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School Certificate Biology.

THERE are indications that, in the not far distant future, there may be removed from our courses of education the reproach that in England alone of practically all civilised countries is it possible for a student at the age of eighteen or nineteen to leave school destitute of any teaching in the fundamental processes of life. Biology as a subject in the School Certificate Examinations has received attention at the Headmasters' Conference ; a report containing suggestions for a syllabus has lately been published by a committee of the British Association ; and a committee appointed by British zoologists " to consider the position of animal biology in the school curriculum and matters relating thereto " has also reported upon the subject. It is, too, a hopeful sign that nearly all examining bodies granting school certificates now include biology among the examination subjects ; and further, that the number of candidates offering it, though still a very small percentage of the whole, shows a steady increase.

It is clear that in formulating a syllabus and in determining the scope of this examination, the opinion of those engaged in teaching biology at schools should carry great weight. They are familiar with the conditions prevailing in the schools ; and, far better than professors and lecturers at the universities, can judge not only what is feasible, but also what is within the mental reach of pupils at the age of sixteen or thereabouts. The Science Masters' Association was thus well advised in arranging a discussion on school certificate biology during its recent conference at the Imperial College of Science, and in endeavouring to secure a consensus of opinion regarding the purpose of such biology and the character of the examination itself. The propositions laid down in order to focus discussion were as follows :

(*a*) Biology should be a subject in which it is possible to obtain " credits ", and must not be regarded as a " soft option " ; but nevertheless it is obvious that the same number of hours will never be allotted to it as to mathematics, languages, etc.

(*b*) School Certificate Biology is intended to be for general education purposes, and not as a preparation for specialised Higher Certificate work.

(*c*) The examining bodies should keep their detailed syllabuses as short and general as possible.

(*d*) A knowledge of Chemical and Physical processes is not to be demanded except in so far as they are necessary for an elementary understanding of definite biological principles.

(*e*) There should be no practical examination ; demonstration lectures taking the place of individual practical work.

(*f*) A syllabus should include :

1. The fundamental principles of plant physiology and propagation, but without any unnecessary anatomical details.
2. The elements of human physiology and dependence of all animal life on the green plant for its source of energy.
3. The carbon and nitrogen cycle, and the part played by bacteria and fungi in nature.
4. Amœba, Hydra, and the Frog. (These should be the only actual animal types mentioned.)
5. Structure of a regular flower to show pollination and fertilisation.
6. An elementary knowledge of, at least, the evidences of Evolution, and the principles of Heredity.

(*g*) Definite "Field Work" is impossible for boys at this stage during school hours.

The suggested syllabus is commendably brief, and appears to include all the essentials ; though teachers will probably allude to other than the three animals specified in (*f*) 4, and to some of the more striking irregular flowers when dealing with pollination ; and will find occasional expansion of this bare minimum desirable. There is clearly no intention to restrict the teacher rigidly to the scheduled items.

The second of the above propositions (*b*) needs strong emphasis. In the past there has been too great a tendency to teach elementary science on lines suited to students destined later to specialise in science, and to disregard the fact that an enormous majority of the pupils at this stage are not so destined. It is not unnatural for a teacher, especially for a young one who has but recently completed an advanced course at the university, to teach on the lines along which he himself, a specialist, has been taught. But the temptation must be resisted. Prior to and up to the school certificate examination, all the science teaching should be solely for purposes of general education and culture. It should pave the way for the future citizen to take an intelligent interest in the progress of modern thought, and in social legislation, hygiene, and the general welfare of mankind ; and should render possible, nay probable, a fuller, happier life, a better use of the environment, and a keener appreciation of its beauty and mystery.

These considerations, coupled with the reference to chemical and physical processes in the fourth proposition (*d*), raise the question—Is the present policy of allowing chemistry, physics, or biology to be offered as separate subjects in the school certificate examinations wise and educationally sound ? Their very separation savours of specialisation. A candidate offering biology must have had some instruction both in chemistry and in physics ; but the converse is not true—greatly to the loss of the candidates concerned.

Now in other school certificate subjects candidates are really examined on work that has been spread over several years, dating back in some cases to the very commencement of their education, though perhaps pressure of the examination 'screw' has been applied only for a year or two preceding the examination. The above suggested syllabus, however, and some of those prescribed by examining bodies for other scientific subjects, can be covered satisfactorily in three or four terms, with a time-table allotment of about three hours per week. It would assuredly be preferable that the period during which the science has been studied should be more nearly commensurate with that pertaining to other subjects of the examination. This end could be achieved if in the school certificate the only science allowed were 'general', and if the 'general science' were based on biology, broadly conceived as the science of life for all.

The Science Masters' Association's syllabus affords abundant opportunity for digressions into the realms of chemistry and nearly all branches of physics. Such digressions might extend over several weeks, or even a whole term ; and would certainly provide ample material for individual experimental work. Even with the short syllabus suggested, the biology master worth his salt is bound to refer in teaching to a large number of topics that already find a place in the elementary text-books of chemistry and physics, for example, the properties of air and of water, oxidation, conservation of energy, and so on. Thus the digressions would have as their objective the elucidation of many of the properties of living matter, and the whole course would gain in coherence and in interest. Such a syllabus might well serve as the nucleus of a two-year or three-year course, according to the number of hours per week assigned in general science for the school certificate examination. The standard, measured by the amount of ground covered, should be low ; but a high degree of accuracy should be demanded. It is only thus that sure foundations are laid.

To carry out such a reform in the teaching will require careful co-ordination of the work, and loyal co-operation among the teachers in each school. Such co-ordinated schemes of science teaching are, and have been for some years, in operation in nearly all the countries of western Europe. The like should surely not be beyond the organising ability of the schools and universities of England.

Statistical Method in the Social Sciences.

The Statistical Method in Economics and Political Science: a Treatise on the Quantitative and Institutional Approach to Social and Industrial Problems. By Prof. P. Sargant Florence. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xxiv + 521. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1929.) 25*s*. net.

UNTIL just recently, statistics have not been regarded as a very essential part of economics or political science, or indeed of any of the social sciences, but have been looked upon as rather dull and drab accessories, to be relegated to the end of the book as mere appendices. There is scarcely a single table or diagram in any of the older classics, and although measurability, in Lord Kelvin's well-known dictum, was supposed to be the hall mark of any true science, it was rather furtively hoped that economics, at all events, if not the other members of the social group, could somehow be shuffled through the portals into the world of science without possessing any great store of measurable data.

There has been some improvement, during the last few years, in the introduction and use of statistical method in economics, but Prof. Sargant Florence is probably right in saying that attempts at the scientific study of mankind in the economic and political spheres have largely broken down owing to faulty liaison work between the non-statistical and the statistical methods of approach. "The mathematical statistician is out of touch with the expert in a special field, and the experts, whether economists, political scientists, or sociologists, generally fail to make use of statistical methods and busy themselves with repeating the same unverified hypotheses, or pitting one equally unverified hypothesis against another." The trail so brilliantly blazed by Jevons has not been adequately followed up, and though there has been considerable advance in the study and appreciation of statistics and a vast output of statistical studies and compilations bearing more or less directly on different fields of economics, little real fusion of economic theory with measured observations has been achieved. There have been, it is true, some notable exceptions among the economists, such as H. L. Moore, Wesley Mitchell, Taussig, Cassel, Pigou, and Marshall, who have combined a profound knowledge of economic theory with sound statistical skill; but in the main, the argument holds that modern economics is still largely concerned with the elaboration or more or less plausible theories insufficiently supported by verifiable data.

A further criticism which seems well justified—although it has always been easy enough to pile up criticism against the economist and all his ways, justifiable or not—is based on the attempts to separate the economic from the political, and to make two entirely distinct entities of economics and political science. For purposes of specialised study this may be desirable, but despite the dictates of specialism, which may sometimes be followed too slavishly and fearfully, it cannot be too strongly insisted that the social sciences at all events should, so far as possible, be studied as one. Certainly economics and political science cannot be separated for long, and this becomes more clearly apparent when their statistical foundations and structure are envisaged. It is the supreme merit of Prof. Sargant Florence, when planning his great work, that he has co-ordinated and correlated in a wonderfully skilful manner, the highly complex data of economics and political science, and used the statistical approach for his purpose in such a way that the result is a triumph in homogeneity, a noble architectural pile, deeply impressing the observer with its massive strength, completeness, well-balanced proportions, and unity.

Various devices have been sought, but seldom found, for counteracting the evils of specialism in modern science, for providing a higher and more comprehensive viewpoint, for seeing a science or branch thereof in its remoter connexions, for co-ordinating related parts. Philosophy has sometimes been called upon to fulfil this important rôle; but that statistical method also could be used to serve the same end, though to a lesser degree, was an original and brilliant conception which Prof. Florence has worked out with indefatigable perseverance, amazing skill, and comprehensive grasp of a vast field in economics and political science. The expert statistician may not always agree with the author in certain details of technique, some of which he himself admits may be heretical; and truly, in such an elaborate technique, even though higher mathematics is eschewed, there are bound to be some controversial points for the hyper-critical specialist; but for the general reader, for the general student of economics and political science, the work is invaluable as a veritable storehouse of the latest research in statistical method as applied to these particular social sciences. It sums up the work of all the best authorities, but most of it is the author's own, is fresh, original, stimulating, and written in that lucid and charming style that

one has been led to expect from Prof. Florence. Its breadth and thoroughness are remarkable, for it is very much more than a mere text-book on statistical method. It is also a comprehensive treatise on economic and political science so far as these are amenable to statistical treatment, and the extent of that amenableness is much greater than is commonly supposed, as may be gathered from the following brief summary of contents, taken from Chaps. i. and ii. :

The function of economics and political science is the discovery and study of fact in the indicative mood, free from moral implications, and from optative or imperative attitudes. Scientific knowledge must first be obtained before it can be applied to produce the results desired for the good of mankind.

In the pursuit of knowledge the primary function of statistics is to describe item facts summarily. Such descriptions may substitute experience for unfounded or ill-founded assumptions, and verify or refute economic or political theory, or suggest pertinent generalisations of their own for theory to interpret. The statistical approach can be shown to be not inferior to deductive reasoning as mental discipline.

The focus and scope of economics and political science are described, and a further subdivision of the complete field is suggested into (*a*) economics ; (*b*) political science proper ; (*c*) political economics ; and (*d*) economic politics. This method of subdividing is perhaps open to criticism. Economic, political, and institutional inter-relations are next dealt with, thus completing Part I. In Part II. are described very fully the methods and technique of statistical measurement. The principles of classification and orientation demanded by qualitative differences and complexities are given in Part III., together with the principles and precautions to be observed in representing qualities through quantitative index numbers. This part includes a discussion of both statistical and non-statistical methods of causal interpretation, such as isolation of factors, experiment, and introspection. In Part IV. we proceed to tackle the intricacies of economic theory, modified in certain important respects, especially in the direction of flexibility, in order to suit statistical requirements. The statistical approach starts from item facts, but may use established theories as plausible working hypotheses. Eventually, statistically tested theories or theoretically interpretable statistics may perhaps be found to rest upon a solid and exact physical or psycho-physiological basis.

