel Prize for physics. He was an honorary member of practically every learned society in the world. Onnes was awarded the Rumford medal of the Royal Society in 1912 and was elected a foreign member of the Society in 1916.

Turning to his personal side, it is impossible to speak of him without emotion. Onnes was one of the most genial, kind-hearted, and accessible men who ever lived. He made unremitting efforts towards the feeding of children in the destitute areas of Europe in the years immediately following the War. To young men, he was an inspiration. The writer will always remember, with gratitude, his extraordinary kindness and hospitality. He practically kept 'open house.'

Onnes's scientific memory is imperishable, and his personality will never be forgotten by any one who had the privilege of knowing him.

F. A. FREETH.

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PROF. F. Y. EDGEWORTH.

BY the death of Prof. Francis Ysidro Edgeworth, fellow of All Souls College and emeritus professor of political economy at Oxford, on February 13, at eighty-one years of age, economists and statisticians alike have suffered a heavy loss. Born at Edgeworthstown, Ireland, in 1845, he was educated at Trinity College, Dublin, and Balliol College, Oxford, and was called to the Bar in 1877. Always a man of the widest interests—classic, mathematician, and philosopher—he was some time in finding his *métier*. Ethics and logic first gave scope to his abilities, but with his appointment as Tooke professor of political economy at King's College, London, in 1890, and his migration to Oxford as Drummond professor in 1891, the trend of his life's work was fixed.

On the foundation of the Royal Economic Society in 1890, Edgeworth became editor of its organ, the *Economic Journal*, and but for one short interval remained co-editor until his death. His early volume, "Mathematical Psychics" (Kegan Paul, 1881), dealing with the application of mathematical methods to economics, is in many ways very characteristic, not only in subject but also in style; in the fact that nearly half the small volume consists of appendices, as many of his later papers bristle with footnotes, and in the adornment of the text by quotations from the Greek. Olympian Zeus, Here, and Athena are but rare visitors to the pages of most economists! His numerous economic writings, for the most part on abstract theory and covering a very wide field, were recently reprinted by the Society in three handsome volumes (Macmillan and Co., 1925), and well exhibit the detached and acutely analytical character of his mind. A fellow of the Royal Statistical Society since 1883, he was awarded the Guy gold medal of the Society in 1907, and in 1912–14 held the office of president.

In statistics, Edgeworth's work was mostly concerned with the theory of error, averages, the normal distribution and its generalisations, and—as mundane a subject as perhaps he cared to touch—index-numbers. He was secretary of the British Association Committee "appointed for the purpose of investigating the best methods of ascertaining and measuring variations in the value of the monetary standard" and responsible for its classical reports (1887–90). The subjects chosen for his two presidential addresses to the Royal Statistical Society, "On the Use of the Theory of Probabilities in Statistics relating to Society" (1912) and "On the Use of Analytical Geometry to represent Certain Kinds of Statistics" (1913), show the bent of his mind. From the first paper he contributed to the very last—a note on "The Element of Probability in Index-numbers" in the *Journal of the Royal Statistical Society* for last July—all exhibit his lively but distinctly difficult style, leaping from one illustration to another: fluctuations of sampling in human statistics elucidated indifferently by counts he had made of the numbers of wasps entering and leaving a nest, or the numbers of dactyls in Virgilian hexameters. Young to the last, in spite of his years, courteous, humorous, and kindly, he will be greatly missed.

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REV. S. J. WHITMEE.

THE Rev. Samuel James Whitmee, who died in London on December 10, was born at Stagsden, Bedfordshire, in 1838, and went to Samoa on behalf of the London Missionary Society in 1863, where he remained until 1877. During this period he contributed many notes to NATURE, including "Earthquakes in the Samoan Islands, South Pacific," "Origin of Cyclones," "Meteors in South Pacific," "Fauna and Flora of New Guinea and the Pacific Islands," and in vol. 12 (1875) a criticism of Prof. Dana's review of Darwin's "Coral Reefs," entitled "Mr. Darwin and Prof. Dana on the Influence of Volcanic Action in preventing the Growth of Corals." His other publication included a list of Samoan birds in *Ibis*, vol. 5; "On the Manifestation of Anger, Fear and other Passions in Fishes" in the *Proceedings of the Zoological Society* for 1878; and a paper on "The Ethnology of the Pacific" in the *Victoria Institute Journal*, vol. 14 (1881).

Mr. Whitmee collected and forwarded to Kew numerous botanical specimens, the ferns of which formed the subject of two papers by Dr. J. G. Baker in the *Journal of Botany* for 1876, in which fourteen new species were described. His other natural history specimens were sent to the British Museum.

Returning to England in 1877, Mr. Whitmee engaged in ministerial work, but returned to Samoa in 1891, where he became the close friend of R. L. Stevenson, to whom he taught the Samoan language. Whitmee finally returned to England in 1894 and settled down at Barnet.

C. H. W.

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WE regret to announce the following deaths:

Prof. A. R. Cushny, F.R.S., professor of materia medica and pharmacology in the University of Edinburgh, on February 25, aged sixty years.

Prof. F. Roth, emeritus professor of forestry in the University of Michigan, known for his work on the technical properties of timber, on December 4, aged sixty-seven years.

Mr. W. F. Wells, president in 1911 of the British Pharmaceutical Conference and twice president of the Pharmaceutical Society of Ireland, on January 28, aged seventy-six years.

## News and Views.

GENERAL satisfaction will be felt at the fact that the Board of Trade has appointed to the Comptrollership of the Patent Office a man who is qualified for the post by definite scientific training. Mr. W. S. Jarratt, the new Comptroller, after becoming an Associate of the Royal College of Science spent some time in research under Sir Norman Lockyer. He next went to Trinity College, Cambridge, as a scholar, became a wrangler, and also obtained a first class in the Natural Sciences Tripos. He then entered the Patent Office as an assistant examiner, and eventually was appointed Assistant Comptroller for Trade Marks. He was called to the Bar in 1910. This is the first time that a Comptroller having scientific qualifications has ever been appointed. Since it became known twelve months ago that ill health was likely to compel the retirement of Mr. Temple Franks, who has done so much by the soundness of his judicial decisions to raise the legal status of the Patent Office to a high level, the problem of the selection of a successor has caused considerable anxiety in circles representing applied science and invention.

THE importance for industry of the principle that the head of the Patent Office should be a scientific man was pointed out some time ago in our columns, and much public interest in the whole question has been aroused. It is believed that the wise step taken by the Board of Trade has given widespread satisfaction, for although strong pleas have been put forward for the policy of raising the salary of the Comptrollership to a substantial figure and throwing the appointment open to general competition, the present demand for public economy must have precluded the adoption of such a plan, and the Treasury may be considered singularly fortunate to have obtained by more conservative measures a man with such excellent qualifications for the post. The position of the new Comptroller is not likely to prove a bed of roses, for there is an urgent demand for various reforms in the patent system, and it will fall to him to advise the Government as to any new legislation which may be necessary in this connexion. It seems safe to assure him, however, of the sympathy and support of the scientific world in handling the intricate and difficult problems which confront him.

FOLLOWING the application of the surgeon's knife to the excessively swollen capital of the British Dyestuffs Corporation, Ltd., the patient is beginning to show signs of convalescence and new energy. On February 26 it was officially announced that the Corporation had acquired a majority of the share capital of Scottish Dyes, Ltd., and that the management of the latter company would continue in the same hands, Mr. James Morton remaining chairman and Dr. J. Thomas, managing director. The board of the Corporation, which was recently strengthened by the appointment of Dr. A. Rée, will now receive the expert assistance of Mr. Morton; and the accession of Sir William Pope to the board of Scottish Dyes, Ltd., will be hailed with satisfaction by the many who believe that no board of this kind is complete unless science is adequately represented upon it. It is also announced that in future the manufacture of vat dyestuffs will be concentrated at the works of Scottish Dyes, at Grangemouth.

THE process of aggregating brains and capital and of segregating manufacture to chosen works, which seems to be the policy of the British Dyestuffs Corporation, Ltd., is familiar to us from the history of the *Interessengemeinschaft*, and we see no reason why its success in Germany should not find a parallel in Great Britain. During the War, Mr. James Morton showed great enterprise in embarking upon the perilous sea of dyestuff manufacture, and by successfully specialising in the production of 'shades,' he acquired a well-deserved reputation. Since then he has initiated and developed the manufacture of vat dyes at Grangemouth; in fact, his policy has been almost the reverse of that pursued by the Government-aided corporation, which, in its endeavour to monopolise the home industry, entered indiscriminately upon the manufacture of a host of products, with the result that it brought few of them to a state of perfection. At the time when demand greatly outran supply, the latter policy was intelligible, but now that dye-producing capacity is everywhere in excess of consumers' needs, the only way of salvation is to concentrate upon quality, low production costs, and efficient salesmanship.

IN August last, a gentleman who desired to remain anonymous, called at the London Hospital and stated that he wished to make a gift for some charitable purpose and asked advice as to the best way of doing so. Eventually it was agreed that most good could be done by endowing medical research in connexion with the Hospital. It was explained to the donor that such research is badly handicapped in that there is little possibility of a man taking it up as a life-work unless he has means of his own. Finally a trust deed was agreed on stating that the income should be spent in salaries, and not on 'bricks and mortar' or laboratory equipment, which it was thought the Hospital itself ought to provide. Later, the donor presented 50,000*l.* and the fund has been named the Freedom Research Fund. Its working is managed by a small committee consisting of a nominee of the donor, the head of the Clinical Laboratory, and the House Governor of the Hospital. Provision has been made for an annual scholarship in pathology of 100*l.* open to students of Oxford and Cambridge, a research studentship of 400*l.* a year for three years, to which Mr. L. Hewitt has been appointed, and the remainder of the fund between two senior pathologists to enable them to devote their whole time to research. Dr. S. P. Bedson, of the Lister Institute, and Dr. W. Howard Florey, of the University of Cambridge, have been appointed for this latter purpose. These workers will have the advantages that they will be engaged entirely on research work, but shoulder to shoulder with the Hospital Laboratory

staff doing the routine investigation work of the Hospital; they will be in touch with the clinical work of the Hospital and especially with the Medical Unit; and they will be working in a centre where unlimited clinical material is available. It is hoped to enlarge this fund.

M. H. PARODI, the chief engineer of the Paris-Orleans Railway Company, read an interesting paper on railway electrification to the Institution of Electrical Engineers on February 18. Since the War, the development of electric railways and the suburban supply of electricity has been very rapid in France. The scheme on which M. Parodi is working is to substitute electric for steam traction on a line where the traffic is very heavy, and to provide a power transmission system for all the districts through which the railway passes. In France, the electrification of the railways forms part of a general network for power supply. This network will be built up gradually by linking together many of the existing distribution systems. The policy adopted by France of co-ordinating the supply of electric power to the railways with the general supply of power is different from that adopted by Germany, Switzerland, Austria and other countries, where the electric traction problem is considered without reference to power supply. If the power transmission lines were to follow the railway from Paris to Toulouse through Orleans, Limoges and Brive, then the great steam power stations of the Paris district could be linked with the hydro-electric stations of the Central Plateau and the Pyrenees. From the electrical point of view the use of very high voltages presents many advantages. Such lines are affected very little if at all by atmospheric phenomena. Whilst the power that can be transmitted varies as the square of the voltage, the first cost only varies directly as the voltage. With the pressure of 150 kilovolts now in use, it is possible to transmit economically 50,000 kilowatts from the Central Plateau to Paris, a distance of about 280 miles. It will be of interest to see how the relative cost of generating electricity by water power and by steam in France works out in practice.

DR. C. HAGBERG WRIGHT took for the subject of his discourse delivered at the Royal Institution on February 26 a remarkable but little-known personality in the literary history of France, the Sieur Nicolas Fabri de Peiresc, a gentleman of France, in the early seventeenth century. Peiresc, whose fame has suffered from the modesty of his character, was satisfied to minister to the needs of his brother authors and scientific workers, without desiring personal reward. Accordingly he gave, lent and borrowed books for his friends, and kept two bookbinders and an engraver continually employed. He had also in his household an astronomer named Garrat, having built an observatory where he carried on astronomical observations by the aid of a telescope constructed by Galileo himself. His studies took a wide range, including astronomy, numismatics, ancient inscriptions and monuments, optics, music and horticulture. Without being, strictly speaking, a pioneer in any of these subjects, it was through his efforts that many aids to science were brought into France, and also valuable manuscripts obtained from Egypt, Cyprus and Syria. Through him the microscope found its way from Holland, where it was invented, into France. In optics his observations were in advance of his contemporaries, and he is said to have been the first to observe the phenomena of negative and positive after-images. In astronomy he co-operated with Gassendi during several years. Towards the end of Peiresc's comparatively short life his love of botany and horticulture became his supreme pleasure. His correspondence with l'Escluse, the great Dutch botanist, remains to testify to his ardour in this direction. Incidentally, Peiresc is believed to have introduced the tulip into France, after it had been brought from Constantinople by an Austrian diplomat, named Busbecq, in 1562, and by l'Escluse carried to Holland, whence Peiresc obtained it. After fifty-seven years of untiring activities Peiresc succumbed to the ill-health which had accompanied him through life.

DR. H. T. CALVERT, of the Ministry of Health, delivered a Chadwick Public Lecture on February 26, taking as his subject, "The Activated Sludge Process of Sewage Treatment." He stated that no aspect of the sewage purification problem has been so much discussed since the War. The process has been developed from the older methods including land irrigation and treatment in contact beds or percolating filters; the activated sludge is obtained from the sewage itself by means of aeration and is then used for the purification of further quantities of sewage. Various methods of applying the process have been invented, all of which aim at oxidising the organic matter of sewage, by means of air and micro-organisms, in the most efficient manner and at the lowest possible cost. As compared with ordinary sludge, activated sludge is of higher manurial value, but the difficulty of removing the water which adheres to the sludge will no doubt stand in the way of a general adoption of the process and a full utilisation of activated sludge as a manure. The capital expenditure to which local authorities in Great Britain are already committed for applying the activated sludge process amounts to approximately one million pounds sterling and a larger amount has already been spent on the process in the United States. Dr. Calvert concluded by asking for more extended scientific investigations of the process, with the view of furnishing the necessary information for the design of further works.