In political science there is no body of accepted theory but merely some structural and functional analysis, and the statistician must build up his own theories empirically by the correlation of varieties of structure, procedure, and transactions, and by the correlation of varieties of objectively distinguishable procedures such as ruling, work-sharing, and manning.

It will be seen that Prof. Florence goes as deeply as is possible for a statistician to go in investigating the complex phenomena of mankind's behaviour in the economic and political spheres, even to the extent of finding a measure for the psycho-physiological (Why not psychological simply ?) factors of exchange ; but since he has necessarily excluded all ethical and moral implications, as ruthlessly indeed as the American economist, General Walker, has done, and adhered faithfully to the indicative mood, the inquiry would seem to stop short at its most interesting and practically valuable stage.

Presumably it is left for the social philosopher to expatiate in the optative mood, and the statesman in the imperative mood. The former, with outstretched arms and full of a burning zeal for the welfare of mankind, seeks persuasively to inculcate political wisdom wherever this is to be found ; whilst the latter imperatively thunders forth his commands. Both should be as well grounded in the statistical approach to economics and political science as Prof. Florence, but is this possible ? Or is it too much to hope that Prof. Florence himself will work out for us the ethical and moral implications, and supplement and co-ordinate such of these implications as are already scattered about in some of his other books, for example, in " Economics and Uplift", continuing on a larger and more comprehensive scale the work already begun by Sir Wilfrid Ashley, Prof. Cunningham, and one or two others ? This would be a real contribution to the clarification of politics, establishing it on a more scientific basis, and a contribution also to the true art of statesmanship which cannot possibly be considered apart from ethics and morals. Prof. Florence's book raises numerous other questions of the utmost importance, discussion of which is precluded by lack of space.

Sterilisation as a Practical Eugenic Policy.

Sterilisation for Human Betterment : a Summary of Results of 6000 Operations in California, 1909–1929. By E. S. Gosney and Dr. Paul Popenoe. (A Publication of the Human Betterment Foundation.) Pp. xviii + 202. (New York : The Macmillan Co., 1929.) 8*s.* 6*d.* net.

THIS little book is a storehouse of information on the efforts which have been made in the United States to improve the human stock by sterilising the feeble-minded and the insane. It appears that although *more Americano* laws have been passed in about twenty states of the Union

providing for the legal sterilisation of sexual perverts, and imbecile and insane patients in public institutions, these laws have been put into practical operation only in the State of California, so that in the book discussion is mainly concerned with the results obtained in that State.

The justification for these attempts to aid Nature in eliminating the unfit is set forth in the introduction. Amongst our unsentimental forefathers, no efforts were made to keep alive weakly and diseased children, and hence the race was propagated only from its most vigorous members; but nowadays, when unreflecting humanitarian sentiment is in fashion, all babies are kept alive so far as medical science can avail, and this science is paid for by levying tribute on the thrifty and self-supporting. The result is that this section of society limits its offspring, and future generations are likely to be recruited not from the fit but from the unfit.

How drastically and efficiently natural selection operated amongst the young in England during the eighteenth century may be gathered from figures given by Miss Buer in her book, "Health, Wealth, and Population in the Early Days of the Industrial Revolution". In 1730, out of all babies born in London, 74 per cent died before they were five years of age; in 1750, 63 per cent died; in 1770 the percentage was 50, and it did not sink to 30 until 1833. The percentage was probably even higher in other parts of the country. The help given by hospitals, and later by the State, to indigent mothers has all grown up in the last century, so that the argument that because we have maintained a vigorous, enterprising, fighting race in these islands for eight hundred years since the Norman Conquest, we shall continue to do so, is not one for which there is any sound basis.

It is, however, not practical politics to suggest a return to the old plan of *laissez-faire*. How then shall the elimination of the unfit be promoted? The authors of this book suggest 'by legalised sterilisation'. The method of sterilisation advocated is cutting the ducts (vasa deferentia in the male, and Fallopian tubes in the female) which convey the germ cells to the exterior. The authors point out that more than six thousand operations of this sort have been already performed in California, and that only seven failures are recorded (three in males, four in females). The operation does not interfere with sexual desire or the performance of the sexual act. The genital organs in man, as in Vertebrata generally, have two functions, namely: (1) to produce the germ cells; (2) to produce a hormone which diffuses through the system and maintains youth and vigour. In a man the spermatozoa forms a minor part of the sexual discharge, the main portion of which is constituted by the prostatic secretion, and some authorities hold that this secretion when absorbed by the female has an invigorating effect on the constitution. As to a woman, when it becomes necessary on account of tumours to remove the uterus, if a portion of one of the ovaries is preserved and sewn to the abdominal wall, this will prevent the premature onset of the menopause and maintain in the patient all the qualities of a young woman.

But are insanity and mental defect hereditary? Some British authorities hold that in many cases they are not. So far as insanity is concerned, however, there is general agreement, as our authors point out, that the condition known as 'dementia præcox' is the result of an inborn weakened constitution, and that it is a mere question of time when it will manifest itself in the life of the unfortunate individual who has inherited this constitution. As to mental defect, the argument that it is sometimes not of hereditary origin, overlooks the consideration that all 'mutations', of which mental defect is one, must ultimately have been produced by some external cause, and there is nothing to show that an 'accidental' mental defective will not propagate mentally defective children. In any event, even if a defective should produce healthy children, such a person would make the worst possible parent to carry out the duty of caring for and training the children; and it is a little too much to ask the State to allow a defective to go on having children on the chance of some of them being normal, if the State has to support them all.

Our authors urge that sterilisation should not be regarded as a punishment but as a hygienic measure; that defectives confined in asylums might be allowed out on condition of their consenting to this operation. But whilst we agree that this argument is good so far as it goes, a little reflection will show that it only touches the fringe of the problem. The defectives most dangerous to society are those who are never confined in institutions at all! The high-grade defectives are just able to support themselves in the lowest paid and most unskilled occupations, and no civilised government would take the responsibility of confining them, and so they go on propagating large families as stupid as themselves. As Mr. Lidbetter has shown,[1] it is from the ranks of just these classes that in the

[1] "Pauperism and Heredity", by E. J. Lidbetter, *The Eugenics Review*, vol. 14, p. 152; 1923.

last hundred years the majority of paupers and criminals of London has been recruited.

It seems to us that in the last resort compulsory sterilisation will have to be inflicted as a penalty for the economic sin of producing more children than the parents can support. Whether a man has a large or a small family is—given a healthy wife—a matter of taste, so long as he provides for his own children; but when he comes to the State and demands that it—that is to say, his neighbours—should support these children, then the State can say, "Very well—we shall help you with the family which you have, but if after this you have any more children you shall be sterilised".

Before, however, such an alternative is presented to any citizen, he may justly claim that he should receive instruction from the State in the means of birth-control. It is obviously unfair that such knowledge should be denied to the poor whilst it is easily accessible to the rich. It is often said, and with justice, that the great objection to birth-control is that the wrong people practise it. But this knowledge once attained cannot be taken away; the middle classes possess it and cannot be prevented from putting it into practice. If, however, the knowledge and practice of birth-control were widely spread among the working-class, there would be created such a resentment against the reckless production of children that the movement to establish compulsory sterilisation of the unfit would prove irresistible. E. W. MACBRIDE.

Index Londinensis.

Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies: being an emended and enlarged edition continued up to the end of the Year 1920 of Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns compiled from Botanical and Horticultural Publications of the XVIIIth and XIXth Centuries. Prepared under the Auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew, by O. Stapf. Vol. 1. Pp. xx + 547. (Oxford: Clarendon Press; London: Oxford University Press, 1929.) 105*s*. net.

IN 1855 Dr. G. A. Pritzel, who was keeper of the Royal Library at Berlin, brought out his well-known work, the "Iconum Botanicarum Index locupletissmus", being what was then regarded as an exhaustive register of all known illustrations of Phanerogams and Vascular Cryptogams, chiefly from the time of Linnæus onwards.

The botanical and horticultural worlds are now able to welcome (what has been long overdue) the publication of the first volume of an emended and enlarged edition of Pritzel's work, under the title of "Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies". The editor of this important work is Dr. Otto Stapf.

About twenty years ago, the necessity of preparing a new edition of 'Pritzel' became not only obvious, but also urgent. The council of the Royal Horticultural Society and Sir David Prain, the then director of the Royal Gardens, Kew, made an unsuccessful appeal for the necessary funds. However, in 1912 the sum of £250 from the profits of the International Horticultural Exhibition at Chelsea formed the nucleus of a fund which made possible the commencement of the work. About the year 1917 the Royal Horticultural Society began the task of organising the big undertaking which a revision of 'Pritzel' would naturally entail, and guaranteed the cost of the compilation, and at the same time received grateful help from contributors interested in the work. Two committees were constituted to draw up a code of recommendations, as a result of which an honorary editor was appointed, and the work was started in July 1918 at the Herbarium of the Royal Gardens, Kew, where the director granted the use of a room and placed the resources of the library at the disposal of the staff.

By the summer of 1927 a prospectus and proof-page of the new 'Index' were issued. At the same time, negotiations were carried on with the delegates of the Clarendon Press, Oxford, for the printing of the work. In the summer of 1928, the card manuscript of the first volume, comprising nearly 84,000 references to illustrations in various books and periodicals from all over the world, was in the hands of the printers. When the remaining five volumes are published, the total number of entries will amount to nearly half a million.

As there were about 107,000 references in Pritzel's old 'Index', the additional 380,000 consists of those which were omitted by him and, added to these, the references to the pictorial literature published since 1865, the date of issue of the supplement to 'Pritzel'. This will give some idea of the great scope of the work. The references are from all publications of post-Linnæan date, that is, from 1753, and extend so far as the year 1920 inclusive. (For example, there are 153 references to illustrations of the common daisy.) However, owing to the high quality of the pictures in certain books of pre-Linnæan date, such as Rumphius's "Herbarium Amboinense" (1741) and Rheede's

" Hortus Malabaricus " (1686), these have been taken up, but not without the aid of certain modern commentaries on those works.

The citations in the new ' Index ' are of illustrations of Phanerogams, ferns and fern allies, the lower Cryptogams being excluded. They represent ' portraits ' of plants showing the habit, and of detached portions of a plant, and of such details as help to indicate the morphology of the various parts. But anatomical structures and fossil plants are excluded. Although teratological forms ('sports', ' monstrosities ') are not, as a rule, admitted, they nevertheless very frequently occur, as no sharp line can possibly be drawn between normal and abnormal structures.