SOME interesting suggestions are put forward by a correspondent in the *Times* of February 24, relative to the origin of the type of the Amenhetep temple at Beisan in Palestine. This temple was one of four of different dates, three being superimposed, discovered during 1925 by the expedition of the University Museum, Philadelphia. It belongs to the Amarna period, in itself a matter of considerable interest, and is very similar in style to the tomb chapels found at El-Amarna. At the same time the cult objects found

in the temples of Seti I. and Rameses II. at Beisan show a resemblance to cult objects from the temple of Ishtar at Assur, in which the cult-room is not so much Assyrian as comparable in type with that of temples at Bogazkeui, the Hittite capital. The existence of an Assyrian colony in Anatolia at the end of the third millennium B.C. appears to supply a link, and the suggestion is thrown out that the temple of Amenhetep at Beisan, which has a certain similarity to the cult-room, may have been built after the model of a Hittite temple and itself have influenced the form of the Amarna tomb-chapels. This latter somewhat unexpected and, some may think, improbable suggestion will give an added interest to the results of further excavation.

DR. T. W. GANN, in the course of a series of articles contributed to the *Morning Post* in the issues of February 22 and the two succeeding days, chronicles one of the most important finds of recent years for the history and chronology of the Maya in Central America. He has found in the Territory of Quintana Roo, Yucatan, a stele with an inscription which contains the Maya Initial Series Date, 9.8.0.0.0.5. Ahan, 3 Chen, or October 26, A.D. 333. This date is more than 300 years earlier than that appearing on the oldest of the stelæ previously found, and is one of only four such Initial Series Dates found among all the Maya ruins in Yucatan. In view of the importance of fixing the date when the Maya first established themselves in Yucatan, this discovery, as Dr. Gann points out, "may cause a complete reversion of the ideas generally held as to their first immigration into this peninsula and their foundation of what is known as the New Empire."

THE forty-eighth annual general meeting of the Institute of Chemistry was held on March 1, Prof. G. G. Henderson, president, in the chair. The Meldola Medal was presented to Dr. Henry Phillips. In moving the adoption of the annual report, which showed that the roll of the Institute now numbers nearly 5000 fellows and associates, the president referred to the decrease in unemployment in the profession, and mentioned that there are indications that not only those industries which are strictly chemical in character but many others are also finding that well-trained research and analytical chemists are necessary to combat the effects of industrial depression. To some extent, the situation has been relieved by members passing into other work and also owing to the fact that the output of chemists from the universities has been less during the last two or three years. The Committee of the Institute has been concerned with matters affecting fertilisers and feeding stuffs, in which valuable assistance was rendered to the Ministry of Agriculture and Fisheries; with the Royal Commission on National Health Insurance, on which the Council represented the views of public analysts responsible for the examination of drugs under the Sale of Food and Drugs Acts; with the Labour Party on the subject of Government scientific publications; and also with the Director of Public Prosecutions. The local sections of the Institute have become increasingly active. The problem of seeking statutory powers of registration for professional, consulting and analytical chemists has been under the earnest consideration of the Council. Prof. G. G. Henderson was re-elected president of the Institute.

THE second Italian National Congress of Pure and Applied Chemistry, to be held in Palermo, opens with a reception in the Botanic Garden on May 22 next and closes on June 2. Many well-known chemists have already made known their intention to be present, and a large attendance is expected. In addition to meetings of the Congress and of its various sections, and visits to works and to places of interest in the neighbourhood of Palermo, the provisional programme comprises a five-days' tour, during which opportunities will be afforded to see Girgenti and its temples, mines and industrial establishments, Syracuse, the asphalt deposits of Ragusa, Catania and its sulphur refineries, Etna, Taormina, Messina, etc. The meetings of the Congress are divided into three groups, dealing with (1) questions of scientific or industrial importance, (2) communications to several sections jointly, and (3) papers and discussions relating to different chemical industries and to branches of pure chemistry. Any chemist wishing to read a paper before Group 1 of the Congress is requested to furnish the General Secretary, Via IV Novembre 154, Rome 1, with a summary of his communication not later than April 30, while for Group 3 the Secretary should be informed of the title by April 30 and should be supplied with the text, together with a résumé, by May 10. Fifteen minutes will be allotted to the reading of each paper, and not more than forty minutes to a discussion of general interest.

THE Wilde memorial lecture of the Manchester Literary and Philosophical Society is to be delivered by Prof. G. Elliot Smith on "Brains of Apes and Men," at 4 o'clock on Tuesday, March 9.

THE recent issue of the index parts of the Physics and Electrical Engineering Sections of Volume 28 completes *Science Abstracts* for 1925. The Physics Section has viii + 1045 pages, of which 41 are devoted to a name index, and 98 to a subject index. The number of abstracts of papers is 2808, and their average length 0·32 of a page. The Electrical Engineering Section has viii + 692 pages, with 23 for name and 51 for subject indexes, and 1811 abstracts of average length 0·34 of a page. As compared with last year the Physics Section has decreased by nearly 200 pages, and the Electrical Engineering Section increased by 40 pages. In both sections there has been a decrease in the average length of an abstract, which in the previous year was 0·36 of a page. So far as we have been able to judge during our use of the abstracts, this decrease of length has not been accompanied by a decrease of value, but is rather a proof of the increased skill of the abstracting staff. To the regular user of *Science Abstracts*, the attitude of the physicist or electrical engineer who regards it as unnecessary is difficult to understand—it seems like prospecting without a pick and shovel.

THE second issue of the *Journal of the Royal Technical College* (Glasgow) is of interest from more than one point of view. In the first place, it demonstrates the high standard of research which is being carried out in the College, and, secondly, it represents a serious attempt to add another to the list of well-recognised periodicals in which research work may find the light. The fifteen original pieces of work published are very much more than merely students' contributions, and the names of Profs. Caven, Wilson, Andrew, Kerr, Mellanby and Ellis are all found among the contributors to this single number; this is in addition to other work they may have published elsewhere. The general standard of papers is undoubtedly high. As an indication of the ground covered it is sufficient to enumerate the individual contributions: The magnetic properties of permalloy; the measurement of rapidly fluctuating temperatures; the production of hydrogen by steam in a hot boiler tube; the presence of air in pure and alkaline water; the pseudo-alums; additions to our knowledge of azoxy compounds; reactions of semicarbazides; some acyl derivatives of hydrazine; the separation of the components of petroleum; the crystalline structure of metals; specific volume determinations of carbon and chromium steels; the evaporative condenser (a paper of 38 pages); a note on blade stresses in nozzle controlled turbines; compression losses in divergent jets, and an investigation into the cause of the blackening of the sand in parts of the Clyde estuary. The issue, like the previous one, is excellently printed and illustrated. Every one interested in the progress of science, especially perhaps in its more practical applications, will join in wishing this, the latest among the scientific journals devoted to the publication of the results of original work, a very long and prosperous career.

THE Barclay Memorial Medal for 1925 of the Asiatic Society of Bengal has been awarded to Lieut.-Col. J. Stephenson, lecturer in natural history in the University of Edinburgh, in recognition of his work as a biologist and as the founder of the School of Zoology in Lahore.

THE ninth Silvanus Thompson memorial lecture of the Röntgen Society will be given on Tuesday, March 30, in the Barnes Hall of the Royal Society of Medicine, by Sir John Thomson-Walker, who will take as his subject "Radiology in Urinary Surgery."

DURING the last five or six years there has been a slight renewal of activity in the well-known earthquake centre at Comrie in Perthshire, and a shock was recorded on February 21 at 4.24 A.M. The tremor was evidently slight, lasted only a few seconds, and was accompanied by the usual sound resembling muffled thunder or an explosion.

AT the annual meeting of the Geological Society of London, on Friday, February 19, the following officers were elected: *President*, Dr. F. A. Bather; *Vice-Presidents*, Dr. J. W. Evans, Sir Thomas Holland, Mr. H. W. Monckton, Sir Arthur Smith Woodward; *Secretaries*, Mr. W. Campbell Smith, Dr. J. A. Douglas; *Foreign Secretary*, Prof. J. E. Marr; *Treasurer*, Mr. R. S. Herries.

THE second Italian National Congress of Pure and Applied Chemistry, to be held in Palermo on May 22-June 2 next, will be made the occasion of the celebration of the centenary of the birth of Stanislao Cannizzaro, which occurred in Palermo on July 13, 1826. On May 24, the body of the great Italian chemist is to be conveyed to the Pantheon, and this ceremony will be followed by the inauguration of the monument erected to his memory.

DURING the month of March, Miss Elizabeth Keith will exhibit at the Royal Anthropological Institute a number of her water-colour sketches of natives of Japan, Korea, China, and the Philippines and of the Ainu. Although in some cases, especially as regards the natives of the Philippines, it is permissible to doubt the purity of some of her types, Miss Keith has on the whole been happy in her choice of subjects, the Ainu, not unnaturally, being the most interesting and possibly the most picturesque. Admission to the exhibition is free.

IT is interesting to note that Sir John Marshall, in his further account of explorations on prehistoric sites in the Punjab and Sind in the *Times* of Feb. 26, records the occurrence of a similar chalcolithic culture at Nal, some 250 miles south of Quetta, in the Jhalawar country of Baluchistan. Polychrome pottery, analogous to that found at Mohenjo-Daro and Harappa, as well as copper implements, grindstones, and other small objects, have been found in a burial-ground in which the dead are buried in sun-dried brick graves or directly in the ground. This marks a distinction from the Mohenjo-Daro and Harappa sites, where at this early period the dead were cremated. The complete skeletons found at Mohenjo-Daro, it is said, are probably to be attributed to the beginning of the Christian era.

WE learn from a recent issue of the *Weekly News Bulletin* of the U.S.S.R. Society of Cultural Relations with Foreign Countries, that at the first meeting of the Academy of Sciences at Leningrad in 1926 a number of new honorary members were elected. The list includes: Prof. A. Svante Arrhenius (Stockholm); Prof. H. A. Lorentz (Leyden); Prof. Max Planck (Berlin); and Prof. Vito Volterro (Rome). The list of correspondents elected includes: Prof. A. Sommerfeld (Munich); Prof. Emil Abderhalden (Halle); Prof. G. Urbain (Paris).

AN Easter tour to the Valley of the Dordogne, lasting from April 1 until April 15, has been arranged by Prof. Patrick Geddes. The headquarters of the party will be Les Eyzies and, afterwards, at Domme. From Les Eyzies visits will be paid to all the more important caves and sites of prehistoric discovery in the neighbourhood. By permission of the Ministry of Public Instruction, M. Peyrony, Conservateur du Musée Archéologique, the well-known French archæologist, will act as guide and will also demonstrate the important collections in his museum. From Domme a series of daily excursions devoted to the regional survey of the geography and history of the most

attractive part of the Dordogne Valley will be conducted by M. Paul Reclus, formerly professor of geography at Brussels. Full particulars of the tour may be obtained from Miss Jowett, 152 Abbey House, Victoria Street, London, S.W.1.

APPLICATIONS are invited for the following appointments, on or before the date mentioned:—A professor of mechanical and electrical engineering at the Artillery College, Woolwich—The Assistant Commandant, Artillery College, Red Barracks, Woolwich, S.E.18. A research mycologist in the Department of Agricultural and Horticultural Research of the University of Bristol, Long Ashton—The Registrar of the University (March 22).

## Our Astronomical Column.

A LARGE SUNSPOT.—A spot now on the sun's disc has been seen with the naked eye, thus making the fifth of its kind to be recorded since the beginning of the year. The spot is of recent origin, as no trace of it was seen on February 9, when its position would have been near to the receding west limb of the sun. Its shape is somewhat irregular, and its size is about half that of the great spot of last January. Further particulars are as follows:

| No. | Date on Disc. | Central Meridian Passage. | Latitude. | Area. |
|---|---|---|---|---|
| 5 | Feb. 25-(Mar. 10) | March 3·6 | 27° S. | 1/600 |

(Area expresses the proportion covered of the sun's hemisphere.)

RECURRENCE OF MAGNETIC 'STORM.'—On February 23, a considerable magnetic disturbance commenced at 16½ hr., reached its greatest intensity between 13 hr. and 19 hr. on February 24, and died away by about 5 hr. on the following morning. The greatest range shown by the declination magnet throughout the disturbance was a little more than 1°. Bright moonlight probably prevented the observation of aurora, which would be a likely phenomenon on the nights of February 23 and 24. The interval between the commencement of this magnetic storm and the preceding one on January 26 is 28·0 days. The sunspot disturbance, with which it is presumably related, is in solar latitude 22° (see NATURE, Feb. 6, p. 208). The time taken for a spot at this latitude to make one complete rotation relative to the earth is, on the average, 27·6 days.

As evidence of the existence of a relationship between sunspots and magnetic disturbances, Mr. E. W. Maunder showed from the Greenwich magnetic and sunspot data that the latter frequently recur at intervals of about 27 days, corresponding to the average period of the sun's rotation relative to the earth as given by sunspots (*Monthly Notices R.A.S.* 65, 2-34, 1904). The last two 'storms' provide an example of such a recurrence.