No distinction is made between illustrations of species, subspecies, varieties, or hybrids, so long as they are accompanied by scientific names, and figures having only a generic name are not admitted. Not more than four names (including the generic one) are used, for example, *Acer pseudoplatanus quinquelobum clausum*. The spelling of plant names is in accord with the Latin as taught in modern schools, but *uniformity* is sought throughout; for example, of the two forms ' ceylanica ' and ' zeylanica ', the former is always used, but the latter is given in a cross-reference. The authors of plant names have been quoted throughout, but absolute exactitude in all cases cannot be guaranteed, especially as regards the authors of varietal names! Certain symbols are used, for example, an asterisk (*) to denote a picture wholly, or in part, coloured; a note of exclamation (!) to signify a ' sport '; and (×) for a hybrid. The sequence is alphabetical for the generic and specific names and the minor grades, but is chronological for the references. In the matter of cross-references, it should be said in the first place that, as regards species, the names under illustrations are simply registered as they are found, no attempt being made to correct inaccuracies when such occur, except when they are obviously due to inadvertent slips.

When, however, as sometimes happens, these names are at variance with those which occur in the text, this fact is mentioned in the reference, and cross-references are introduced under the respective quotations. As regards *genera*, species are often put under generic names with which they have long ceased to be connected; a system of cross-referencing has therefore been devised, based on Dalla Torre and Harms' " Genera Siphonogamarum " (1900–7), or, where this is out-of-date, on modern monographs or the editor's personal knowledge.

The preface, by the president of the Royal Horticultural Society, is in English and Latin. The editor's introduction, giving a brief sketch of Pritzel's life and an account of the scope of the whole work, is in English only. The key to the use of the ' Index ', on account of its great importance, has been printed in English, French, and German. This is followed by a list of subscribers.

Vol. 1 consists of 547 quarto pages and contains references to illustrations from *Aa* to *Campanopsis*, the letter *C* being thus split up between Vols. 1 and 2. Five more volumes will appear in due course. The price of the work is £5 5*s*. per volume.

No one who has not been actually engaged in the task can adequately realise the enormous amount of work and thought which the production of the manuscript of the ' Index ' entails. The delegates to the Clarendon Press are to be congratulated on the admirable way in which it is being printed. While the ' Index ' will scarcely be as useful to gardeners as would seem to have been at first surmised by its promoters, it will be of undoubted utility to the editors of gardening journals, to universities, and in botanical libraries like those at Kew and South Kensington.

If, henceforward, the student in botany or horticulture finds the task of turning up pictures of any particular plant or plants immensely easier than he ever did before, it will be due to the facilities provided by the " Index Londinensis ".

W. C. W.

Physiological Mechanics of Piano-playing.

The Physiological Mechanics of Piano Technique: an Experimental Study of the Nature of Muscular Action as used in Piano-playing, and of the Effects thereof upon the Piano Key and the Piano Tone. By Otto Ortmann. (The International Library of Music.) Pp. xv + 395 + 49 plates. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., Inc., 1929.) 21*s*. net.

AS a treatment of the physiological mechanics of the particular motions used in piano-playing, the present volume is of intrinsic interest to comparatively few scientific workers. It is of much wider interest as an example of research involving more than one of the sciences. The difficulties of such research due to the ever-increasing specialisation of research workers are frequently emphasised. The intensive cultivation of so many small branches of the separate sciences has, however, the compensating advantage that in each the technique is so fully developed that, for

example, the nthematical physicist may well find, as did Einein, a special mathematics ready for his applicatn, whilst the physiologist finds that the developents of telephony provide him with electrical struments of remarkable sensitiveness. The fudamental difficulty lies in getting in touch with te required developments of the unfamiliar scien, and appears to indicate not only the increing importance of adequate indexing and atracting of scientific literature, but also the dirability of definite training of research workersn library technique.

A good examp is provided by this book. One would not at fst associate piano-playing with industrial fatigu problems, and yet Report No. 14 of the Indust Fatigue Research Board deals with "Time an Motion Study", and from its detailed bibliogphy we soon find that even in 1915 an elegan method had already been devised to study the motns made by workers in factories. A tiny electric lap attached to the moving limb is photographed tereoscopically to give a three-dimensional reco of the *path*, the light is flashed on and off agai rapidly at regular intervals to indicate the *spee* of motion along the path, and the constants of e circuit are adjusted to increase the difference in e rate of brightening and dulling of the lamp filamnt so as to indicate the *direction* of motion. It idisappointing, therefore, to find that the author of the work under notice uses merely ordinary photography of a continuously illuminated lamp attached to the pianist's hand. Numerous recor reproduced in the book might otherwise have ylded quantitative data. There is no section on motion study in the extensive eight-page biblioaphy.

The difficulties of obtaining quantitative data on the actual nscular motion are very much greater. As is early explained in the text, one part of a large regularly shaped muscle may under some colitions give obvious external changes of shap whilst another part gives no such measurable change. From this it follows that precise decctions upon the movement of the whole muscle cannot be formed from observations with any pparatus which makes contact with such a mule at a selected small part of its surface. Wn, in addition, the contacting apparatus involv the use of the old tambour device (p. 106), te results are still more unsatisfactory, and it is well to emphasise that many of the displacement-time records reproduced in the book are more qulitative than quantitative.

It is stated in e preface that the experimental work has occupied five years, and that a considerable part of the time has been devoted to improvements in methods of recording. There is but little quantitative data given on the new methods, and the statement on p. 185 is surely a confession that the dynamograph was not always suited to the work. Whilst many interesting qualitative results are given, they are almost all to be found scattered elsewhere in the writings of pianists, and the value of the research would have been very considerably increased if the author, realising that his experiments were purely physical, had taken full advantage of superior methods of measuring already available to the physicist.

The avoidance of references in the text to similar work by others is undesirable in a non-pedagogic scientific book, tending as it does to give a false impression of newness to the contents. There is an excellent subject-index, but no author-index.

W. H. GEORGE.

Our Bookshelf.

Experimental Building Science. By J. Leask Manson and Francis E. Drury. Vol. 2: *Being an Introduction to Mechanics and its Application in the Design and Erection of Buildings.* (The Cambridge Technical Series.) Pp. xiii + 468. (Cambridge: At the University Press, 1929.) 18*s.* net.

FOLLOWING the first volume under the same title, which dealt with the application of general elementary science to building work, the authors in this work have proceeded to develop the principles of mechanics relevant to the subject, including elasticity and strength of materials, and have applied them to the commoner forms of building construction, in such a way as to make their presentation practical and easily intelligible, without too much academic treatment. The volume is in three sections. The first describes the general principles governing the equilibrium of systems of forces and their application to framed structures, incidentally making reference to certain types of building plant which involve a consideration of forces in more than one plane. Section 2 is mainly concerned with the theoretical aspects of elastic bending in loaded beams, and Section 3 consists of a series of chapters devoted to a practical consideration of the foregoing principles in actual work.

It will be seen that the ground covered is largely the same as that in other text-books, though not necessarily in a single volume, and the advantage in the present case is that the builder and the student of building construction are provided with a manual containing, in addition to the normal traditional matter of the subject, discussions of certain important problems which are perhaps more commonly associated with the province of structural engineering, though the boundary between

the two departments is difficult enough to define. Reinforced concrete thus comes in for an appreciable and appropriate amount of attention. The calculation of stresses in the framed members of buildings, in which this composite material takes a leading place, it must be admitted, is now a very essential part of a knowledge of present-day building construction.

The treatment of the various subjects is lucid and systematic, the figures clear, and the type all that can be desired. There is a serviceable index and a number of test problems with answers.

B. C.

Life and Work in Prehistoric Times. By Prof. G. Renard. Translated by R. T. Clark. (The History of Civilisation Series.) Pp. viii + 228 + 9 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1929.) 12*s.* 6*d.* net.

IT is some time since any work has appeared in English which has attempted a reconstruction of prehistoric times on the scale of M. Renard's work. In fact, to find anything of analogous character approaching it in completeness, we must go back to the work of Lord Avebury. British writers, in dealing with prehistory, however comprehensive their scope, have as a rule confined themselves for the most part to the more or less direct evidence of archæology and the relevant elements in geology and palæontology, referring to the customs of modern primitives sparingly for illustration and elucidation only. M. Renard attempts a more synthetic treatment and draws largely on the data of ethnology and ethnography. He treats of both material culture and social organisation. In regard to the former, a more precise documentation would have been an advantage in many cases. For example, in the generalised account of the origin of cultivated plants, it would have added to the value for the reader for whom a book of this type was intended had the evidence for the probable origin of cultivated plants been cited more precisely. The same applies to domesticated animals, especially the dog and horse. In his account both of art and of personal adornment and clothing, M. Renard gives less weight to the influence of religion and magic than most archæologists and ethnologists would be prepared to allow. It is difficult to admit that tattooing, for example, is, either in origin or in practice, purely a matter of personal adornment.

The Practice of Spectrum Analysis with Hilger Instruments: including a Note on the various Types of Emission Spectra. Compiled by F. Twyman. Fourth edition. Contributors: Prof. E. N. da C. Andrade, Dr. Samuel Judd Lewis, D. M. Smith, S. Barratt, A. A. Fitch, J. W. Ryde. Pp. 39. (London: Adam Hilger, Ltd., 1929.) 1*s.* 6*d.* net.

As the title suggests, this is a practical handbook, giving in detail the experimental procedure to be followed in the solution of various academic and industrial problems. The usual arc and spark methods receive full notice with numerous references to possible difficulties, for example, confusion by adjacent lines; it is shown how these may be avoided in ordinary practice. The exploded wire method for fine wires or filaments is described at length, showing, for example, how 0·2 per cent of thorium in a tungsten filament may be not only detected, but also determined, when the piece available is only 1·5 cm. long and weighs one-fifth of a milligram. The application of the recently introduced 'R.U. Powder' (Raies Ultimes) prepared so as to give under suitable conditions a composite spectrum exhibiting a small number, usually about seven, of the most persistent lines of about fifty elements, is demonstrated in the text and by photographs. The purpose is to identify the chief lines of all the elements in a sample by producing its spectrogram in juxtaposition with that of a portion of the R.U. powder. Useful information is given on quantitative spectrum analysis as conducted without resort to special equipment.

The chapter on the various types of spectrum discusses the theoretical bases on which the practical processes are formulated, and will be found both helpful and suggestive in the laboratory.

Engineering for Masonry Dams. By William Pitcher Creager. Second edition. Pp. xiv + 294. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 20*s.* net.