THE SPECTRUM OF THE RECENT AURORA.—In a letter received from Prof. L. Vegard, Universitets Fysiske Institut, Oslo, an account is given of the aurora of January 26, which appeared at the time of the magnetic storm noted in NATURE for February 6. Prof. Vegard writes that the striking feature of this aurora was its intense red colour, which spectroscopic analysis showed was mainly due to one single sharp line in the red, about $\lambda = 6323$ Å.U. Spectrograms taken at Oslo and Tromso also showed the characteristic auroral spectrum consisting of the 'auroral line,' 5577 Å.U., and the negative bands of nitrogen. The prominent red line has been recorded on two previous occasions at Tromso in 1923–24, and its mean wave-length deduced from the three observations is 6322·4 Å. Prof. Vegard states that the line, which is of the same character as the 'auroral line,' cannot be due either to hydrogen, helium, oxygen, or the ordinary spectrum of gaseous nitrogen. When, however, solid nitrogen is bombarded with cathode rays, two pairs of narrow bands ($N_1N_2$) and ($N_3N_4$) appear in the red and green parts of the spectrum. The relative intensities and character of these bands vary considerably with the magnitude of the nitrogen particles, the properties of the electric discharge, and when an inert gas, such as neon, is introduced (see also NATURE, May 1924, p. 716, for Prof. Vegard's account of his investigations of the auroral spectrum). From these laboratory experiments, Prof. Vegard thinks that this red line, 6323, is to be regarded as the limiting aspect of the band $N_3$, just as he considers the auroral line, 5577, to be the limiting aspect of $N_1$. Moreover, the study both of the luminescence spectra of solidified gases and the oscillation band series suggests to him that the changes of colour so frequently observed in auroræ may result from a transformation of the spectrum due to oscillations.

Another letter, received from the Chief of the Polish Maritime Station at Dantzig, gives observations of the same aurora seen at that place and at the Hel peninsula. The colour is described as varying from brick-red to dark carmine and its brightness as being very variable.

Attention may be directed to two other recent contributions to the problem of the auroral spectrum appearing in *Proc. R.S.*, Series A. vol. 106, p. 117 and p. 138, by Lord Rayleigh, and Prof. McLennan and Dr. Shrum, respectively.

COMETS.—Ensor's comet is now well placed for observation in the morning; it is moving north so rapidly that it will soon be observable throughout the night. The following ephemeris is for 6h A.M.:

| | R.A. | N. Decl. | log *r*. | log Δ. |
|---|---|---|---|---|
| Mar. 4. | 21h 2m 48s | 21° 4′ | 9·8124 | 9·9643 |
| 8. | 21 13 23 | 30 33 | 9·8661 | 9·9481 |
| 12. | 21 28 14 | 40 13 | 9·9134 | 9·9419 |
| 16. | 21 48 56 | 49 36 | 9·9552 | 9·9466 |
| 20. | 22 17 48 | 58 12 | 9·9928 | 9·9616 |

Its naked eye visibility during this period is doubtful, but it will probably be an easy telescopic object. On the morning of March 8 it will be ½° east of Zeta Cygni, on March 14 1½° east of Rho Cygni. It then passes through Cepheus and the northern part of Cassiopeia.

Blathwayt's comet has grown fainter, but should still be within reach of moderate apertures. The following ephemeris is for 0h:

| | R.A. | N. Decl. | log *r*. | log Δ. |
|---|---|---|---|---|
| Mar. 4. | 5h 53m 14s | 42° 47′ | 0·2055 | 0·0123 |
| 8. | 5 41 24 | 43 50 | 0·2140 | 0·0620 |
| 12. | 5 32 35 | 44 30 | 0·2225 | 0·1061 |
| 16. | 5 26 1 | 45 3 | 0·2312 | 0·1462 |

The comet is in Auriga, moving nearly parallel to the line joining Beta to Alpha.

Tuttle's comet may be visible with moderate apertures when the moon is absent. The ephemeris for 0h is:

| | R.A. | N. Decl. | log *r*. | log Δ. |
|---|---|---|---|---|
| Mar. 3. | 1h 21·7m | 30° 43′ | 0·1222 | 0·2249 |
| 11. | 1 52·1 | 28 25 | 0·0991 | 0·2226 |
| 19. | 2 22·2 | 25 49 | 0·0769 | 0·2212 |

Prof. A. Dubiago gives the following hyperbolic elements for Van Biesbroeck's comet, based on observations on Nov. 19, Dec. 4 and 21, Jan. 12.

| | | |
|---|---|---|
| T | 1925 Oct. 3·00066 U.T. | |
| ω | 106° 25′ 13·0″ | 1925·0 |
| Ω | 334 34 29·9 | |
| *i* | 49 19 38·4 | |
| log *q* | 0·19500, | |
| *e* | 1·002442 | |

## Research Items.

RECENT STUDIES OF PITHECANTHROPUS. — In *Natural History*, the journal of the American Museum of Natural History, Vol. 25, No. 6, Dr. J. H. M'Gregor summarises recent views on *Pithecanthropus erectus*, but in addition contributes to the discussion of the place of these remains in our knowledge of the phylogeny of man the conclusions at which he himself has arrived as the result of first-hand study of the bones themselves and of Dr. Dubois' endocranial cast. Owing to erosion of the outer bone by the action of sulphuric acid, casts of the calvarium give an erroneous impression which can only be corrected by examination of the actual bones. 3·5 millimetres and more must be added to the maximum length, making it 184 mm. Further, the nuchal surface of the occiput to which the powerful neck muscles were attached has also suffered. The original occipital slope was therefore more vertical and consequently more ape-like than the cast. The corrected breadth measurement, allowing for erosion, gives an index of 71·5. In the endocranial cast both the development of the so-called Broca's convolution and the marked expansion of the middle temporal convolution support the view that Pithecanthropus could produce and appreciate articulate speech. In a reconstruction of the size and form of the brain made by Dr. M'Gregor, the hominoid features outweighed the pithecoid very decidedly and gave a volume of 940 cc. The general brain form is more like the gibbon than the gorilla, though in convolution it is more like the latter. In both size and form, however, the brain is distinctly closer to man than that of any ape.

THE SIGNIFICANCE OF THE CHARACTER OF THE HAIR IN MAN.—Dr. Fritz Sarasin has contributed a study of changes in the character of the hair in Melanesian and African children to *L'Anthropologie*, T. 35, pts. 5-6, in which he arrives at conclusions of no small importance in relation to the question of the significance of hair as a criterion of race. It has been stated by Martin that the form of hair characteristic of the different races is already to be observed in the newly-born, and the same or similar statements have been made by other anthropologists. Dr. Sarasin is unable to endorse this view as a result of his observations among the Melanesians and Africans. Among New Caledonians, infants up to the age of a year or a year and a half have almost straight or slightly wavy hair, of brown, light brown, or even blond. It does not begin to change until about five years, and does not become completely frizzy like that of an adult until about six years, when it is still slightly lighter in colour. This observation is supported by the records of observers in the New Hebrides (Speiser, Heim), in Africa (Collignon, Frédéric, Junod, Borel), and among the negroes of the United States (Schultz). Among negroes, however, the hair is black and not lighter in colour, and the change in form takes place rather earlier. It follows that frizzy hair must be considered a secondary character in man. No anthropoid or other ape has frizzy hair. Thus it must have been acquired at a later geological epoch, the straight or wavy hair being the primary character. Further, if it is a secondary character, it must be possible for it to have been acquired by the different races of which it is now a character at different times and in different ways. Frizzy hair, therefore, cannot be regarded as a possible basis for racial classification.

PREDICTIONS OF A MACKEREL FISHERY FROM SALINITY OBSERVATIONS.—In No. 8 *Medd. fra Komm. f. Havundersøg. Ser. Fiskeri*, Bind 7, 1925, Copenhagen, Dr. A. C. Johansen deals with the occurrence of mackerel in the Kattegat and adjacent parts of the Skagerak. In the waters of the Kattegat and Belt Sea, two layers occur usually; a surface layer of relatively low salinity, and a lower layer with relatively high salinity. This stratification is due in the main to the outflow of relatively fresh water from the Baltic, and the inflow of relatively salt water from the Skagerak. In the upper layer, to a depth of about 10 m. to 25 m., the resulting current is directed towards the Skagerak and the North Sea, while in the lower layer it is towards the Baltic. Johansen advances evidence to show that there is a connexion between yearly catches of mackerel in the Kattegat, a strong ingoing current in the lower layer in April and May indicated by a high salinity, and a low temperature of the surface waters in June. He concludes that a prediction with a certain degree of probability whether it will be a good or bad mackerel year can be given so soon as salinity observations in March and April are to hand, or about one or two months before the fishery in the Kattegat begins. Dr. Johansen adds a footnote to the effect that predictions will be published in *Dansk Fiskeritidende*.

ENCYSTMENT IN DIDINIUM.—C. Dale Beers records (*Proc. Nat. Acad. Sci. U.S.A.*, vol. 11, Sept. 1925) the results of studies on encystment in the ciliate *Didinium nasutum* with the view of ascertaining the cause of the conflicting conclusions reached by Calkins and by Mast. Calkins picked out from each of ten pure lines of this ciliate a single individual and supplied it with nine specimens of Paramæcium daily as food. As generations passed the fission-rate gradually decreased and the encystment rate increased, the latter reaching 100 per cent. in the 131st generation. Calkins concluded that in Didinium the passage of generations results in diminished vitality and ultimately in encystment with nuclear reorganisation and rejuvenescence, and that there are two types of encystment, one which protects against environmental adversity, and the other which occurs periodically and independently of the environment and results in rejuvenescence. Mast's experiments differed from those of Calkins in that at each isolation of Didinium, he placed with this ciliate enough Paramæcium to ensure a surplus of food, and he found no evidence to indicate that encystment occurs periodically. The present author has carried out two series of experiments on Didinium descended from one individual—one series of four lines was cultivated according to the procedure of Calkins, *i.e.* each Didinium was supplied daily with nine Paramæcia; the second series of four lines was supplied, as in Mast's investigations, with sufficient food to ensure a surplus. Except for this difference the two series were kept under the same conditions. The first series behaved like those in Calkins' experiments and the second like those of Mast. The encystment in the first series was due to the unfavourable condition —lack of food. The mere passage of generations does not result in encystment or in decreased fission-rate, provided the environment is favourable. The evidence indicates that all the cysts of Didinium are of one type—protection cysts.

EFFECT OF ULTRA-VIOLET RAYS ON THE GERMICIDAL ACTION OF THE BLOOD.—Colebrook, Hill, and Eidinow showed that when the skin is exposed to sources of ultra-violet rays the power of the blood to kill bacteria is greatly increased when tested *in vitro*—by so much as 65 per cent. in the rabbit

and 17 per cent. in man. Further work (A. Eidinow, *Brit. Journ. of Radiology* [B.I.R. Section], vol. 31, No. 306, 1926, p. 35) has shown that this increased germicidal power of the blood is evoked only when the rays produce erythema (reddening) of the skin—preferably a mild erythema that disappears within twenty-four hours. An excessive exposure of the skin to the sun's rays may cause a diminution of the bactericidal power of the blood. It is only ultra-violet rays shorter than 3100 Å.U. which produce erythema and likewise increase bactericidal function of the blood, and those derived from the mercury vapour lamp, the carbon arc, and sun's rays are equally efficient. The mechanism of the action is uncertain, for there is no experimental evidence to support the view that the irradiated skin cells form a bactericidal substance. If an animal is injected with bacteria so as to cause a septicæmia or blood-poisoning, the natural bactericidal power of the blood falls to a very low degree, and irradiation of the skin with ultra-violet rays during this stage does not increase the bactericidal power of the blood, so that acute infections of this kind cannot be treated by these means. Direct exposure *in vitro* of defibrinated blood to ultra-violet rays destroys such bactericidal power as it may possess, but injection of 10-20 cc. of this irradiated blood into a rabbit results in a marked rise in the bactericidal power of the blood of the animal after a latent period of two hours. The phenomenon appears to be due to some effect on the corpuscles, for it is not obtained with irradiated blood-serum without corpuscles.

A FLORA OF UTAH AND NEVADA.—Volume 25 of Contributions from the United States National Herbarium is a flora of Utah and Nevada, by Ivor Tidestrom. This area lies wholly within the arid region, but is very diversified in character with high mountains separated by dry desert valleys or by tablelands. The flowering plants and ferns are treated systematically, some 3700 species being included, with keys to the species and larger groups. In an interesting introduction the author draws a striking parallel between topography and vegetation of this corner of the United States and the Iberian peninsula in Europe. H. L. Shantz gives a brief summary of the main characteristics of the chief plant communities from the point of view of the ecologist, whilst Arthur W. Sampson deals with the environment of the flora of the alpine regions and foothills. Within this region the flora typical of the western United States meets the flora typical of northern Mexico, the line of demarcation being described by Tidestrom as conspicuous in south-western Utah and southern Nevada, where it coincides with the northern limit of *Covillia tridentata*, the creosote-bush.

TRAUMATROPIC CURVATURES IN PLANTS.—This conception of curvature in plants as resulting from the "stimulus" of a wound is perhaps of doubtful validity, and Adolph Beyer has recently completed an examination of the subject (*Biologisches Zentralblatt*, vol. 45, pt. 12), which leads him to an alternative interpretation. Such curvatures, he thinks, should be explained as due rather to an interference with the normal nutritional correlation as a result of the wound. He thus explains curvatures in seedling hypocotyls, coleoptiles, and roots as due to a disturbance of one of two correlations, namely: (i.) Growth-promoting substances moving from the apex of the coleoptile, or the epicotyl in the case of the Helianthus seedling; (ii.) food supplies moving to growing tissue from regions of storage.