THE second edition of this text-book on masonry dams is a revision to date of the earlier volume (which was reviewed in NATURE of June 20, 1918, p. 301), with the deletion of certain obsolete matter and the inclusion of new data and information, making a net enlargement of 57 pages. The chapter on details and accessories, in particular, has been extended so as to include a fuller description of outlet control and floodgates. A quantity of relevant material has been incorporated which is included in the hydro-electric handbook, by the same author jointly with Mr. Justin, published in 1927.

The book is, of course, mainly a reflection of American practice, and in view of the attention which is being given on the western side of the Atlantic to the development of water power and the impounding of water supplies for this and other purposes, the experience obtained and recorded in the volume is of no little interest and value to water engineers.

B. C.

The Purple Land: being the Narrative of one Richard Lamb's Adventures in the Banda Orientál, in South America, as told by Himself. By W. H. Hudson. Pp. 368 + 13 plates. (London: Gerald Duckworth and Co., Ltd., 1929.) 15*s.* net.

IMAGINE Don Quixote with a dash of Scottish caution, and we have the beloved naturalist in his youth. His main concern is with the pretty girls of Uruguay, and his treatise should prove irresistible to all young biologists. Other scientific themes are carefully avoided, but there is all the fun of a comic revolution, which is tragic enough to draw tears—both sides of humour. It is a grand book, by one of the heroes of science.

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.*]

Anent Metameric Hydrogens.

AT the recent anniversary meeting of the Royal Society, Sir Oliver Lodge, with his accustomed charming perspicacity, in moving the vote of thanks to the president, referred to the happy way in which he endeavours to interpret to the old fogies the mystic feats of the juvenals who now soar into mathematical-physical empyreans not only beyond the reach but also beyond the comprehension of us weak ordinary mortals. Well might the Primate remark at the anniversary dinner that "the relations of religion and science have never been more cordial". This is so—not because the clerics are being made wise by 'science' but because its reputed followers are more and more walking in the clerical train and tending to write superstition for science. Nothing could be further from the truth than the Archbishop's reported statement—"that both religion and science had given up the bad habit of being dogmatic". The mistake comes from the fact that, on both sides, the language used is so mystical that no one knows what it means: pure hyperbole is current in both camps. If coming together, it is because the body scientific is more and more being given over to dogma, doctrine and fashion, fast losing the sense of modesty and disregarding the Pauline mandate to—Prove all things!

The president, this year, has dwelt upon the picture the younger wiselings are drawing of the jinks and jazz indulged in, 'they guess', by molecules so simple and staid as we have thought those of hydrogen to be. Granted the existence of two metameric forms of so primitive a molecule, attention may be directed to what *is* surprising (not the existence of varieties of the gas)—the observed prolonged stability of the one form and the influence of charcoal in effecting its rapid transformation. Apparently, the change from one form into the other is no mere temperature nor time effect. Physicists are apt to pay no attention to the process of change—they seem to have thermodynamic minds: theirs not to reason how. If the physicist have a living soul, it is one that lacks the sense of purity; he could never have paid so much attention to impure materials had he had one. Electricity just passes through a gas; electrons are supposed to have no truck of convoy. The evidence that chemical change only takes place in a tripartite conducting circuit is not considered; at most it is airily dismissed with a summary reference to ions—the pink silk stockings worn to-day throughout the 'scientific' community—which not only can do no wrong but also are rated capable of anything and everything.

A great number of instances of metameric change are known to us. One of the most fundamental is that of acetoacetic ether, a compound existing in two isodynamic forms, one a keto form containing the radicle $\cdot CH_2 \cdot CO \cdot$, the other an enol form containing the isomeric group $\cdot CH : C(OH) \cdot$. In a highly purified state, these change so slowly that it is rational to assume that they would not change if *pure*: an inconceivable worldly condition. The passage from one into the other undoubtedly takes place under the influence of an *electrolytic determinant*, whereby CO becomes CX(OH) and X then walks away with an H from the contiguous CH_2—or vice versa. I venture to assert this and deny that mere kinetic collision can 'do the trick'.

It has long been an article of faith in my religion, that spectral lines, and now even the assumed orbital shifts in electron-levels, are consequences of this order of process. Like Joan of Arc, I at times am told by 'my voices'. The process I contemplate is a sort of a kind of incarnation—mayhap resembling that of which Sir Oliver Lodge dreams. As he would say: 'I don't know'. That one form of hydrogen should pass into the other when brought into contact with charcoal might, I suggest, be due to an electrolytic determinant at its surface. The condensation of a gas at the surface of charcoal is undoubtedly a chemical process, one to which arguments may be applied similar to those used by Aitken and others with reference to the formation of Water (rain drops) from hydrone. The existence of two forms of hydrogen in equilibrium makes no greater call upon my imagination than does the passage of water into ice: being so familiar with the fact, we in no way regard the expansion as remarkable. Surely, there must be some great change in fundamental molecular contexture. Water, unfortunately, has no power to-day to soothe the subsidised breast of the modern researcher: we are only worried by it, if it come through our roof and the valleys are flooded: as it is so prone to function in waves, perhaps wave mechanicians will some day deign to notice it.

We have long been aware that elementary molecules are not always fixed structures. In this connexion, Sir James Dewar's remarkable but little regarded observations upon the sudden change in the specific heats of many metals at liquid hydrogen temperatures are specially noteworthy. Whilst the so-called atomic heat (sp. ht. $\times$ at. wt.) is almost a constant at ordinary levels, the values vary periodically at very low temperatures. The alkali metals alone seem to preserve their equanimity. I have always thought of such changes in elementary materials as evidence of the existence of metameric forms.

Sir Ernest Rutherford speaks of a "very weak coupling" between the two states of hydrogen. He also talks mysteriously of symmetrical and anti-symmetrical orbital wave functions. That so great a master of the art of simple expression should speak in terms so meaningless to most of us, I suppose comes from the fact that the language of wave mechanics cannot be translated down to our level. It cannot be that he has joined camp with the *Jargonotropists*, protonotropist though he be. When we are sufficiently quantised to be hypnotised by such terms, doubtless we shall all be worshippers of the new faith. We need, however, a little more instruction before confirmation—it is difficult to recite a catechism in terms of an unknown tongue.

Here the question is perhaps pertinent—Have we a known tongue to-day? I notice that the heading to Sir Ernest's address is "Recent Reactions between Theory and Experiment". Should we not read guess or speculation for theory? Is not theory a sacred word, of sublime import, to be used only on royal occasions? In NATURE I fear it is almost systematically put to vulgar use—even by the great. Prof. Eddington, a master in the art of expression, in the issue of Nov. 30, speaks of proposing "a theory" of electronic charge—which is so little a theory that he gets a value of 136 one week and 137 another. Remembering him as I do, as a most active member of the Astronomical Corps de Ballet that entertained us in 1914 on the way out to Australia, I can see him gaily dancing through the scale of numbers and giving us other values in weeks to come. I have been brought up to regard a theory

as a body of established doctrine, not a shifting guesswork. In the same number of NATURE, in the review on the "Origin of Coral Reefs", the word is systematically perverted—it almost always is. I go among schoolmasters advocating scientific method: How am I to hold up my head when, in using words, my tribe is so careless? We weigh things to the *n*th decimal—but rarely our words. Cannot we do something by way of example, so that our youth may not always 'babel on'? We have yet to learn to serve up our dish of science with proper trimmings.

Even the word 'science' has no established meaning. In the introduction to his recently published all-comprehensive "History of Science", Mr. W. C. D. Dampier-Whetham tells us that the English word science is used as a shortened term for natural science, though the nearest German equivalent, *Wissenschaft*, still includes all systematic study. Surely, this is wrong. 'Science' *is* 'the business of knowing'; the production of knowledge; truth of whatever kind. What some of us are trying to do is to exclude from it unnatural knowledge, as was the desire of the early founders of the Royal Society.

HENRY E. ARMSTRONG.

Early Rhodesian Gold.

THE preliminary report by Miss Caton Thompson and the letter from Prof. J. W. Gregory (NATURE, Nov. 9) are of great interest to students of history. It is well to bring forward the contradictory evidence, as Prof. Gregory has done. In regard to the estimate of a gold production, in ancient or medieval days, amounting to £75,000,000, I venture to express a warning. The production and disposal of any such quantity of gold would have made a big stir at any time in the world's history. Its commercial value in medieval days, or earlier, would be, at least, twenty times its present value, and an addition of the equivalent of £1,500,000,000 to the world's wealth would be a great event, would it not? We have no whisper in historical records of any such contribution coming from the gold mines of any region before the Californian and Australian discoveries. The Spaniards obtained most of their South American gold from the graves, not the mines, of Peru, Colombia, and Venezuela. Again, £75,000,000 in gold represents a weight of 625 tons.

As a mining engineer, informed concerning the Rhodesian mines, I beg to submit that the estimates made by Edwards, Hammond, or others should not be accepted by archæologists, because they were made at a time when the Rhodesian diggings were being boomed on the London stock exchange. Such estimates have no value for the historian. The removal of 100,000,000 tons means the excavating of a vast number of cubic feet of rock; Where is the evidence of such extensive work?

As to the ingot found in Falmouth harbour; we have no evidence as to its Phœnician origin; the statement by Diodorus concerning the *astragalos*, or knuckle-bone, pattern has nothing to do with the Phœnicians; he is referring to the tin trade of his own day, that is, about 25 B.C., when the tin was carried overland from Corbilo, at the mouth of the Loire, to Massilia, at the mouth of the Rhone. I have examined the Falmouth relic and I have seen a soapstone mould of a supposedly same type in the Bulawayo museum. They have nothing in common. The Falmouth ingot has a shape evidently suited for convenience in packing on horseback across Gaul. We have no proof that the Phœnicians mined Cornish tin or went thither to obtain it; on the contrary, the evidence suggests that they traded with the Veneti, or their predecessors, at the mouth of the Loire, where, in Morbihan, they themselves mined for tin, and probably also traded with the Britons, meeting them on the island of Ictis, as described by Diodorus. The supposed identity of ingot moulds is to be taken no more seriously than the idea that phallic emblems necessarily signify Phœnician operations at Zimbabwe.

T. A. RICKARD.

Faculty Club,
University of California,
Nov. 25, 1929.

DR. RICKARD's letter carries the weight of his high authority on early mining. Yet the estimates of the great gold output from Rhodesia were not made on the London Stock Exchange, but by responsible mining engineers who were well acquainted with the ancient workings. When discussing Telford Edward's estimate with the local authorities in 1905, they expressed the view that his figure would have to be increased owing to the discovery of many additional workings. In view of the size and number of the ancient mines, I felt that the excavation from them of 100 million tons was not exaggerated. The workings are direct evidence of an output of gold which, as Dr. Rickard says, would have made a stir in the world. The discoveries at Ur and in Egypt show that the people of those countries had tons and tons of gold. If the Rhodesian gold mining had been medieval, we should surely have evidence of it in the gold or by tradition.