THE OLD RED SANDSTONE FLORA OF SCOTLAND.—Prof. W. H. Lang contributes an interesting paper to the *Transactions of the Royal Society of Edinburgh* (vol. 54, Pt. 2, No. 2), in which he continues the important studies which he commenced with the late Dr. R. Kidston. He has studied the plant-remains from the fish-beds of Cromarty and finds evidence of the existence of a considerable bulk of vegetation of varied character. By extracting the remains of spores and sporangia from the rock, he has recognised nine distinct types of spores and two types of sporangia. Some of the spores have a very characteristic form and ornamentation, but the plants which bore them are as yet unknown, and they indicate that several more plants of the epoch remain to be discovered. The other plant-remains are fragmentary, but under Dr. Lang's careful treatment have yielded valuable results. He has found that Thursophyton had circinate buds like Psilophyton. The genus Hostimella has received further elucidation, and two new species with characteristic sporangia have been described. One, *H. pinnata*, shows a series of incurved pinna-like branch systems with sporangia at their tips. No suggestion is as yet made as to the systematic position of these forms, but their remoteness from the Lycopodiales is pointed out. To a less cautious observer they suggest a resemblance to some of the much dissected fronds of the Lower Carboniferous pteridosperms and ferns. Another organism described, *Hostimella racemosa*, is a sporangium bearing branch system; it was derived from the Stromness beds. This is a remarkable structure consisting of an axis bearing sporangium-like organs on either side, each sporangium being surrounded by a zone where the rock is stained a darker colour forming a sort of halo. There is no evidence as to the type of plant on which these branches were borne and it is provisionally placed in the genus Hostimella, but it is clear that this artificial genus, while possessing little vegetative differentiation, had reproductive organs of a varied character. The whole work is a valuable contribution to our scanty knowledge of the earliest known land flora of the world.

MOUNTAIN BUILDING AND IGNEOUS ACTION.—In the *Proc. Am. Phil. Soc.* vol. 64, 1925, p. 283, Prof. R. A. Daly returns to his geological exploration of the possibilities arising from the assumption that the Taylor-Wegener hypothesis of continental drift is correct. He conceives that the moving continents slide on a substratum of hot basaltic glass which, though rigid to stresses of short periods, is extremely weak. Mountain chains are then explained as structures that have been compressed on the down-stream side of continental "landslides." Upstream, breaking tensions are necessarily developed, and mobile fractions of the substratum are forced up the abyssal fissures, the general type of magma generated being basaltic. Downstream, the granitic crust beneath a geosyncline is overridden by the sliding foreland, and part of it sinks down into the underlying basalt which is thus displaced, and tends to erupt along the soles of thrust-planes. The sunken crust then melts, and gives rise to secondary magmas that invade the crumpled sediments as batholiths and stocks with all their attendant dykes and lavas. The rise of magma is aided by gas pressure, the juvenile gases acting as fluxes in the development of volcanoes of the central type. A combination of the Joly and Wegener hypotheses may make this or some similar scheme workable, but it is difficult to believe in the glassy substratum, for seismology persistently fails to provide any evidence for the existence of a basaltic layer beneath the continents. A rock-layer of

density about 3·4 is indicated, and this may be eclogite, since the geological evidence is conclusively in favour of a basaltic composition. The possibilities thus seem to be eclogite during periods of solidity and basaltic magma during epochs of fusion, basaltic glass being completely ruled out.

A GIANT CRATER IN ALASKA.—During recent exploration of the country west of the Aleutian Mts. by a United States geological survey party, a gigantic crater was discovered, which, with its associated features, closes what was supposed to be a wide gap in the volcanic line of the Alaska Peninsula. Mr. W. R. Smith gives an interesting account of the crater in Prof. Paper 132-J of the U.S. Geological Survey, 1925. The rim is nearly circular and has an average diameter of more than six miles. The area of the crater thus exceeds that of Crater Lake, Oregon (5½ miles in diameter), but is only about half the area of the craters of Ngorongoro in East Africa and Aso-san in Japan. These three craters are all examples of the type known as calderas and are due to subsidence. The newly discovered crater, named Aniakchak Crater (after the river that rises within it), belongs, however, to the explosive type, of which it is now the largest example known, Katmai Crater, also in Alaska, having previously held the record with a diameter of three miles. If the volcano had originally possessed a low cone, then about 15 cubic miles of material must have been blown away. Much of this can be accounted for by the great spreads of volcanic ash already known to the east and south. Within the crater is a large truncated cinder-cone, rising to 2200 feet above Surprise Lake, which occupies part of the north-eastern floor of the crater. The volcanic formations lie on a basement of Upper Jurassic sediments, and the inner wall of the crater is made up of layers of pink and black lava—probably obsidian—with quartz-diorite below. Black obsidian is also found ten miles away, though exposures of lava flows are rare owing to the thick covering of the surrounding country by fragments of glassy lava, pumice, and ash. The volcano is now completely quiescent, no fumerolic activity having been detected.

CURRENTS IN THE UPPER AIR.—The Meteorological Office, Air Ministry, in Professional Notes, No. 42 (London: H.M. Stationery Office, 1925, price 1*s.* 6*d.* net), gives the result of an "Investigation of the Winds in the Upper Air from Information regarding the Place of Fall of Pilot Balloons and the Distribution of Pressure," by Mr. J. Durward. This note discusses the horizontal movement of pilot balloons in relation to the distribution of pressure. The data used are obtained from post cards, on which the date, place, and time of origin are entered, attached to the pilot balloons. The finder of the balloon is requested to return the card after entering the place and time of finding. During 1923 more than 1000 cards were returned. The results throw some light on the direction of winds at high levels, but the method is attended by so many uncertainties that it is, on the whole, inferior to the careful observation of high clouds, although it is practicable in all weathers.

VARIATIONS IN RADIO SIGNALS.—In broadcasting it is well known that there are great variations in the quality of the reception. These variations are due to many factors, including sunlight, temperature, barometric pressure, humidity and human agencies. As they occur not only from season to season, but even from hour to hour, they are far too complex to permit of a simple analysis. The only satisfactory method of attacking this problem is the statistical method, namely, to analyse similar observations taken over specified areas by a number of competent observers during a considerable period of time. A test of this nature was organised by the Bureau of Standards over a period of a year (1922–1923). Mr. C. M. Jansky has analysed the results in Paper No. 297 of the Bureau of Standards. The results shown by observations made of KDKA, the transmitting station of the Westinghouse Co. at Pittsburgh, prove that "fading" is most pronounced in September and October, and least in February and April. The atmospherics were worst in August and September, and least in February and March. It has sometimes been stated that signals from distant stations are often of greater intensity than signals from stations of similar power but situated much nearer to the observer. The results obtained by two entirely different sets of observers on two different transmitting stations verify this. It is clearly indicated that somewhere between 100 and 200 miles the signals are less satisfactory than the signals received from much more distant stations. From the scientific point of view this is of importance.

STRUCTURE OF GRAPHITE.—In No. 3 of the *Scientific Papers of the Institute of Physical and Chemical Research, Tokyo*, G. Asahara has shown by means of measurements of the diffraction of X-rays that, however finely powdered, graphite possesses a crystalline structure. In the case of thirty-four different forms examined, amorphous carbon and graphite are essentially identical.

SEPARATION OF INDIUM.—Reprint No. 5 from the *Scientific Papers of the Institute of Physical and Chemical Research, Tokyo*, is a description of the detection and separation of indium. A method was devised of precipitating indium by means of ammonium sulphide from a dilute solution acidified with sulphuric acid, after the addition of a small amount of tartaric acid and neutralisation with ammonia. This proved satisfactory when tested with mixtures of several kinds.

"KNOCK" IN INTERNAL COMBUSTION ENGINES.—Report No. 979 (E. 15) of the Aeronautical Research Committee (London: H.M.S.O., price 2*s.* 6*d.* net) deals with closed vessel explosions of mixtures of air and liquid fuel (petrol, hexane, and benzene) over a wide range of mixture strength, initial temperature, and initial pressure. Attention was particularly directed to the production of detonation in internal combustion engines. The conclusions are too numerous to summarise, but a few points may be mentioned. At 100° C. the air-fuel ratio for maximum explosion pressure is considerably less than that required for complete combustion. Rich mixtures of all three fuels give rise to a knock, the intensity of which increases with decrease in the air-fuel ratio and is apparently preceded by high frequency vibrations. Raising the temperature sometimes eliminates the knock. With normal mixtures the explosion time diminishes with increase in initial temperature and increases with increase in charge-density. The addition of about 6 per cent. of exhaust gas to a normal air-hexane mixture has but little effect in suppressing knock at 230° C. initial temperature. Comparatively large percentages of water vapour can, apparently, be added to the charge without affecting appreciably the efficiency of the conversion of the chemical energy of the fuel into pressure energy, even when the explosion time is largely affected by these additions. The results connecting tendency to knock and the richness of the charge appear to contradict experience with actual engines. The report is fully illustrated.

## The Carnegie Trust for the Universities of Scotland.

EVEN a cursory perusal of the twenty-fourth annual report of the Executive Committee of the Carnegie Trust leads to the conclusion that the beneficial influence exercised by the Trustees for nearly quarter of a century in furthering the cultivation of science in the Scottish universities shows no sign of abatement. Moreover, the financial support afforded by the Trust is not confined to the universities, but is now extended to a number of colleges and institutions which are more or less closely associated with the universities and are doing work of equivalent standard. About one-half of the income of the Trust is utilised partly in the endowment of research in all branches of science and partly in assisting the universities and other institutions to provide buildings and equipment for libraries and scientific laboratories, to endow professorships and lectureships, and to develop the social side of student life by the erection of unions and hostels.

As regards the first object, a sum of more than 18,000*l.* was expended in the academic year 1924–25 in the provision of teaching fellowships, the holders of which are expected to devote most of their time to research, research fellowships and scholarships, and research grants to members of the staffs and other investigators. Grants were also made to the Scottish Marine Biological Station at Millport, the Rowett Research Institute at Aberdeen, and the Animal Breeding Research Department at Edinburgh.

For the academic year 1925–26, 20 teaching fellows, 10 research fellows, and 31 research scholars have been appointed, while in addition, grants in aid of research have been given to 36 individuals. During the year 1924–25, 17 scientific papers were published by teaching fellows, 28 by research fellows and scholars, 27 by recipients of research grants, and 13 by investigators working in the laboratory of the Royal College of Physicians; in these papers the following subjects are represented: Mathematics, physics, chemistry, geology, botany, zoology, anatomy, palæontology, physiology, pathology, medicine. The judgments of the experts appointed by the Trust to report on the work of fellows and scholars are uniformly favourable, and it is recorded that many of those who in former years were thus assisted to pursue their scientific careers now occupy prominent positions in the academic or industrial world.

With respect to the provision of opportunities for the prosecution of scientific research in the Scottish universities, the operations of the Carnegie Trust have brought about a marked change for the better. Previous to Mr. Carnegie's munificent donation, there were very few post-graduate science scholarships, and many of the most promising students were compelled, by the necessity to earn a livelihood, to leave the universities as soon as they had graduated. Now a selected number of graduates are enabled to enter upon courses of research, vastly to their own advantage and to that of the universities. Moreover, as is evidenced by the following quotation from the report, the activities of the Trust have also benefited the universities in a less direct manner: "... it is evident that the cause of University education commands to-day the consistent confidence and support of private benefactors and of public bodies. On more than one occasion the Committee, in intimating their quinquennial grants, have expressed the hope that these would act as an incentive in stimulating local effort to supplement the Trust's contributions, and hasten the completion of many important purposes to which the Trust were able to give only partial assistance. It is gratifying to find that a large measure of help has been forthcoming. During the past Quinquennium alone private benefactions to the four Universities have exceeded 800,000*l.* Yet large as are the sums now devoted to University work in Scotland, there are few sections which do not call for some further advance, and the help which the Trust has been able to give is to be regarded as only an indication of the opportunities which still exist to benefit the people of Scotland through the Universities."

## The Genetics of Cereals.

THE study of the cytology of cereals has come to have an important place in agricultural plant breeding. In both wheat and oats, diploid, tetraploid and hexaploid species are known, the haploid number of chromosomes being seven. In rye and barley the fundamental number is the same, but polyploid varieties have so far not been discovered. But as much less work has been done with the latter cereals, it is not improbable that polyploid species may yet be found in them. Dr. K. V. Stolze[1] has published a summary of our present knowledge on this subject, in which all the earlier work is reviewed.

In certain forms of wheat and oats eight pairs of chromosomes have been described. Some of these records may be due to error, but certain of them are probably correct. Stolze suggests that such forms, which are indistinguishable from the normal, have arisen through transverse segmentation of one chromosome. This is more probable than the alternative method of origin through non-disjunction as in *Œnothera lata*, since in the latter case external differences appear. But the author himself figures in rye a homotypic nucleus with six chromosomes, which is an indication that non-disjunction occurs in this species.

The author recognises that the determination of whether, in any case, a transverse or a longitudinal split has occurred, depends largely upon comparative measurements of chromosomes and nuclear volumes. The usual view has been that in the wheats the polyploid conditions have arisen through longitudinal splitting of the chromosomes, probably accompanied by crossing. Stolze favours the view that fragmentation of the chromosomes has been concerned. Further investigations alone can settle this question. It seems very probable that both longitudinal and transverse splitting of the chromosomes have occurred in different genera of plants, but in the wheats the view of multiplication by a transverse split encounters serious difficulties, both genetical and cytological. The determination of this point would throw further light on the relationships of the various forms.

A dwarf form of wheat, which originally appeared in experiments of de Vilmorin, has since been carefully studied by Messrs. Engledow and Wadham (*Journ. Genetics*, vol. 16, No. 1), with interesting and important results. It was known that the dwarfs gave rise to talls which bred true and dwarfs which continued to 'split' in a ratio which might be interpreted as 1 : 2 : 1, including certain bushy plants

[1] "Die Chromosomenzahlen der hauptsächlichsten Getreidearten nebst allgemeinen Betrachtungen über Chromosomen, Chromosomenzahl und Chromosomengrösse im Pflanzenreich." Von Karl Viktor Stolze. (Bibliotheca Genetica, Band 8.) Pp. iii+71. (Leipzig: Gebrüder Borntraeger, 1925.) 9.60 gold marks.

which never flowered. Also, the talls and dwarfs could not always be distinguished by their heights. It was found that in each generation dense-eared plants (a safer character to deal with than dwarfness) gave (1) lax-eared, (2) dense-eared, (3) short plants with one stem and no ear, and (4) bushy pigmy plants with no ear. The last, when grown under special conditions, produced ears which were found to be denser than the normal dense-eared form. Dense-eared plants showed wide fluctuation in height, which made classification on a height basis impracticable. Usually, height and ear-density are inherited independently and are hence presumably determined by different chromosomes. It is therefore suggested that in this ever-splitting race there may have been a fusion of these two chromosome pairs, this being a part at least of the mutational change to which the dwarf form owed its origin. A number of ever-splitting races of cereals are discussed. It is hoped that a cytological investigation of this peculiar dwarf will be made, which may help to clear up the genetic peculiarities of such ever-splitting races.

In another paper in *Journ. Genetics*, vol. 16, No. 1, Messrs. Engledow and Hutchinson give some results of crossing between *Triticum turgidum* and *T. durum* or rivet and Kubanka wheat. Since these are both tetraploid species, there is no sterility in the hybrids. The $F_1$ plants from this cross showed the vigour of heterozygosis. In previous experiments with wheat the endosperm characters of the seed have appeared to show maternal inheritance, in spite of the fact that double fertilisation takes place, which might be expected to lead to the phenomena of xenia, or paternal influence on the endosperm. In *T. turgidum* × *T. durum* the grains were larger than in either parent, but while intermediate in certain features, the vitreous texture and extreme hardness of the durum endosperm were dominant. Moreover, the grains on each $F_1$ were uniform, although the endosperm really belongs to an $F_2$ generation and might be expected to show recombinations. In the $F_2$ plants the same condition held, but in addition to the plants with endosperm like *turgidum* or like *durum*, there were other plants in which the grain showed various mixtures of the two kinds of tissue. The striking difference between the phenomena of xenia in maize endosperm and maternal inheritance in wheat endosperm leads to the suggestion that since in wheat seeds the endosperm cells are already dead, the paternal character determined by the male nuclei has not had a chance to express itself. But the same conditions would appear to obtain in the maize seed, where xenia occurs.

In these crosses the inheritance of solidness of straw has also been studied. The "lodging" of cereals is believed to be due to lack of elasticity, rather than lack of strength, in the stems. Solid straw has greater elasticity. In different varieties of wheat various kinds of solidness were found, and these were in general unifactorial differences; but the results were influenced by other factors for size of straw.

From these crosses it should be possible to produce a rivet wheat with high yield, hard, 'baking' endosperm, and solid, non-lodging straw.

R. RUGGLES GATES.

## Dielectric Constant and Molecular Structure.[1]

THE physical methods for investigating the structure of molecules are principally five in number: (1) the ratio of the gaseous specific heats at constant pressure and constant volume; (2) the arrangement of atoms in crystals found by X-ray diffraction methods; (3) the molecular band spectra as interpreted by the quantum theory; (4) phenomena indicating strong fields of force around certain types of molecules; (5) refractivity and dielectric properties. The connexion between dielectric constant and molecular structure was to some extent realised by Faraday, but the theory has been developed by Lorentz, Debye, J. J. Thomson, Gans and Pauli. Recent tests have confirmed the basis of the theory.

The electrons in a molecule are displaced in an electric field, causing the appearance of an electric moment. Account must also be taken of the facts that not all electrons are similarly situated in the molecule and that an effect is produced on the field of its neighbours by the displacement of an electron. The effect produced on the displacement of any electron by that of other electrons in the same molecule must also be considered. If each molecule is a permanent electric doublet of moment $\mu$, there is a tendency of molecules to orient themselves with their electric axes in the direction of the field. This is hindered by the thermal agitation and a statistical average degree of alignment results, depending on the moment of the doublet, the strength of the field and the temperature. All these factors are included in the equation of Debye:

$$\frac{\epsilon - 1}{\epsilon + 2} = 4\pi N\left(\frac{e^2}{3}\sum_1^n \nu_p \gamma_p L_p + \frac{\mu^2}{9kT}\right) = \left(A + \frac{B}{T}\right)D.$$

[1] Abstract of an address by Prof. K. T. Compton, of Princeton University, retiring vice-president of Section B (Physics) of the American Association for the Advancement of Science, delivered at the Kansas City meeting on December 30, 1925.

In this $\epsilon$ is the dielectric constant; $N$ the number of molecules per unit volume; $e$ the electronic charge; $\nu_p$ the number of electrons of type $p$ in the molecule; $r$ the binding constant; $L_p$ a factor to take account of the effect produced on the displacement of any electron by that of other electrons in the same molecule; $k$ Boltzmann's gas constant; $T$ the absolute temperature; $A$, $B$ are constants, and $D$ is the density.

In the case of gases the equation has only recently been tested with sufficient accuracy; $\epsilon$ is very near unity. One of the experimental methods, used by Herweg and improved by Zahn, consists in amplifying the electrical beats between two differently tuned oscillating circuits, one of which contains the experimental condenser alternately filled and emptied of gas. The electrical beats are made audible by a telephone receiver and produce acoustical beats with the sound from an electrically driven tuning-fork. This method is capable of measuring a change in capacity of one part in two millions. By plotting $(\epsilon - 1)vT$, where $v$ is $1/D$, a straight line is obtained, from which $A$, the binding constant $r$ and $B$, or the permanent electric moment $\mu$ of the molecule, may be computed. The values of $\mu$ so found vary from $1{\cdot}03 \times 10^{-18}$ for hydrogen chloride to $0{\cdot}06 \times 10^{-18}$ for carbon dioxide. In the case of liquids, the values vary from $0{\cdot}20 \times 10^{-18}$ for benzene to $2{\cdot}15 \times 10^{-18}$ for amyl alcohol; the value for water is $1{\cdot}98 \times 10^{-18}$. The application to liquids is not very good, probably on account of the mutual actions between molecules not allowed for in Debye's formula, and Gans has derived a much more complicated formula. C. P. Smyth has shown that it may be combined with the Lorentz dispersion formula to permit at least an *approximate* calculation of the electric moment in many cases. In some cases the moment varies with temperature, apparently due to association.

If assumptions are made as to the structure of molecular models, the consideration of dielectric constants will enable these to be tested, although of course it will not explicitly give us the structure of the molecule. Prof. Compton gives examples of the Lewis-Langmuir type and shows that the electric moments produced by the shifts of the electrons in the formation of molecules are reasonable values.

The binding constant may also be calculated from refractivity data, and the figures derived by Born and Heisenberg, Fajans and Jooz, Smyth and others indicate that the electrons are most easily shifted in ions with small central positive charges (cores) and also in large atoms, where they are far removed from the centre. The deformability of molecules thus indicated has an important bearing on the theory of spectra, and a difficulty in the Ritz formula may perhaps be resolved if it is assumed that the electron shell is distorted by the field of the valency electron rotating about the core of the atom. Prof. Compton indicated that numerous interesting problems still await investigation in other aspects of dielectric constants.

## University and Educational Intelligence.

ABERDEEN.—The Senatus has resolved to confer the honorary degree of LL.D. on Prof. F. W. Oliver, professor of botany in University College, London; Dr. R. W. Reid, emeritus professor of anatomy in the University of Aberdeen; Prof. T. B. Wood, professor of agriculture in the University of Cambridge.

BIRMINGHAM.—The report of the Principal (Mr. C. Grant Robertson) presented to the annual meeting of the Court of Governors on February 25, shows that the number of students, which had been steadily diminishing since the abnormal period of inflation following the War, last year reached its minimum, and there are indications that recovery has already begun. The percentage of unmatriculated and part-time students continues to decrease.

The construction of the new block for the biological departments at Edgbaston is rapidly progressing, and it is expected that the building will be in use next session. The transfer of these departments, however, will raise a serious problem, in that the Harding Library in its present form will be quite inadequate to meet the consequent increase in the demands on its space.

The new building for the Department of Petroleum Mining is already occupied, and is shortly to be formally opened. In addition, a new laboratory has been erected for the Mining Department and equipped with large-scale experimental plant for the study of scientific and technical problems of coal treatment, the funds being provided by the Central Committee of the Miners' Welfare Fund. The Principal directs attention to the fact that the Mining Department now serves as the post-graduate mining school for the Universities of Oxford and Cambridge.

An appeal is made for more generous support of the University by the midland area generally. In particular, "What is needed to-day is the establishment, on an adequate scale, of post-graduate scholarships. Its absence is a cause of national waste; and no better service to the cause of true education and a heightened national efficiency could be rendered than by the creation of such an endowment."

CAMBRIDGE.—Mr. G. F. Shove, University lecturer in economics, has been elected to a fellowship at King's College. Mr. I. A. Richards and Mr. F. McD. C. Turner have been elected to fellowships at Magdalene College.

A slight change has been introduced into the regulations governing medical studies; it is now laid down that no student may attend any course of instruction for the third M.B. examination until he shall have passed the last part of the second examination (pharmacology and general pathology). Some 'young men in a hurry' may find this distasteful, but there is little doubt that the principle on which the change is founded is sound.

The Board of Research Studies is proposing that a summary of each successful thesis for a research degree shall be published in the *Reporter*. Such summaries would then be distributed to the universities from which non-graduate research students are drawn. The present practice is that dissertations are placed in the University Library; some of them never appear in print, and in this way good work is sometimes lost to sight and memory. It is thought that the present proposal would both obviate this possibility and also avoid overlapping in research work. Incidentally, the great increase in numbers of research students at Cambridge in recent years will become apparent.

The governing body of Emmanuel College is offering to a research student, commencing residence in October 1926, a studentship of the annual value of 150*l*. Preference will be given to a candidate who has already completed at least one but not more than two years of research. Applications should reach the Master of Emmanuel (The Master's Lodge, Emmanuel College, Cambridge, England) not later than June 30. Candidates should submit two certificates of good character, a statement of the proposed course of research, and evidence of general ability and of special fitness for the proposed course of research.

LONDON.—The offer of the Petrie Medal Committee, on behalf of the subscribers, of a Petrie Medal and Fund amounting to 75*l*. has been accepted. The Medal is to be awarded once in every three years for distinguished work in archæology, preferably to a British subject.

Prof. C. A. Lovatt Evans has been appointed as from Aug. 1 to the Jodrell chair of physiology tenable at University College. Since March 1922 Prof. Lovatt Evans has been University professor of physiology at St. Bartholomew's Hospital Medical College. During this period he has published "Recent Advances in Physiology" (1925) and edited a new edition of Bainbridge and Menzies' "Essentials of Physiology" (1925).

Dr. G. V. Anrep has been appointed as from March 1, 1926, to the University readership in physiology tenable at University College. Dr. Anrep was educated at the University of Dorpat and at the Medical Faculty of the University of Leningrad. From 1912–14 he was engaged in research work at the University of Leningrad and at University College, London. From 1917 until 1920 he was senior assistant in physiology at the Institute of Experimental Medicine of Leningrad and in 1920 he was appointed assistant, and in 1923 senior assistant in physiology at University College, London. He obtained the D.Sc. degree in physiology in 1923 and has been awarded the Schäfer Prize and the Julius Mickle Fellowship (1924–25) for his research work in this University. His published work includes numerous articles in the *Journ. of Physiol.* (1912–25); *Proc. Roy. Soc.* (1923–25); and in *Heart*.

APPLICATIONS for the Beit fellowships for scientific research should be made upon a prescribed form and sent to reach the Rector, Imperial College of Science and Technology, South Kensington, S.W.7, by, at latest, April 19.

## Contemporary Birthdays.

**March 8, 1855.** Prof. Karl E. Ritter von Goebel.
**March 8, 1859.** Sir Robert Blair.
**March 9, 1862.** Sir Sidney F. Harmer, K.B.E., F.R.S.
**March 10, 1858.** Maj.-Gen. Sir R. Havelock Charles, G.C.V.O.
**March 10, 1861.** Sir Arthur E. Shipley, G.B.E., F.R.S.

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Prof. KARL E. RITTER VON GOEBEL, LL.D. (St. Andrews), a foreign member of the Linnean Society, was born at Billigheim, Baden. He was educated at the universities of Tübingen, Würzburg, and Strasbourg. Elected to the chair of botany at Strasbourg in 1881, he later occupied posts at Rostock and Marburg, down to the time when he became professor of botany at the University and director of the Royal Botanic Gardens, Munich. An authority on the mosses and liverworts (Bryophyta), some of his work has appeared in English under the titles, "Sketches of Plant Biology" (1889), "The Organography of Plants" (Oxford, 1905).

Sir ROBERT BLAIR, Education Officer of the London County Council from 1904–24, is a graduate of the University of Edinburgh. Early he had practical experience as a schoolmaster, afterwards engaging in new avenues of work as Chief Inspector, Technical Education, Ireland, 1901–4. In 1903 he was a member of the Mosely Education Commission to America. He was president of the Educational Science Section at the British Association meeting in 1920. Sir Robert has written informing papers on features of American education; on the relation of science to industry, and cognate subjects.

Sir SIDNEY HARMER, Director of the Natural History Departments, British Museum, was born at Norwich. Educated at University College, London, he graduated at King's College, Cambridge; afterwards he was Assistant Tutor there (1890–1908) and Superintendent of the University Museum of Zoology.

Sir HAVELOCK CHARLES, sergeant-surgeon to the King, is a Knight of Grace of the Order of St. John of Jerusalem. He was educated at Queen's College, Cork, Dublin, and at one or more foreign universities. He passed into the Indian Medical Service from Netley in 1882. Formerly professor of surgical and descriptive anatomy in the medical colleges at Lahore and Calcutta, he was also surgeon of the Mayo Hospital, Lahore. Sir Charles accompanied their Majesties the King and Queen to India, 1911–12. Formerly he was president of the Medical Board and Medical Adviser to the Secretary of State for India. An authority in tropical diseases, he was for some time Dean of the London School of Tropical Medicine.