In view of the suggestion that the gold was mined in connexion with the Arab settlement of the East African coast, I recently asked Sir Robert Hamilton whether he knew of any evidence of the Arabs there having had any large quantities of gold. He replied: "I have seen and myself collected a few gold and gold-inlaid ornaments on the coast; some, the majority, were obviously not very old, being made out of sovereigns; others were older, these mostly from Lamu and Patta, which generally appeared to be of Persian origin or design. In any case the amount was trifling. On the other hand, old swords and daggers, which are often treasured possessions, are generally hilted and adorned with silver work of Arab origin. While there are traditions of wealth in ivory and slaves, I have never come across traditions of wealth in gold or of trading in gold, and so far as my reading of history goes I do not recollect any recorded accounts of the early European discoverers and explorers on the E. coast finding the Arabs in possession of wealth in the shape of gold nuggets, dust, or ornaments. The evidence is naturally defective and negative, but I should hesitate to believe that the medieval coast Arabs possessed gold in any quantity without a great deal more positive and convincing evidence than I have yet seen."

In reference to the Falmouth tin ingot, the stamp on it has been described as the mark of a Phœnician or Greek trader. The ingot was accepted as Phœnician by the best opinion of the time of its description by Sir Henry James, for Lord Leighton, who was careful to obtain the best expert advice, pictured it in his fresco in the Royal Exchange of the Phœnicians trading with the ancient Britons. Dr. Rickard remarks that this ingot and the Zimbabwe ingot-moulds have nothing in common. Their similar shape seemed to me so significant that I published outline drawings of them, to show their resemblance, in *Trans. Inst. Min. Eng.*, vol. 31, 1905–6, Pl. I. Figs. 2 and 3. The loss of the ingot near the entrance to Falmouth Harbour was attributed by Sir Henry James to the boat having been wrecked while seeking shelter there "on its voyage coastways to Boulogne".

Some of the tin for Phœnicia may have been carried across Gaul to Marseilles from the mouth of the Loire; but the use of the Boulogne route for the Cornish tin has been generally accepted.

J. W. GREGORY.

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The Product of the Radioactive Disintegration of Potassium.

IT has been shown by numerous investigators that potassium and salts of potassium are radioactive, the activity being due to the emission of β-particles by the atoms of potassium. In accordance with the radioactive displacement law, Hahn and Rothenbach (*Phys. Zeit.*, **20**, p. 194; 1919) pointed out that this β-transformation of potassium should result in the production of an isotope of calcium, without change in atomic weight. On the other hand, S. Rosseland (*Zeit. f. Phys.*, **14**, p. 173; 1923) has put forward an ingenious suggestion which does not necessitate the production of a calcium isotope. Later, Hevesy and Løgstrup (*Zeit. anorg. Chem.*, **171**, p. 1; 1928) showed experimentally that the radioactivity of potassium appears to be confined to the isotope of mass 41; Aston had previously shown that potassium consists of two isotopes of masses 39 and 41. If only the isotope of mass 41 is radioactive, Holmes and Lawson (*Phil. Mag.*, **2**, p. 1218; 1926) worked out the half-value period of this isotope, and on the basis of this result, Hevesy and Løgstrup calculated that, if we assume the earth to have existed for 10^9 years, about 0·001 of all the potassium in the earth must have been transformed into calcium of atomic weight 41.

As a result of an examination carried out by one of us on a series of samples of microcline from Miask (Urals), a variety has been found containing 11 per cent of potassium and only 0·042 per cent of calcium. In accordance with the calculations of Hevesy and Løgstrup, there should be present in this mineral about 0·01 per cent of Ca^{41}, which has been generated from potassium during the life of the mineral, assumed to be 10^9 years. If the remainder of the calcium (0·03 per cent) were present in the mineral during its formation, and if it had the atomic weight of ordinary calcium (40·07), we have calculated that the total calcium in the above mineral should have an intermediate combining weight of 40·30.

Through the kindness of Mr. Smolianinoff, director of the Mineralogical Museum of the First Moscow State University, we have been able to obtain a quantity of this mineral microcline, from which 0·15 gm. of CaO was extracted. After careful purification by repeated precipitation as $CaSO_4$ and CaC_2O_4, in quartz vessels and using carefully purified reagents, the atomic weight of the resulting calcium was determined by evaluation of the ratio $CaCl_2 : CaBr_2$, the weighings being accurate to 0·01 mgm. Two determinations yielded concordant results, 40·21 and 40·24, as compared with the calculated value of 40·30. The slight discrepancy can be explained by the loss of part of the calcium during its long sojourn in the earth's crust.

In order to examine the accuracy of this method of determining the atomic weight and the efficiency of the method of purification, ordinary calcium (Merck's 'calcium carbonate') was mixed with salts of barium, strontium, magnesium, aluminium, and iron, and then extracted and purified by the same methods as had been used for the calcium from the microcline. The atomic weight of this calcium was then determined, and the results of three experiments gave respectively, 40·06, 40·16, and 40·08, as compared with the value 40·07 of T. W. Richards. The mean of these three results is 40·10.

It is our intention to continue this investigation, and to determine accurately the atomic weight of calcium from microcline, by using a larger quantity of the material.

A. V. FROST.
O. FROST.

Vasily Island,
Leningrad.

WE are indebted to the Editor of NATURE for the privilege of reading the above interesting communication, which, so far as it goes, seems to indicate a calcium isotope of mass 41 as the disintegration product of potassium.

In view of the uncertainty which is likely to arise from the use of so small a quantity of material (0·15 gm. CaO), and the rather large difference (0·1 unit) between the extreme values of their three determinations with ordinary calcium, we shall look forward with interest to the results of the authors' projected work with larger quantities of material.

The suggested explanation of the discrepancy between the experimental and calculated atomic weights of calcium from microcline would surely tend to make the experimental value higher instead of lower than the calculated value. It would be predominantly 40·07 calcium that would be involved if calcium were lost during the life of the mineral.

The calculated value of the atomic weight of the calcium from microcline is necessarily far from trustworthy, as it involves not only the uncertainty of the disintegration constant of potassium, but also an undoubted error in the age assigned to the microcline. According to Backlund, the pegmatites of Miask are younger than the biotite-granite of the region and the cataclastic deformation that followed: that is to say, they are a little younger than the orogenesis of Artinskian (Lower Permian) time. Stratigraphically they are directly known to be younger than the Middle Carboniferous. As von Bubnoff has pointed out, sedimentary deposits younger than the Middle Carboniferous are not known in the East Urals, and exact time definition is therefore not practicable.

It is nevertheless clear that the age to be considered in making the atomic weight calculation should be not 10^9 years, but rather less than 2×10^8 years. Adopting the latter figure, the amount of Ca^{41} in the extracted calcium from the microcline would be only 5 per cent as against 25 per cent previously assumed. It is here tacitly assumed that the average atomic weight of ordinary calcium was the same 2×10^8 years ago as it is now. There is no means of estimating the difference, but as it is in any case quite inappreciable, it may safely be ignored. For an age 2×10^8 years the atomic weight of the microcline calcium is calculated to be almost exactly 40·1.

ARTHUR HOLMES.
ROBERT W. LAWSON.

Measurements of Noise by Means of a Tuning-fork.

IN recent work I have been assessing the loudness of certain noises by means of an audiometer of the type in which a note in a telephone earpiece over one ear is adjusted in loudness until it appears to be as loud as the noise observed by the other ear, or alternatively, is just masked by it. For general observations of everyday noise when the instrument is not at hand, I find it possible to use a tuning-fork on the same lines. The fork is struck in a standard manner, and note is made of the time which elapses before the loudness of the fork, when placed as close to the ear as possible with the flat of a prong facing the auditory meatus, falls to the loudness of the observed noise.

The total interval which elapses before the fork is masked by the noise is also taken for check purposes.

Since the sensation-stimulus law of the ear and the law of decay of the fork vibrations are both practically logarithmic, it follows that equal intervals of time give approximately equal reductions in the loudness of the note from a struck fork. The fork actually used had a frequency of 640 vibrations per second. The intensity of the note when the fork was first struck was about 90 decibels [1] above the threshold and it died away to inaudibility in about 62 seconds. The average rate of decay was thus about 1½ decibels per second. Actually it was found that the decay of the fork was rather greater at large amplitudes than at small—a fact that may be associated with an observed drift in the performance of the fork during the months it has been in use. Since it was known that the pres-

noisy at Kingston as near Oxford Circus in London, and had the general loudness of accelerating cars and buses. Experiments in the first and third class compartments of a certain train revealed that the noise levels were about the same until the windows were closed, and then the first class compartment was definitely the quieter by some 5 decibels or so.

Loud radio speech at home corresponded with really loud conversation, and transmission through a 4½ in. brick wall into an adjacent room reduced the level by some 30 decibels to that of rather quiet conversation. In an interesting case where complaint was made of the noise from a loud-speaker which could be heard up and down a residential street, the loudness observed through open windows in a room in the house on the opposite side of the street was also of conversational level. The fatigue of conversation in busy streets,

LOUDNESS LEVELS OF VARIOUS NOISES.

Fork Loudness (Decibels above Threshold).	At Home.	In Street.	In Vehicles.	Miscellaneous.
130	..	..	..	Threshold of painful sounds.
120	..	..	..	..
110	..	..	..	Aero engine (10) (unsilenced).
100	..	..	..	Express train (12) (estimated).
90	..	Pneumatic drill (20).	Tram on v. noisy rails.	..
80	V. l. radio music.	Motor horn (20).	Tube train.	..
70	L. radio music.	V. busy traffic, accelerating cars and buses.	Bus top. Tram. Train (open windows).	Electric train starting. V. noisy restaurant. Typewriter.
60	L. radio speech.	Busy traffic.	Saloon car (35 m.p.h.).	..
50	Q. radio music. Conversation.	Q. car. Q. street, behind Regent St.	Train (windows shut), 1st class.	Moderate restaurant clatter.
40	L. whisper (5). V. q. radio.	..	Saloon car (25 m.p.h.).	Q. restaurant in Strand.
30	..	Q. street, evening, no traffic, suburban.	..	Walking on gravel. Rustle of leaves in wind.
20	Q. garden.	..	..	..
10	Q. whisper (5).	..	..	..

(Q = quiet. L = loud. Figures in brackets are distances in feet from the source.)

sure variation in the minimum sound of this pitch audible to the observer's ear was about 1 millidyne per sq. cm., the scale of the loudness of the fork is an absolute one.