Sir ARTHUR SHIPLEY, eminent as a zoologist, Master of Christ's College, Cambridge, since 1910, was educated at University College, London, and Christ's College. He was demonstrator of comparative anatomy in his university, 1885–94. From 1917–19 he was vice-chancellor of the University of Cambridge. In 1887 he was delegated by the Colonial Office to investigate a plant disease in the Bermudas. Translator of Weismann's work on heredity, he has been a voluminous writer in all branches of zoological science. Sir Arthur is chairman of council of the Marine Biological Association.

## Societies and Academies.

LONDON.

**Royal Society**, February 25.—O. R. **Baldwin** and G. B. **Jeffery**: (1) The relativity theory of plane waves. Weyl showed that gravitational waves of small amplitude may be resolved into waves of three types—longitudinal-longitudinal (L-L), longitudinal-transverse (L-T), and transverse-transverse (T-T). Eddington showed that the only physically real waves are T-T waves, and identified a particular type of T-T wave, accompanied by an electromagnetic wave, with light. It appears that these waves are not purely periodic, but are accompanied by a cumulative change, which seems to indicate that plane light waves cannot be propagated indefinitely. Waves of *finite* amplitude are now discussed without approximation. Whether accompanied by electro-magnetic waves or not, L-L and L-T waves are fictitious, while T-T waves propagated with the velocity of light are physically real. The exact differential equation of light waves is obtained. Eddington's conclusion that plane light waves cannot be propagated without a cumulative change is confirmed by the more exact treatment. (2) Electronic orbits on the relativity theory. For an electron and nucleus attracting according to the law of the inverse square of the distance, either one can describe about the other a circular orbit of any radius, or, if on the balance there is a mutual repulsion, no circular orbits are possible. On the relativity theory the inverse square law is no longer accurately obeyed, and the circumstances in which a circular orbit can be described are less simple.—Margaret **Stimson** and G. B. **Jeffery**: The motion of two spheres in a viscous fluid. The stream function of the motion generated by two spheres moving with equal velocities in their line of centres is calculated. The fluid thrust on each of the spheres is calculated and numerical values are computed for the case of equal spheres.—A. L. **McAulay** and F. P. **Bowden**: Evidence for a film theory of hydrogen overpotential from surface tension measurements. In order that hydrogen may be liberated at the cathode a film of high surface tension must first be formed over the mercury. In a pure acid electrolyte the passage of extremely small quantities of electricity produces this film, which remains intact when the circuit passing the current is broken. Addition of small quantities of ions of metals more noble than copper destroys the film completely and instantly; metals less noble than copper leave the film intact. The film when fully formed seems to have a definite place in the electrochemical series. Production of overpotential at the cathode requires the initial establishment of the film. In building up the film, single electrode potential measured above reversible potential of mercury is proportional to surface tension of film; and finally, further addition to the film increases single electrode potential, but leaves surface tension approximately constant.—J. H. **Wolfenden**: Critical potentials of hydrogen in the presence of catalytic nickel and copper. By comparison with results obtained when molecular hydrogen was the preponderating source of ionisation, it is concluded that substantial quantities of atomic hydrogen are present at the metal surface. Similarity exists between the effect upon the form of the ionisation curve of the presence of the catalyst metal and that of an incandescent grid (as determined by Olmstead).—J. P. **McHutchison**: Adsorption experiments with radium D and radium E. An isotopic precipitate, formed under such conditions that one of the two analogous radio-active compounds is soluble, exhibits a preference for its own isotope, whereas a

non-isotopic precipitate displays no such preference. The addition of a soluble lead salt to a solution of radium D and radium E stops the adsorption of radium D by charcoal, and in this way radium E has been extracted in a state of great purity. The half-life period of radium E has been so determined as 4·9 days.—J. S. **Dunn**: (1) High-temperature oxidation of metals. The oxidation of three copper-zinc alloys has been investigated. It is controlled by diffusion through a protective film of oxide, and the rate of oxidation varies exponentially with the temperature. The variation of diffusion rate with temperature is deduced. (2) The low-temperature oxidation of copper. Oxidation of copper in its normal commercial state follows the theoretical parabolic law over comparatively short time intervals. Oxidation of catalytically active copper proceeds more rapidly. The origin of this departure from the ideal law is traced to changes occurring in the oxide film, and a general parallel is established between catalytic behaviour and oxidation rate.—J. **Heyrovský**: A note on the significance of the electrode potential. The stages of the author's cycle, described by J. A. V. Butler as irreversible, involve the correct free energy terms.

**Geological Society**, February 3.—S. James **Shand**: The alkaline rocks and ring-intrusions of Pilansberg (Transvaal). Pilansberg, a group of hills in the western Transvaal, is the largest of the secondary eruptive complexes which are super-imposed upon the great complex of the Bushveld. The energy which caused the extrusion of the Bushveld felsites, and the intrusion of the sheets of norite and red granite, was not quite exhausted by these tremendous events; but reactions went on underground, which led to the opening of new channels through which alkaline magma ascended. Plugs and dykes of syenite and foyaite cut the granite and the norite in Sekukuniland, in the Pretoria district, and in the west, where Pilansberg presents one of the greatest intrusions of purely alkaline rocks in the world. The Berg is circular in outline, and covers about 200 square miles. The rocks may be grouped into (1) a volcanic series and (2) an intrusive series. The former includes felsites, phonolites, tinguaite, and a great development of tuff and breccia; these rocks formed a cover under which the intrusive series crystallised.

**Linnean Society**, February 4.—A. Bruce **Jackson**: On a new hybrid conifer (*Cupressus macrocarpa* × *nootkatensis*). The tree was raised in 1911 from seeds of a cone taken from a tree of *Cupressus macrocarpa*, growing about 50 yards from one of *C. nootkatensis*, which was evidently the pollinating plant.—B. O. **Coventry**: Coloured photographs of Cashmir plants.—C. C. **Hurst**: On the nature and origin of species in Rosa. The genus Rosa may be divided into two major groups: (1) Diploid, with 7 gametic chromosomes; (2) Polyploid, with multiples of 7. Diploids fall naturally into 5 discontinuous species which breed true to their structural characters, are intrafertile and intersterile. Polyploids (except a few duplicated cultivated forms) are composed of various combinations of characters and chromosomes of the 5 diploid species. Chromosomes of diploid and polyploid species may be frequently observed working in septets during mitosis and meiosis. This presents a new mode of heredity with non-Mendelian ratios, and offers a solution of the problem of the inheritance of acquired characters. Three diploid species which do not conform to the septet formulæ are classed as distinct genera; they may be relics of the Tertiary flora. The distribution of species coincides with accepted views of the arctic origin of the land flora of the northern hemisphere, and points to an origin by descent from an arctic decaploid species with 5 double septets of chromosomes and characters, generalised and adapted to variable conditions, which, by successive losses of whole septets, gave rise to the lower polyploid species and eventually to the five specialised diploid species. The original decaploid species would most probably arise by duplications of an ancient diploid species under luxuriant conditions. This would be followed, in secular time, by differentiation of the five double septets of chromosomes and characters by duplicational segregations and gene mutations. Evolution would be an alternating process, from diploid to polyploid species (*i.e.* creative) and from polyploid to diploid species (*i.e.* emergent), according to geological conditions.

**Optical Society**, February 11.—W. M. **Hampton**: The annealing and reannealing of glass. (iii.) The determination of annealing temperatures. The formulæ deduced in pts. i. and ii. are applied to the case of heating glass under constant gradient, and the temperature at which strain disappears is obtained, the effect of the known change in the coefficient of expansion on this temperature being discussed. (iv.) The annealing of glass at low temperatures. The annealing equation is considered from the point of view of dimensions.—F. W. **Preston**: The nature of the polishing operation. The evidence for the existence of a surface layer on polished glass differing from the underlying material and from the surface layers of ground, or fire-glazed glass, or crystalline surface layers in the case of quartz, is slight or negative. The polishing process may be one of ultra-microscopic abrasion complicated by the fact that the fissures produced by one grain of the abrasive lie in the territory of its neighbour, and that the abrading efforts of the several grains tend to neutralise one another.

DUBLIN.

**Royal Irish Academy**, January 25.—H. **Ryan** and Amy **Markey**: The action of nitric acid and of nitrogen peroxide on triphenylamine. Nitrogen peroxide converted triphenylamine (in solution) into a tetranitrotriphenylamine which did not melt below 280° C. Nitric acid at the ordinary temperature and at low concentrations in acetic acid or carbon tetrachloride solution converted triphenylamine into the same tetranitro derivative, and in addition to it a trinitro derivative melting at 219° C. and a hexanitro derivative melting at 272° C. were obtained. The nitrotriphenylamine melting at 139° C. previously obtained by Herz (*Ber. Chem. Ges.*, 18, p. 2157) was shown to be 4-nitrotriphenylamine by synthesis from 4-nitrodiphenylamine.—H. **Ryan** and Mary **Glynn**: The relative speeds of the removal of nitric acid from systems containing certain aromatic compounds. Equimolecular amounts of nitric acid and diphenylamine, diphenylnitrosamine, stilbene, phenylbenzyl ether, diphenyl ether, o-tolylurethane, diphenylurethane, and ethyl-o-tolylurethane respectively were allowed to interact at the same concentrations in carbon tetrachloride solution at 60° C. The speed of the removal of the nitric acid was greatest in the case of diphenylamine and diphenylnitrosamine. The initial speed in the case of stilbene was greater than that with phenylbenzyl ether. Diphenyl ether reacted less rapidly than phenylbenzyl ether but more rapidly than the urethanes.—H. **Ryan**, D. T. **Flood**, and P. T. **McNulty**: The nitric compounds of β-dinaphthylene oxide. β-dinaphthylene oxide, in carbon tetrachloride solution and at the ordinary temperature, was converted by nitric acid at low concentrations into mononitro-β-dinaphthylene oxide,

melting at 185° C., which was previously obtained by Hodgkinson and Limpach (*J.C.S.*, 59, p. 1100), and a dinitro-β-dinaphthylene oxide melting at 318° C. The latter substance was also got by the action of nitrogen peroxide on β-dinaphthylene oxide in acetic acid solution, but in the absence of a solvent a tetranitro-β-dinaphthylene oxide decomposing about 320° C. was obtained. Another crystalline tetranitro-β-dinaphthylene oxide melting with decomposition at 342° C. was formed by treating the dinaphthylene oxide with fuming nitric acid.

EDINBURGH.

**Royal Society**, February 8.—Henry **Briggs**: The Wheatstone bridge as the means of measuring linear and angular dimensions at a distance, and its application to borehole surveying. The paper consisted for the most part of a description of the author's borehole surveying instrument known as the "Clinophone." In this instrument, by means of liquid resistances held in shallow cups provided with electrodes, the principle of Wheatstone's bridge can be utilised in obtaining polar co-ordinates and in reading such co-ordinates at any distance. Thus a transmitter, placed in a borehole of any depth, automatically furnishes messages to a surface receiving station, from which the direction and amount of deviation from the perpendicular of the hole can be obtained.—E. T. **Whittaker**: On the adjustment of Sir J. J. Thomson's theory of light to the classical electromagnetic theory. In a recent paper Sir J. J. Thomson has suggested a corpuscular or quantum theory of light, in which the light is supposed to consist of closed circular tubes of electric force moving, with the velocity of light, at right angles to their planes, like vortex-rings. This theory is now brought within the compass of the classical Maxwell-Lorentz theory of the electromagnetic field. Thomson's theory is extended by adjoining to the Maxwell-Lorentz equations certain terms which represent a "magnetic current." Any theory of the type of Thomson's necessarily involves the introduction of these terms. A kind of "electric vortex-ring" is thus obtained and expressed analytically: such a structure would behave as a light quantum.

LEEDS.

**Philosophical and Literary Society**, January 27.—W. P. **Milne**: The ten nodes of the Hessian of the cubic surface.—S. **Brodetsky**: The equations of the gravitational field in orthogonal co-ordinates. The equations of the gravitational field in Einstein's theory, when put down in their general form in terms of tensors, have the disadvantage of not being immediately intelligible. On the other hand, if an attempt is made to write out the equations in explicit form, the result is too complicated for analytical use. The gravitational equations are now worked out in terms of orthogonal co-ordinates with no other restriction. The similarity with Lame's transformation of Laplace's equation is interesting and suggestive.—E. C. **Stoner**: The atomic moments of ferromagnetics. The magnetic moment per atom of ferromagnetic metals and alloys may be found from the variation in susceptibility with temperature above the Curie point, and from the saturation intensity of magnetisation at low temperatures. Interpreted on the basis of the quantum theory of atomic magnetism, the apparently discordant values deduced by the two methods are compatible with each other, and with the values found for paramagnetic ions in solid salts and solutions.—G. F. **Brett** and R. **Whiddington**: Note on the passage of electrons through small apertures. It has been found in agreement with previous workers that if electrons *in vacuo* are accelerated towards an anode furnished with a narrow and more or less central aperture, only a small fraction of those electrons which appear on the further side have energies corresponding to the full potential difference. When the magnetic spectrum is examined, there is not a continuous gradation of energies as hitherto supposed, but a many-lined or banded spectrum depending on the conditions of the experiment.—H. S. **Patterson** and B. **Whytlaw-Gray**: Photophoresis. Photophoresis is of very general occurrence; it varies from substance to substance, and the negative effect never occurs without the positive. In some substances the negative effect is very difficult to detect. The effect is most marked with highly absorbent bodies such as carbon and organic dyestuffs.—Mrs. M. S. **Burr**: Preliminary note on solvate formation. An equation has been deduced representing the solubility of 2 : 4-di-nitrotoluene in sulphuric acid-water mixtures of different concentrations between 84·5 per cent. and 95 per cent. acid. Similar equations appear to be valid for other nitro-compounds, and may be explained by supposing that the solute forms, with the better solvent, a continuous series of solvates in equilibrium with a certain amount of free solute. The application of the equation may be complicated by the formation of compounds between the two constituents of the solvent, although no great difficulty is experienced where the compound is sharply defined, as, for example, in sulphuric acid monohydrate.—Sylvia **Garstang** and W. **Garstang**: Preliminary note on the development of Botrylloides and its bearing on the ancestry of the Chordata. The inclusion (Tunicata) or exclusion (Amphioxus-Craniata) of the hypophysial region within the neural folds is compared with the continuity or discontinuity of the longitudinal ciliated bands of echinoderm larvæ. The evolution of Chordata is due to elaboration of the original larval organisation, and its partial (Tunicata) or complete (Amphioxus-Craniata) supersession of an original sessile adult condition (*i.e.* pædomorphosis).—D. **Greenwood** and W. H. **Pearsall**: Observations on geotropism. Earlier conclusions are confirmed that geotropic curvatures are associated with changes in the hydrogen-ion concentration of tissues during the period of curvature. In *Vicia faba* stems and roots, the convex flank is slightly more acid. The differences in *p*H value observed are sufficient to cause differences in volume on the convex and concave flanks and hence to account for the curvatures observed. The different behaviour of the stem and root is associated with observations on the *p*H value of the fluids exuded from stem and root—these being of low *p*H in the stem. It is also found that geotropic curvature is more rapid in plants grown in the light (as compared with those kept in the dark), and also in plants which have been exposed to coal-gas.