By extrapolating an approximately average linear relation found to exist for moderately loud noises between 'equality' results and 'masking' values, it was possible to use 'masking' values alone in assessing noises which were louder than the fork, and the scale was thus extended to 110 decibels above the threshold.

A number of observations of the ordinary level of daily noise taken over a period of some months have been summarised in the table. It is not claimed that the table is complete, or that conditions were always average, but consistency and reasonableness were revealed when observations made over a period of some months were summarised. For example, an accelerating bus gave the same result when observed in Regent Street as when observed on a quiet night in Teddington. A really busy street was practically as

[1] A change of 1 decibel—a power step of $10^{0.1}$ fold or 1·26 fold—is of the order of the minimum difference in loudness detectable by the ear.

trams, buses, trains, and noisy restaurants, is to be expected from the fact that the level of noise is generally greater than that of conversation.

A. H. DAVIS.

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Thames Floods and Pollution.

THE note on the Thames flood of 1928 (NATURE, Jan. 4, p. 32) is of the very greatest topical interest, for not only have the recent December floods covered an unexpectedly large area, again submerging districts upon which council houses have been built, but they have also shown how river pollution must rapidly increase as fields get replaced by residential quarters with drainage systems far below the level of the river.

According to the old order of Nature, flood waters used to accumulate above Oxford, perhaps submerging the water-meadows for weeks at a time, but at any rate much water was there ponded, helping to save from

serious flooding more valuable lower reaches of the Thames nearer London. Recent experiences seem to show that the Conservators of the Thames are changing this. By costly enlargements of weirs, channels, and bridges, the water is hurried down from the upper pastures on to the residential areas below. These areas, being land liable to flooding, would never have been built upon but for the optimistic parrot-cry of 'No more floods', whenever some notable work of river engineering has been accomplished. Either in spite of what has been done, or in consequence of it, the failures have been so frequent and so costly, that the time is ripe for a thorough and scientific investigation of very complex problems that need never have arisen. The river is no longer adequate to meet all the requirements of those huge and increasing populations that have settled within its watershed. It therefore becomes necessary to define the objects of primary importance that are served by the Thames, and what should be subordinated thereto.

That there are good grounds for mistrust in the future is shown by a recent publication, "The Thames Valley from Cricklade to Staines", in which the urgent duty of the preservation of the beautiful and beloved 'landscape character' of the river is most strongly advocated. But it behoves a scientific statesman to approach the subject from a rather different point of view.

The essential of a river is not its setting, but its water. London draws a large percentage of its drinking water from the Thames. Oxford and Reading are equally dependent upon it. The few barges and factories upon the upper reaches are surely matters of small consequence as compared with London's need of pure water. Birmingham, Liverpool, Glasgow have all acquired Nature reserves as catchment basins for their water-supply, and take extraordinary precautions to preserve the purity of their sources. Streams that are possible sources of pollution have been diverted, dwelling-houses have been pulled down, tenants have been evicted, the very hillsides have been rationed in the matter of grazing cattle. The result is a city supply of a beverage that is worth drinking. London has been strangely apathetic in the matter, with the result that she drinks the bath-water of other towns: indeed, much of her 'water' is stuff to which that blessed word 'effluent' has been applied several times over. Oxford drinks the effluent of factories on the upper Thames and its tributaries, and puts effluent back into the river at Kennington for the benefit of towns below. Similarly, Reading uses what it desires, and excretes an 'effluent' for others. Finally, the water after final chlorination is served in the flat form familiar to the citizens of the capital city of the Empire.

All through the drought of the past summer, the stagnant river had barely current enough to shift an oily scum, derived from motor boats and the washings of motor-cars. This scum is most harmful to bird and animal life, and is most deterrent to picnickers. During the past month the upper Thames has suffered pollution through the gushing of sewage from low-lying drains into the Thames; by the washing out of gas-water from a huge gasometer into the river—and water over which coal-gas has been standing is perhaps one of the most deadly of effluents to fish-life; and by the unhindered flow of inky black effluent (untreated) from the refuse dumps of Oxford directly into the Thames. It is obvious that the river is also receiving water that has been slowly flowing over acres of manured allotment grounds, and through thousands of ill-kept back-yards of slum houses. Everything soluble, and much that can be carried in suspension, will go floating down stream to the intakes of the Water Board. We admire their assiduity in sterilising and their success in preparing drinking water from such polluted sources.

The real question to be settled is why precautions which are taken to preserve the purity of the water of Lake Vyrnwy or Lake Thirlmere should not be applied to the Thames. The scheme of confining the river to a narrow canal would be costly, inefficient, and inexpedient, but the preservation of a natural river flowing beside a definite flood-zone of water meadows, free from exceptional sources of contamination, would be Nature's own way of dealing with the needs of the Thames.

An independent potamological station for the scientific investigation of the Thames has often been suggested. It could perform a national service now.

R. T. GUNTHER.

Visible Electron Diffraction.

UNTIL now diffraction of electrons has only been made evident by delicate electrometric measurements or by photographic exposures of several hours. I have succeeded for the first time in making visible on a fluorescent screen diffraction rings produced by a crystalline powder. This latter is a thin film of zinc oxide obtained according to the process described by M. Ponte (*Comptes rendus*, **188**, 244; Jan. 1929). This film is formed by an agglomeration of microcrystalline particles of smoke and possesses marked electrical conductivity. While working the tube, one can bring a given sample or a given area of the sample into the path of the electron beam. With a current of some tenths of a milliampere and a voltage exceeding 8000 volts between the cathode and the collimator tube, the two principal rings of zinc oxide are easily visible (Fig. 1). They are some tenths of a millimetre wide and some centimetres in diameter.

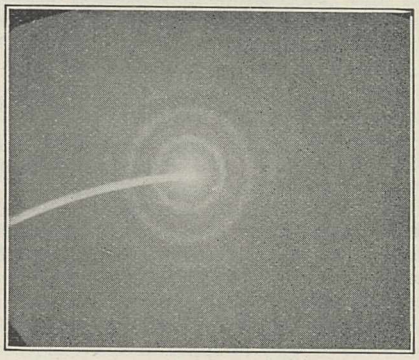

FIG. 1.—Diffraction rings of zinc oxide.
$V = 19$ k.v. $D = 13$ cm.; exposure = 10 seconds.

One can follow on the screen their variation in diameter according to the voltage. The moving of a magnet near the tube displaced the entire diffraction pattern. Using ordinary photographic plates, the necessary time exposure under 15 k.v. pressure does not exceed ten seconds. The law of M. Louis de Broglie is easily verified with an approximation of a few hundredths. The sight on the screen of movable rings of a variable diameter seems thus to provide the most direct and convincing proof of crystalline electron diffraction.

A. DAUVILLIER.
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Paris, Nov. 18.

Reflection of Protons from Calcite.

I HAVE recently found that hydrogen canal rays give a complex reflection pattern when they are allowed to fall on a cleavage face of a calcite crystal at almost grazing incidence. Fig. 1 shows one of these patterns. The crystal was placed horizontally and was held by a wire spring bearing on the top. A narrow bundle of the rays struck the crystal underneath the wire, which was not in absolute contact with the crystal at the centre point. Some of the canal rays passed over the surface of the crystal without hitting it and fell on the photographic plate 15·5 cm. distant, giving rise to the central spot seen in the lower part of Fig. 1. This spot appears white because of solarisation of the plate due to the concentrated neutral bundle.

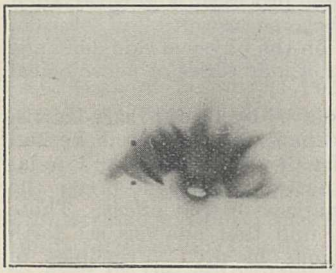

FIG. 1.

The upper part of the photograph shows positive particles reflected from the surface of the crystal. It consists of a series of curved and straight lines forming a regular pattern which is not perfectly symmetrical about the vertical axis. By increasing the angle of incidence the central spot was cut off and the figure was considerably altered. The figure has a certain resemblance to the secondary lines obtained by many authors with X-rays, using the rotating crystal method of analysis (Sir William Bragg; "An Introduction to Crystal Analysis", 1928, p. 38); however, the angular divergence of the original bundle was scarcely large enough to give the variation in the angular deflections actually observed, and the Bragg equation gives far smaller angles than those observed if we assume an equivalent wave-length from the de Broglie formula. A more promising interpretation is that the lines are due to diffraction of the rays at the two-dimensional gratings formed by the rows of atoms in the crystal surface. With the de Broglie wave-length, the angles deduced are of the right order of magnitude.

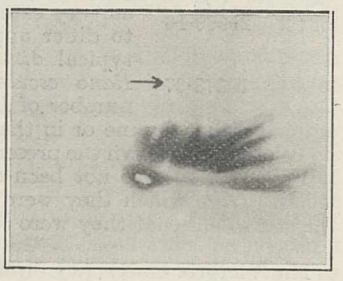

FIG. 2.

By applying a magnetic field it was found that the whole pattern was shifted as shown in Fig. 2. The arrow shows the direction of the force on a positive particle, and its length indicates the distance in the figures that subtends an angle of 0·01 radian. As the blackening of a photographic plate by positive hydrogen canal rays is chiefly due to charged hydrogen atoms, we may conclude that the pattern is caused by the impact of protons. The maximum potential on the discharge tube was approximately 40,000 volts, and a magnetic analysis showed that the positive ions were distributed over a considerable range of energies.

Since the magnetic field does not destroy the lines, we may consider the different points as corresponding to particles of different velocities. A line is thus a velocity spectrum of the protons; or, in terms of wave mechanics, a diffraction spectrum of their equivalent wave-lengths. It is very significant that no undeflected pattern was observed, although neutral hydrogen atoms are present in large numbers in a canal ray beam. The theories of wave mechanics would not at present distinguish between the wave-lengths associated with a proton and a neutral atom of the same velocity.

A. J. DEMPSTER.
Ryerson Physical Laboratory,
University of Chicago, Nov. 26.

Nature of Disease-Producing Viruses.

IT has been pointed out on more than one occasion that, if filterable viruses constitute a group of ultramicroscopic organisms, it is remarkable that no saprophytic forms are known. In NATURE of Aug. 17 last (p. 267), Dr. J. J. Davis questions the validity of this argument, at least in the present state of our knowledge. "Until viruses can be known other than by the effects of their parasitism, it would seem to be quite impossible to detect corresponding bodies that are not parasitic," he says, and "until some method is devised by which the constituents of the virus can be recognised, it would seem to be useless to look for them".

In other groups of micro-organisms, however, numerous forms are known, which, though normally parasitic, are yet facultative saprophytes which can be cultivated on artificial media as well as on their natural host. So far, however, no one has been able to cultivate a virus on an artificial medium. Re-inoculation into the natural host should provide a perfectly valid test for the success of such saprophytic cultivation if it occurred. There is thus a very distinct gap between the viruses and known types of living micro-organisms indicated here.

Again, in the case of the normally saprophytic, bacteria almost on the borders of visibility can be cultivated on solid media, forming colonies visible even to the naked eye. But no colonies which might be considered those of a saprophytic virus have ever been observed on artificial media, whether on agar, gelatine, or silica-gel.

There are other facts which make it difficult to imagine the viruses as a group of micro-organisms of somewhat the type we know in the bacteria or protozoa, only much smaller in size. It would seem preferable, therefore, to keep an open mind for the present on the subject of what a virus really is, and to continue experimental work, rather than to postulate already a "hypothetical intermediate combining molecular structure, metabolism, and reproduction", and to term it a vitamol. In fact it is difficult to see the distinction between *vitamol* and *virus*, and the former term is objectionable in giving a certain definiteness of ideas as to structure which our present knowledge does not warrant.

GEOFFREY SAMUEL.
Waite Agricultural Research Institute,
University of Adelaide,
South Australia.

Some Bands of the Carbon Molecule.

THE spectrum of a condensed discharge in hydrocarbons contains, besides the well-known CH and the Swan bands and some other less prominent bands, a strong system, the structure of which does not seem to have been investigated before. We were able to photograph these bands in the second and partly in the fourth order of a 21-ft. concave grating, and could thus resolve completely the rotational fine structure. The bands have a very strong resemblance to the Swan bands and undoubtedly arise from the same

molecule. The bands investigated fit into the following scheme (wave-lengths of the heads) :

n' \ n''	0	1	2	3
0	*3852·1*	*4102·3*		
1	*3607·3*	*3825·6*	*4068·2*	
	3399·8	*3592·9*		*4041·9*
3		3398·1	3587·7	

The seven bands given by figures printed in italics have been investigated for fine structure. Combination relations prove the correctness of the scheme.

Each band consists of two P- and two R-branches. Alternatively, the red and violet doublet components are missing. This fact, which is very striking even on a rough inspection of the plates, proves that the bands must be due to a symmetrical molecule and that the nuclear spin of the atoms in question is zero. There is therefore scarcely any other possibility but that the bands come from a C_2-molecule, which has also been made responsible for the Swan bands. The lines are sharp and single, and our plates allow us to say with a very high degree of probability that three lines near the origin are missing. The terms can be represented with great accuracy by the usual quadratic formula : const $+B(j+\frac{1}{2})^2-\beta(j+\frac{1}{2})^4$. All these facts show that we have here a $^1\Pi\rightarrow{}^1\Pi$ transition, and we believe that the electron configuration (except, of course, the orientation of the spins) is the same as that of the terms of the Swan bands.

The molecular constants calculated from these bands are very near to those of the Swan bands, but they can be obtained with much greater facility and accuracy because of the simpler structure of the bands. We give here the values of some of the constants. It is possible that the final values, which will be calculated with the help of the complete material, will be slightly different.

	B'	B''	J'	J''	ω_0'
$^1\Pi\rightarrow{}^1\Pi$	1·7732 1·7744	1·6086 1·6081	15·62	17·22	1764·9
$^3\Pi\rightarrow{}^3\Pi$ (Swan bands)	1·750	1·626	15·84	17·03	1752·4

ω_0''	ν_0
1584·2	25969·16
1618·1	19373·87

In this table $B=h/8\pi^2J$, J moment of inertia, ω_0 the difference between the first and the second vibrational state, and ν_0 the origin of the $0\rightarrow0$ band. The constant a which determines the degree of coupling of the orbital moment of momentum to the nuclear axis and therefore the 'σ-doubling' is roughly $5\cdot9\times10^3$ for the initial and $1\cdot3\times10^4$ for the final state.

Full particulars will be published elsewhere.

G. H. DIEKE.
W. LOCHTE HOLTGREVEN.

Natuurkundig Laboratorium der
Rijksuniversiteit, Groningen, Nov. 30.

The Muscular Sense.

IN reference to the note by Prof. Fraser-Harris on the "Subjective Demonstration of the Existence of the Muscular Sense", in NATURE of Nov. 23, I beg to point out that so far from the existence of this sense being demonstrated by the simple experiment he describes, he has really got no further than the indication of the nature of the problem. William James was well acquainted with such evidences, yet he decided that the muscular sense was a "needless encumbrance". My own position is different from both ; the muscular sense, or as I call it, the sense of effort, has an existence, but the affirmation of Prof. Fraser-Harris or the denial of William James has no particular weight, as neither is based on any analysis of a searching character.

The question is not whether a distinct sensation is perceptible in the act of raising the arm, as in the example of Prof. Fraser-Harris, but whether this sensation is determined by, and entirely explained by, the production of the efferent nervous stimulus necessary to activate the muscular system involved.

The question of the sense of effort is one of the most elusive in the whole range of psychology, and I did not find it possible to offer a definite answer until I had completed the analysis which led to the formation of the "Fundamental Processes of the Mind". Once the meaning of these processes is grasped, such problems of psychology become susceptible of solution. A complete explanation on the physical side demands a minute examination of a long series of neurological phenomena.

Nothing of this is suggested by Prof. Fraser-Harris, while on the part of William James, though he had intuitions of the necessity of ascertaining the Fundamental Processes, he has not given us even the beginning of a valid analysis to that effect. Those who are interested will find that analysis set forth with the necessary rigour in my "Principles of Psychology".

ARTHUR LYNCH.

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Occurrence of *Cepedea* in Frogs.

WHILST examining a number of *Rana temporaria* for intestinal protozoa recently, I encountered one single frog infested with a species of *Cepedea* (Protozoa, Ciliata, Opalinidæ). So far as a survey of the available literature has revealed, the only previous record of the occurrence of a species of this genus in *R. temporaria* is that of André (*Rev. Suisse de la Zoologie*, vol. 21, p. 6, May 1913), who reports the occurrence of *Cepedea dimidiata* in frogs of this species obtained in Switzerland.

The species recorded here has not yet been examined in sufficient detail to enable me to state whether it is *C. dimidiata* or not, though a cursory examination has shown it to differ appreciably in size from typical *dimidiata* obtained from *Rana esculenta*. Out of a large number of frogs obtained and examined either by me or in the course of class work, no others have shown the presence of this species ; unfortunately, I have not been able to determine the locality from which they were obtained, apart from the statement that they were collected in England.

W. REES WRIGHT.

The Victoria University of Manchester,
Dec. 16.

The Secondary Split in the Maturation Divisions of Liliaceous Plants.

APPROPRIATE destaining in mid pachytene has disclosed two, and only two, rows of genes ; minute bodies nearly at the limit of microscopical vision. Repeated observations have shown that the sets of four chromioles seen at late pachytene are united in two pairs, like two dumb-bells, one on each side of the primary split. Here the secondary split has not yet been completed. Observations of diplotene in *Lilium*, *Fritillaria*, *Kniphofia*, and *Allium* have proved that there is only one split visible throughout, even at the nodes. Hence I agree with Gelei, who also made an intensive study of the pachytene stage, that the primary split alone opens out at diplotene.

JOHN BELLING.

Carnegie Institution of Washington,
Department of Plant Biology,
University of California,
Berkeley, California, Nov. 13.

The Discovery of Tertiary Man.[1]

By Prof. HENRY FAIRFIELD OSBORN, For.Mem.R.S., Research Professor of Zoology, Columbia University, Honorary Curator of Vertebrate Palæontology, American Museum of Natural History.

THE discovery of Quaternary man was the central biological achievement of the nineteenth century. For twenty-four centuries the largely speculative idea of a natural rather than a supernatural origin of man had been slowly developing through the observations of zoologists and the dissections of comparative anatomists. From the time of Anaximander (B.C. 547), of Galen (A.D. 131), of Leibniz (1700), of Buffon (1755), of Goethe (1790), of Erasmus Darwin (1794), of Lamarck (1809), of Chambers (1844), of Leidy (1847–73) to that of Charles Darwin (1859–71) one bit of evidence after another was added from comparative anatomy, until in the sixteenth century comparative zoology contributed the strong likeness to man of the anthropoid apes—the chimpanzee and gorilla of Africa, the gibbon and orang of eastern Asia. The most significant and prophetic observations in comparative anatomy were those of Goethe in the discovery of a separate intermaxillary bone in the upper jaw of man which both he and Leidy rightly interpreted as linking man with the apes and other primates in which the upper jaw is composed of two bones. Up to 1859, the relatively new science of palæontology had thus far contributed nothing because the female Neanderthal skull of Gibraltar in 1848 and the male Neanderthal calvarium of Germany in 1856 were misinterpreted by Virchow, Huxley, and other anatomists.

I emphasise comparative anatomy and zoology, for as regards *direct* evidence our speculative position toward Tertiary man in 1929 is very much the same as Lamarck's and Darwin's speculative position toward Quaternary man between 1809 and 1871, because we are still largely dependent upon the facts afforded by comparative anatomy and comparative zoology, in the absence of direct palæontological evidence in Middle and Lower Tertiary time. This statement is not true as regards *indirect* evidence, for human palæontology is now in a very strong position even to the very base of Quaternary time, a period estimated by geologists at 1,250,000 years. Fossil human remains of more than a hundred Quaternary individuals have been found, including: *Palæanthropus Neanderthalensis* of Neanderthal, 48+; *Homo sapiens* of Cro-Magnon and Chancellade, 42; 2 of the Trinil race of Java (1891), *Pithecanthropus erectus*; 2 of the Piltdown race, *Eoanthropus dawsoni*; 1 of the Heidelberg race, *Palæanthropus Heidelbergensis*, also 1 and possibly 2 more individuals recently reported by Freudenberg under the name *Hemianthropus*; 27 of the recently discovered Chinese *Sinanthropus Pekinensis* (Schlosser, 1903; Zdansky, 1926; Black, 1927–28).

All these human fossils constitute a firm and broad human palæontology for Quaternary time and the close of Tertiary time. Each generic name, for example, *Palæanthropus*, *Pithecanthropus*, *Eoanthropus*, *Sinanthropus*, and *Homo*, demonstrates an entirely distinct branch of the fossil human families of Quaternary time; each branch is known to palæontologists as a *phylum* and the special scientific analysis of these several branches is termed *phylogeny*. Phylogeny is a relatively new and very important branch of biology, the principles of which were entirely unknown to Darwin (1859–71) and only in part known to Huxley, as they are now revealed by the brilliant and world-wide discoveries by invertebrate and vertebrate palæontologists. My forecast of the Tertiary anatomy and habits of the 'dawn-man' is greatly influenced by our direct knowledge of the phylogeny of other mammals.