PARIS.

**Academy of Sciences**, January 25.—Léon **Guillet**: The properties of certain treated chrome-nickel steels. It is known that under certain conditions of heat treatment, some special steels, especially chrome-nickel steels, become very fragile, although their other mechanical properties remain practically unchanged. Details are given of experiments forming a systematic study of this phenomenon.—A. **Vayssière**: The systematic position of the genus Erato, a prosobranch gasteropod mollusc.—A. **Myller**: The wrapping of surfaces.—Arnaud **Denjoy**: The iteration of analytical

functions.—D. **Mordoukhay-Boltovskoy**: The generalisation of the theorem of Eisenstein indicated by Tchebychef.—René **Lagrange**: A class of conformal representations.— — **Kivéliovitch**: The calculation of the conditions of primary shock in the problem of three bodies.—V. **Fock**: The reduction of the plane problem of elasticity to an integral equation of Fredholm.—Bernard **Lyot**: The polarisation of the planet Venus. The explanation of the polarisations found for Venus would appear to depend on the properties of clouds formed of minute drops of water.—E. **Darmois** and P. **Gabiano**: The polarimetric study of mineral and organic dimolybdomalates. An application of Oudemans' law. An extension of work already published on the dimolybdomalates of sodium and ammonium to other bases (lithium, potassium, aniline, barium, calcium, methylamine, etc.). All these are characterised by the anion $4MoO_3,2C_4H_6O_5$.—V. **Posejpal**: Resonance absorption in the domain of the X-rays.—Jean **Gandillot**: The presence of a bed of coal in the metamorphic strata to the south of Limoges.—P. **Fallot** and R. **Bataller**: The tectonic of the mountains between Montalban and the coast of the Province of Castellon (Spain).—L. **Eblé** and J. **Itié**: The values of the magnetic elements of the station of Val-Joyeux (Seine-et-Oise) on January 1, 1926.—L. **Blaringhem**: Methods and results in the formation of hybrids of flax.—Mlle. Laura **Kaufman**: The growth of the body and organs of the pigeon.—Lucien **Daniel**: The variations of inulin in the grafted Jerusalem artichoke.—F. **Granel**: The morphological and functional signification of the pseudobranchia of fishes.—Auguste **Lumière**: The invisibility of certain flocculates.—Mme. **Phisalix**: The rabicidal power of the blood of the hedgehog.—H. **Violle**: The antiseptic power of chloropicrin. Details of experiments proving the great antiseptic power of aqueous solutions of chloropicrin with various types of pathogenic organisms.

February 1.—H. **Deslandres**: The magnetic perturbation of January 26, 1926, at the Meudon Observatory. This magnetic storm was indicated on the recording instruments for about 15 hours, and at the same time an aurora borealis was visible. The state of the sky prevented simultaneous observations of the sunspots with the spectro-heliograph. Measurements of the intensity of wireless waves received from Rome and Bordeaux are made daily at the Observatory, and on this day it was noticed that the intensity of reception was greatly increased, those from Rome being about four times the average strength.—A. **Blondel**: The reversibility of frequency multipliers with iron cores.—V. **Grignard** and F. **Chambret**: The ketonic splitting of the tertiary alcohols. The decomposition by distillation of tertiary alcohols into water and an unsaturated hydrocarbon is well known, but in a few cases a splitting into ketone and hydrocarbon has been observed. It has been found that under certain conditions, detailed in the paper, the dehydration can be suppressed and the formation of ketone increased.—M. Camille Matignon was elected a member of the section of Chemistry in succession to the late M. A. Haller.—Charles **Jordan**: New developments for the application of the theorem of Bernoulli.—N. **Mandelbrojt**: Transcendant numbers and analytical functions.—Nikola **Obrechkoff**: The summation of divergent series and the analytical prolongation.—V. **Nechville**: A new form of differential equations of the restricted elliptic problem.—Jean **Fallou** and A. **Mauduit**: The maintenance of a non-sinusoidal free oscillation by resonance of one of its harmonics.—Pierre **Thomas** and Mlle. Marie **Sibi**: Contribution to the study of the structure of jellies. Details of the study of the behaviour of the gel formed by the dibenzoyl acetal of sorbite.—Etienne **Audibert**: The mechanism of the fusion of coal. A study of the effect of rate of heating on coke formation.—Louis **Grenet**: Quasi-limiting states in crystallised bodies.—Ch. **Courtot** and Jan **Krolikowski**: A new preparation of α-indanone. This substance is obtained with yields of 90 to 95 per cent. by the oxidation of α-chlorindane with chromic acid. Crude indene, obtained by a careful rectification of phenolic oils from coal tar and subsequent removal of phenols by soda, can be converted into the chlorindane by hydrochloric acid.—**Pastureau** and Mlle. **Zamenhof**: The preparation of propylidene and isoamylidene acetone with intermediate production of the corresponding ketols. Propionic aldehyde and alcohol are condensed with aqueous soda in the presence of ether to the ketol $CH_3-CH_2-CH(OH)-CH_2-CO-CH_3$ and this is readily dehydrated by oxalic acid to the unsaturated ketone. Isoamylidene acetone is obtained by a similar reaction.—L. **Royer**: The mutual orientations of crystals determined by the single coincidence of a plane link of the two species.—Ch. **Maurain** and L. **Eblé**: The magnetic storm of January 26, 1926. Details from the records of the magnetograph at the Val-Joyeux Observatory.—Raymond **Chevallier**: Extinction of the magnetic perturbations at the periphery of Etna.—Jean **Dufay**: Polarisation of the light from the nocturnal sky.—P. **Lavialle**: The polymorphism of the anthers in *Knautia arvensis*.—Pierre **Lesage**: The carnosity of the cotyledons and the bushy form of the stem in *Lepidium sativum* acclimatised to salt water.—Francois **Pellegrin**: The affinities of the flora of the volcanic summits of Tibesti (Central Africa).—R. **Souèges**: Embryogeny of the Umbelliferæ: The development of the embryo in *Carum Carvi*.—Armand **Dehorne**: Cytological indices of the presence of cholesterol in the normal eye.—J. **Wolff**: The presence in various fungi of an oxydase not previously described. In a certain number of fungi there exists an oxydase, accompanying laccase and tyrosinase but distinct from these two ferments, which has the property in the presence of oxygen of oxidising ferrous salts of organic acids to ferric salts. The name ferrase is proposed for the ferment.—G. **Leven** and Emile **Coudert**: New data on the pathogeny and therapeutics of incoercible vomiting in pregnancy.—Georges **Mouriquand**: Pellagra. Its experimental realisation.—L. **Auger**: The experimental realisation of vitular fever.

### MELBOURNE.

**Royal Society of Victoria**, December 10.—E. **Kidson**: The annual variation in the velocity of cirrus clouds over Melbourne. The velocities were deduced from nephoscope observations. The predominating westerly component has a marked minimum (16·5 m/s) in February, a second in May, then rises to a maximum (26·3 m/s) in November. The variation is of a similar type for the south component, but opposite for the north and east. There is close correlation for each component between the velocity and the frequency of observation. The resultant mean direction is approximately 270° from January to April, 280° from May to August, thence veering to 265° in December.—Gerald F. **Hill**: Australian termites (Isoptera). Notes on Stolotermes, Calotermes, and Coptotermes with descriptions of new species.—New or little-known fossils in the National Museum, Pt. xxix.—On some tertiary plant remains from Narracan, S. Gippsland. The flora described occurs in a comparatively thin seam on the Ten Mile Creek near Thorpdale, and is part of a thick bed of sand-

stone and quartzite underlying the older basalt. It is apparently older than that of the Morwell Coal, and of a kind that compares closely with Berwick in Gippsland, and even with Dalton near Gunning, New South Wales. The "Acer" earlier recorded from the Australian Tertiary undoubtedly belongs to Sterculia. —A. J. **Ewart** and A. H. K. **Petrie**: Contributions to the flora of Australia (xxxi). Noteworthy among the new genera and species from the Northern Territory are the genera Wycliffea and Sideria, the former of which belongs to the Caryophyllaceæ and shows a response to xerophilous conditions by complete cleistogamy, while the latter belongs to the Malvaceæ and shows remarkable reduction of the androecium.—A. D. **Hardy**: Delayed dehiscence affecting several species in the families Myrtaceæ, Proteaceæ, and Coniferæ. A hedge of *Hakea leucoptera*, twenty years old, has retained its earliest fruits unopened, and several young "Cypress pines" have withheld seed of six years of fruitings. In Callistemon and Melaleuca delay is habitual. Some hedge plants of *Cupressus macrocarpa* showed five years' reservation. In *Eucalyptus platypus* var. *acuminatus* specimens from one tree in various stages showed that in six years the inch-long umbel stalks became immersed in the stem or branches. *Protea mellifera* and *Isopagon ceratophyllus* retain indehiscent fruits in persistent heads.

ROME.

**Royal Academy of the Lincei**, December 1925.—G. **Bruni** and A. **Ferrari**: Solid solutions between compounds of elements of different valency. Anhydrous lithium and magnesium chlorides. When examined by the powder method, anhydrous magnesium chloride gives a photogram corresponding with a cubic lattice coincident with that of lithium chloride; the elementary cell contains two molecules of magnesium chloride or four molecules of lithium chloride. Since the magnesium salt is doubly refracting and uniaxial, it has a pseudo-cubic structure belonging to one of the tetragonal or hexagonal systems.—F. **Zambonini** and R. G. **Levi**: Isomorphism of molybdates of rare earth metals with those of calcium, strontium, barium and lead. In the isomorphous molybdates of the alkaline-earth and cerium group metals, the elementary solids are found to contain equivalent volumes of these compounds.—E. **Bompiani**: Construction of projective-differential invariants of a surface.—Carlo **Severini**: Convergence of the series of orthogonal functions. —Beniamino **Segre**: Quadratic complexes of straight lines of $S_4$.—Giovanni **Sansone**: Indeterminate equations of the unit of negative type in real quadratic bodies.—Antonio **Signorini**: Presso-flexion of masonry. —Arnaldo **Belluigi**: Somigliana's theory of seismic waves.—G. **Natta**: Crystalline structure of cadmium and nickel hydroxides. For these hydroxides, which crystallise in the rhombohedral system, the dimension of the cell has been verified by calculation of the density and the atomic arrangement controlled by calculation of the intensity, various values being ascribed to the parameters. Both hydroxides are analogous in structure to magnesium and manganese hydroxides.—A. **Terni** and C. **Padovani**: Action of sodium hypophosphite on stannic chloride. In dilute solution these compounds do not appear to interact, but at higher concentrations they yield a voluminous white precipitate of the formula, $SnCl_4$, $Sn(H_2PO_2)_4$, $3H_2O$.—Nathan **Shalem**: A new cenomanian fauna of Palestine.—Virginia **Gennaro**: Piedmontite in mica-schists in the Lanzo valleys (Piedmont Alps).—G. **Amantea** and G. **Martino**: Investigations on spermatic secretion (xvii). Fasting and testicular activity in the pigeon.—Luigi De **Caro**: Variations of the electrical resistance of the muscles.

VIENNA.

**Academy of Sciences**, December 17.—M. **Kohn** and A. **Segel**: Communications on bromo-phenols, (xix.). Brominated nitro- and dinitro-cresol.—L. **Schmid** and B. **Becker**: Condensation of 2-amino pyridine with thiophosgene, and condensation of 2-amino pyridine with aliphatic aldehydes.—E. **Schrödinger**: The relation of the four-colour to the three-colour theory. —L. **Waldmann**: Geological survey of the Moravian mountain foundations north of Sigmundsherberg.—R. **Andreasch**: Carbamide and guanidine derivatives of the sulpho fatty acids (iv.).—O. **Abel**: An attempted solution of the Flysch problem. The Flysch sediments in the Alps and Carpathians are very uniform, poor in fossils, with unexplained traces of life and associated with petroleum, suggesting that the Flysch must be a shallow water deposit. The mangrove swamps of south Florida and of Cuba suggest that the Inoceramen strata of the Alps and Carpathians may have been laid down in a tidal mangrove girdle.—H. **Handel-Mazzetti**: New Chinese plants (xxxviii.), with index to species described during the year 1925.—R. **Schwinner**: Mountain land north-east of Graz.

## Diary of Societies.

*SATURDAY*, MARCH 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Sir William Milligan: Hæmorrhagic Types of Ear Disease occurring during Epidemics of Influenza.—H. G. Estcourt: Gradenigo's Syndrome.—Dr. A. R. Friel: Demonstration of Experiments on Ion Action.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Rare Gases of the Atmosphere and their Importance in Atomic Theory (1).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Annual Conversazione.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4.—G. Mortimer: Aluminium Foundry Practice.

*MONDAY*, MARCH 8.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Miss N. B. Eales: The Anatomy of the Head of a Fœtal African Elephant, *Elephas africanus* (*Loxodonta africana*).—Dr. C. M. Yonge: The Digestive Diverticula in the Lamellibranchs.—Prof. W. Peddie: Present Problems in Colour Vision: the Laws of Visual Fatigue, and of Resultant Sensation.—Dr. F. A. E. Crew: Fertility in the Domestic Fowl.—Prof. H. W. Turnbull: The Invariant Theory of Forms in Six Variables relating to the Line Complex. —*Read by title only*:—Prof. P. Humbert: Some Hyperspace Harmonic Analysis Problems introducing Extensions of Mathieu's Equation.—W. Saddler: A Geometry associated with the Double Binary (2.2) Form.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: The Egg (4): The White.

INSTITUTION OF STRUCTURAL ENGINEERS (Students' Meeting) (at 2 Victoria Street), at 6.—H. J. Deane and others: Discussion.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7.—Mr. Topliss: The Metallurgist in Inspection and Design.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—F. Creedy and others: Discussion on A Recent Development in A.C. Apparatus.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—R. B. Matthews: Electro-Farming; or the Application of Electricity to Agriculture.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB, at 7.30.—Annual General Meeting.

INSTITUTE OF METALS (Scottish Local Section) (Annual General Meeting) (at Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow), at 7.30.—W. R. Barclay: Nickel and its Alloys.

BRITISH PSYCHOLOGICAL SOCIETY (Education and Medical Sections) (at Royal Society of Medicine), at 8.—Drs. Cyril Burt, M. Hamblin Smith, W. Rees Thomas, F. C. Shrubsall, and A. F. Tredgold: Symposium on The Definition and Diagnosis of Moral Imbecility.

SURVEYORS' INSTITUTION, at 8.—Discussion on papers by C. P. Sanger, Sir John Oakley, C. H. Bedells, F. W. Hunt, and H. E. Sherwin on The Various Statutes which comprise the New Law of Property.

MEDICAL SOCIETY OF LONDON, at 8.30.—Sir Thomas Horder, Dr. C. E. Lakin, and others: Discussion on Obscure Pyrexia in Adults.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.

INSTITUTE OF CHEMISTRY (Manchester and District Section).—Dr. M. Young: The Endocrine Glands.

*TUESDAY*, MARCH 9.

MANCHESTER GEOLOGICAL AND MINING SOCIETY, at 4.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, at 4.—Prof. G. Elliot Smith: Brains of Apes and Men (Wilde Memorial Lecture).

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Prof. W. W. C. Topley: Experimental Epidemiology (Milroy Lectures) (3).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. A. Wade: The Search for Oil in Australia.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. F. P. Stowell: The Purification of Sea-Water by Storage.—Dr. F. B. Nopcsa: Heredity and Evolution.—Dr. W. C. Osman Hill: A Comparative Study of the Pancreas.—Isabella Gordon: Notes on a Number of Muriceid Genera (*Alcyonaria Gorgonaceæ*) with Special Reference to Spiculation.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—R. A. Chattock: Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—Prof. S. P. Smith: An All-Electric House.

ROYAL PHOTOGRAPHIC SOCIETY, at 7.—Annual General Meeting.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at Burnley Municipal College), at 7.15.—A. E. Wilson: The Usefulness of Wood Patterns mounted on Boards.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at Broadgate Café, Coventry), at 7.30.—P. Brewster: The Preparation of Motor Cycles for Speed Events.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—D. J. Scourfield: A Microscopic Fossil Crustacean from the Rhynie Chert, Aberdeenshire.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—Edmund White: British Pharmacy and its Relation to Continental Practice.

ROYAL SOCIETY OF MEDICINE (Surgery, Medicine, Electro-Therapeutics, and Therapeutics Sections), at 8.—Discussion on The Treatment of Exophthalmic Goitre (continued).

*WEDNESDAY*, MARCH 10.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M. and 2.—G. Mortimer: The Die-Casting of Aluminium Alloys—A Review of Current Methods.—S. L. Hoyt and T. R. Schermerhorn: The Hardness of Cold-Rolled Copper.—R. W. Bailey: Note on the Softening of Strain-Hardened Metals and its Relation to Creep.—W. Feitknecht: Crystal Growth in Recrystallised Cold-Worked Metals.—R. Genders: The Interpretation of the Macro-structure of Cast Metals.—W. L. Kent: The Brittle Ranges of Bronze.—D. Stockdale: The Copper-Rich Aluminium-Copper-Tin Alloys.

INSTITUTE OF HYGIENE, at 3.30.—Dr. C. E. Shelly: The Incidence of Infectious Diseases in Public Schools.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. J. E. Marr: The Pleistocene Deposits of the Lower Part of the Great Ouse Basin.—Sir T. W. Edgeworth David and Dr. W. G. Woolnough: Cretaceous Glaciation in Central Australia.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—R. B. Matthews: Electro-Farming; or the Application of Electricity to Agriculture.

INSTITUTE OF METALS (Swansea Local Section) (at University College, Swansea), at 7.15.—Discussion on Annealing.

RADIO SOCIETY OF GREAT BRITAIN (at Institution of Electrical Engineers), at 7.30.

ROYAL SOCIETY OF ARTS, at 8.—Dr. R. Thiessen: The Microstructure of Coal.

INSTITUTION OF CHEMICAL ENGINEERS (at Burlington House), at 8.—H. M. Dunkerley: Refrigeration in Chemical Manufacturing Processes.

ROYAL SOCIETY OF MEDICINE (Surgery, Medicine, Electro-Therapeutics, and Therapeutics Sections), at 8.—Discussion on The Treatment of Exophthalmic Goitre (continued).

EUGENICS EDUCATION SOCIETY (at Royal Society), at 8.30.—Dr. A. S. Parkes: Sterility and Vitamin Deficiency: a Review.

INSTITUTION OF STRUCTURAL ENGINEERS (Lancashire and Cheshire Branch).—R. Travers Morgan: Building Construction from a Surveyor's Point of View: a Survey of Regulations governing Buildings.

*THURSDAY*, MARCH 11.

INSTITUTE OF METALS (Extraordinary General Meeting and Adjourned General Meeting) (at Institution of Mechanical Engineers), at 10 A.M. and 2.—T. B. Crow: Some Experiments on the Soft-Soldering of Copper.—A. Glynne Lobley and D. Jepson: The Influence of Gases on Copper at High Temperatures. Part I.—A. J. Murphy: The Constitution of the Alloys of Silver and Tin.—W. Hume-Rothery: Researches on the Nature, Properties, and Conditions of Formation of Intermetallic Compounds, with Special Reference to Certain Compounds of Tin. Parts I.-V.—H. J. Tapsell and J. Bradley: The Mechanical Properties at High Temperatures of an Alloy of Nickel and Copper, with Special Reference to Creep.—B. S. Evans and H. F. Richards: Determination of Zinc Oxide in Brass.—Prof. C. O. Bannister: Note on the Corrosion of an Ancient Tin Specimen.—A. M. Portevin: Striation due to Working or to Corrosion in Microscopical Metallography. A Contribution to the Study of the Mode of Action of Etching Reagents.

ROYAL SOCIETY, at 4.30.—J. A. Campbell: The Effects of Ultra-Violet Radiation upon the Metabolism of Healthy Subjects.—E. Ponder: A Study of certain Forms of Inhibition and Acceleration of Hæmolysis.—Dr. S. B. Schryver and H. W. Buston: The Isolation of some Undescribed Products of Hydrolysis of Proteins.—*To be read in title only*: —A. W. Greenwood and Dr. F. A. E. Crew: Studies on the Relation of Gonadic Structure to Plumage Characterisation in the Domestic Fowl.—Prof. E. P. Cathcart and W. A. Burnett: The Influence of Muscle Work on Metabolism in varying Conditions of Diet.—E. Fischer: The Heat liberated by the Beating Heart.

ROYAL ANTHROPOLOGICAL INSTITUTE (Edinburgh and the Lothians Branch) (at Royal College of Surgeons, Edinburgh), at 5.—D. M. Greig: Prehistoric Trepanning.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—R. H. Fowler: Atom-Mechanics (Lecture).—W. Saddler: Apolar Triads on Cubic Curves.—J. H. Grace: (*a*) A Point in Enumerative Geometry; (*b*) The Four-square Theorem.—W. E. Baker: A Particular Cubo-cubic Cremona Transformation.—H. B. C. Darling: On the Sums of Divisors of Numbers (Moduli 3 and 6).—Prof. G. H. Hardy: A Theorem Concerning Harmonic Functions.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. B. Hart: The Development of Psycho-pathology and its Place in Medicine (Goulstonian Lectures) (1).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. D. Ellis: The Atom of Light and the Atom of Electricity (3).

ROYAL AERONAUTICAL SOCIETY (Students' Section), at 6.—Flying-Officer R. L. Ragg: Experimental Flying from the Pilot's Point of View.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with the Bristol Section of the Society) (at Bristol University), at 6.—A. Ogilvie: Sifting Plant.—T. J. Stevenson: Sifting Machinery and Processes.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—A. F. Stevenson: Cable Troubles.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—R. Kingslake: Application of the Hartmann Test to the Measurement of Oblique Aberrations.—W. G. Collins: Some Physical and Optical Characteristics of the Stylus-on-Celluloid Method of Recording.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre (Dublin)) (at Trinity College, Dublin), at 7.45.—Dr. J. F. Crowley: Recent Developments in the Production of Synthetic Ammonia.

ROYAL SOCIETY OF MEDICINE (Neurology Section) (at National Hospital for the Paralysed and Epileptic, Queen Square), at 8.

*FRIDAY*, MARCH 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—P. ten Bruggencate: Note on the Problem of Cepheid-Variation.—S. D. Tscherny: Occultations of Stars and Planets by the Moon, observed at Kiew in the year 1925.—W. Eichelberger and A. Newton: The Orbit of Neptune's Satellite and the Pole of Neptune's Equator.—Dr. H. Spencer Jones: Note on the Secular Motion of the Pole.—Prof. R. A. Sampson: The Structure of the Solar Cluster.—M. C. Johnson: The Velocities of Ions under Radiation Pressure in a Stellar Atmosphere, and their Effect in the Ultra-Violet Continuous Spectrum.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Clinical Meeting) (at Royal London Ophthalmic Hospital, City Road), at 5.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—R. M. Archer: Heat Losses from Vacuum Vessels.—Dr. A. H. Davis: A Ripple Tank for the Study of the Acoustics of Buildings.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Parts concerned in the Secretion and Absorption of Cerebrospinal Fluid.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (jointly with Institution of Electrical Engineers) (at Armstrong College), at 7.—R. W. Gregory: Paper.

ROYAL PHOTOGRAPHIC SOCIETY, at 7.—J. S. Hodgson: Whaling in the South (Lecture).

INSTITUTE OF METALS (Swansea Local Section) (at University College, Swansea), at 7.15.—Discussion on Annealing.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Swansea Technical College), at 7.30.—E. A. Tyler: Some Notes on Pure Chemicals: An Inquiry into the Purity of Available Supplies.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. E. Webb: Paint Spraying.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 7.30.—R. J. Eyres: What is Sea Speed?

ROYAL SANITARY INSTITUTE (at Town Hall, Hastings), at 8.—Prof. H. R. Kenwood: A City of Health (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir J. J. Thomson: Radiation from Electric Discharges.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow).—J. Mitchell: Corrosion.

*SATURDAY*, MARCH 13.

ROYAL SANITARY INSTITUTE (at Town Hall, Hastings), at 10.30 A.M.—Dr. G. R. Bruce, Miss Hester Viney, Dr. J. Fenton, and others: Discussion on Mothercraft and Fathercraft.—J. Parkin, H. T. Taylor, and others: Discussion on The Effect of the Public Health Act of 1925 on the Work of Municipal Engineers and Sanitary Inspectors.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Rare Gases of the Atmosphere and their Importance in Atomic Theory (2).

SCOTTISH JUNIOR GAS ASSOCIATION (at Royal Technical College, Glasgow), at 7.—S. H. Hunter: Scientific Service.

BIOCHEMICAL SOCIETY (at University College).

## PUBLIC LECTURES.

*SATURDAY*, MARCH 6.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: The Other World of the Ancient Egyptians.

*MONDAY*, MARCH 8.

UNIVERSITY OF LEEDS, at 5.15.—Prof. W. H. Lang: The Flora of the Devonian Period.

*TUESDAY*, MARCH 9.

UNIVERSITY COLLEGE, at 5.30.—Dr. C. F. Ariens Kappers: The Evolution of the Nervous System. (Succeeding Lectures on March 10, 11, and 12.)

*WEDNESDAY*, MARCH 10.

LONDON SCHOOL OF ECONOMICS, at 3.—Prof. A. Radcliffe-Brown: The Study of Backward Peoples: its Method and Practical Value. (Succeeding Lectures on March 12 and 15.)

*THURSDAY*, MARCH 11.

ROYAL SOCIETY OF ARTS, at 8.—W. A. Harvey: Housing, Past, Present, and Future. Its Effect on the Health and Outlook of the People (Chadwick Lecture).

*SATURDAY*, MARCH 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. H. Graham Cannon: How Animals Feed and what they Eat.