As Quaternary fossil man was the central biological contribution of the nineteenth century, so Tertiary man constitutes the goal and peak of biological discovery in the twentieth century. Thus far I have been dealing with well-known facts because these Quaternary fossil men have become household words all over the world. On the other hand, the discussion of Tertiary man carries us into the unknown, into one of the most interesting fields of human speculation and anatomical controversy, into several divergent camps of human opinion and interpretation, along several great lines of comparative anatomy of the principal organs concerned, namely, the brain, the skull and jaws, the limbs, the hands and feet. Both with Lamarck and Darwin the 'ape-men' descent was never more than a working hypothesis based upon the closer approach of the anthropoid apes to man than that observed in any other group, for want of any positive data. Both Lamarck and Darwin postulated a *reversible* evolution in function and structure whereby an animal with all the psychical and anatomical adaptations of arboreal apes could secondarily take on a gradual change of habit and function and gradually enter a new erect career with radical changes in habit and in mind as well as in the anatomy of limbs, hands, and feet. Darwin's starting-point (1871), after picturing as our ancestor a hypothetical ape not far from a primitive Miocene chimpanzee, concluded with the following all-important sentence both as to habit and habitat:

The foot was then prehensile, judging from the condition of the great toe in the fœtus; and our progenitors, no doubt, were arboreal in their habits, and frequented some warm, forest-clad land.

More recently (August 1927), in his presidential address to the British Association, Sir Arthur Keith summed up this hypothesis as follows:

DATE OF MAN'S EMERGENCE.—It is useless to go to strata older than the Miocene in search of man's emergence; in such strata we have found only fossil traces of emerging anthropoids. All the evidence now at our disposal supports the conclusion that man has

[1] Retiring presidential address delivered before the American Association for the Advancement of Science at Des Moines on Dec. 27, 1929.

arisen, as Lamarck and Darwin suspected, from an anthropoid ape not higher in the zoological scale than a chimpanzee, and that the date at which human and anthropoid lines of descent began to diverge lies near the beginning of the Miocene period. On our modest scale of reckoning, that gives man the respectable antiquity of about one million years.

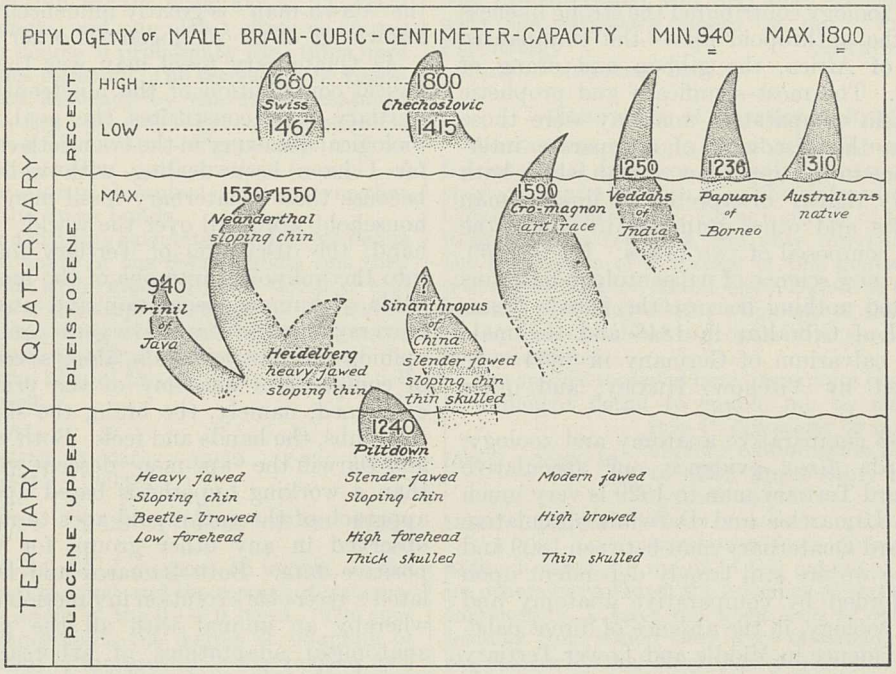
This Lamarck-Darwin working hypothesis has been greatly strengthened and in large measure adopted by an army of human and comparative anatomists including all the leading and most brilliant men of our time, such as Sir Arthur Keith (1927), Prof. G. Elliot Smith (1926–29), Prof. William King Gregory, Dudley J. Morton, and Robert M. Yerkes, as well as by a host of other able but less widely known anatomists. So great has been the force of nearly unanimous adherence to the Lamarck-Darwin hypothesis that it has gained world-wide acceptance even among the most intelligent scientists, as may be seen in passages in two outstanding works of the present decade, Eddington's "The Nature of the Physical World" (1928) and Jeans's "The Universe Around Us" (1929). A parallel instance of the world-wide assumption of a working hypothesis is that of Lamarck's hypothesis of the inheritance of acquired characters as the prime cause of evolution. Although never demonstrated, the Lamarckian hypothesis was universally accepted until Weismann gave it a death-blow in 1880. Such may be the fate of the 'ape-man' hypothesis.

I was myself rather suddenly converted to the opposite 'dawn-man' hypothesis in a roundabout manner. When in 1919, after years of search, the American Museum discovered in Middle Pliocene time the complete skeleton of a horse named *Pliohippus leidyanus*, a perfect horse in all except name and perhaps colour, the bearing of this case of precocious adaptation on human descent flashed across my mind, and before a meeting of the National Academy of Sciences I predicted that the greatest surprise in store for twentieth-century science would be in the discovery of a large-brained Tertiary man! This anatomical prophecy has unexpectedly been confirmed by recent palæontological evidence that *Eoanthropus*, the 'dawn-man' of Sussex, is of Upper Pliocene or Tertiary age.

The large brain of *Eoanthropus* suggests as our first quota of counter evidence a review of our greatly enriched knowledge of the Quaternary fossil brain.

Brain Surprises of Quaternary Discovery.

These surprises arise from the profound researches and independent discoveries of Dubois, Smith Woodward, Boule, Keith, McGregor, Black, Economo, and Lebouco, to which honour roll we should add Frederick Tilney's "The Brain from Ape to Man" (1928). The six outstanding points as to the brain are as follows: (1) that certain races of fossil man of the last 1,250,000 years had a brain cube equal to or greater than that of modern man; (2) that the much despised cave man (*Palæoanthropus*) was inferior to ourselves neither in brain cube nor in hand ability, although far inferior to ourselves in civilisation; (3) that certain of the cave men (*Homo sapiens* Cro-Magnon) were our superiors both in average brain capacity and in average artistic ability; (4) that at the close of Tertiary time there lived a race (*Eoanthropus dawsoni*) with a brain cube equal to the minimum of that of the living Veddahs, Papuans, and native Australians; (5) that the ratio of human brain weight to body weight in Quaternary time was



Photo] [American Museum of Natural History, New York.

FIG. 1.

apparently the same as it is to-day, namely, 1 : 50 (Weber, 1896), in contrast to the anthropoid apes, in which it is as follows :

	Brain to body weight ratio.
Super-arboreal Gibbon of south-east Asia (130 gm.)	1 : 66 or 1 : 73
Arboreal Chimpanzee of west Africa (412 gm.)	1 : 51 or 1 : 61
Super-arboreal Orang of Borneo (400 gm.)	1 : 183 or 1 : 194
Terrestrio-arboreal Gorilla of central and west Africa (565 gm.)	1 : 150 or 1 · 200

(6) as Dietrich has shown, *Pithecanthropus*, the Trinil race of Java, is not an ancestral Pliocene type, as was formerly supposed, but a surviving mid-Pleistocene branch, the companion of a stegodont elephant ; the Trinil brain is a case of arrested development.

The conclusion is inevitable that *the main cubic evolution of the human brain took place during antecedent Tertiary time and not, as we formerly thought, during the Quaternary age of man or Glacial period.*

These six points are supported by the following comparison :

	Brain cube in c.c.
Summit of Quaternary and *Modern* time :	
Homo sapiens, Cro-Magnon of Mentone	1550
Palæanthropus, Neanderthal Caveman, La Chapelle-aux-Saints	1530
Homo sapiens, average modern Swiss	1467
,, ,, average modern European	1450
,, ,, Alpine race of Czechoslovakia	1415
,, ,, fossil Alpine race of Ofnet	1400
,, ,, native Australian race	1310
,, ,, native Indian Veddahs	1250
Mid-Quaternary :	
Pithecanthropus erectus (Trinil man of Java)	940
Summit of Tertiary :	
Eoanthropus dawsoni (Piltdown Dawn Man)	1240
Living Papuans of New Guinea	1236

It is well known that the *brain cube* is not a trustworthy test of brain power or capacity, as Leboucq has recently pointed out in striking examples from recent times :

	Brain weight in grams.
Tourgenieff, Russian novelist	2,012
Cuvier, founder of palæontology	1,829
Byron, poet	1,807
Gambetta, statesman	1,246
Anatole France, littérateur	1,017 (to 1,317)

Doubtless this *cube-versus-intelligence* disparity in brain function also prevailed during the Quaternary age of man, although in the few fossil cases where comparison is possible we note a similar disparity between male and female brain weight.

We must, therefore, adduce collateral and very substantial proof that Upper Tertiary man, whom we may provisionally designate 'the dawn man' after Smith Woodward's well-chosen term *Eoanthropus*, made highly intelligent use of his 1240-1300 cubic brain measurement.

This brings us to the most startling discovery of the twentieth century, the full significance of which we have only recently learned to estimate.

The First Positive Discoveries of Tertiary Man.

Archæologists are still divided as to the human origin of *eoliths*, so that we cannot class these rude flints as positive evidence.

One of the most striking coincidences in the history of human palæontology is that indubitable flint implements of Tertiary man were discovered by J. Reid Moir on the east coast of Anglia in the year 1909, and that in 1911, only two years later, an indubitable human skull and jaw of what proves to be Tertiary man were found in Piltdown, Sussex, by Charles Dawson. It has required eighteen years of research by Moir and Smith Woodward, aided by the most able archæologists and anatomists of the world, to establish the full significance of these epoch-making discoveries of 1909–11. By adding year by year implement after implement from two strata of Upper Pliocene time, J. Reid Moir, originally an amateur collector of Ipswich, has finally overcome all incredulity and even hostility and has thoroughly established the Red Crag and sub-Red Crag strata of the Upper Pliocene coast of Anglia as the site of a widespread and highly varied flint and bone industry, including the 'eagle's beak' (rostro-carinate), 'skin cutter', 'side scraper', 'push plane', 'borer' and 'chopper' and 'piercing tool', all indicating a race of hunters highly adept at flint flaking ; finally, for killing purposes, a perfected 'sling-stone', ranking as a work of Palæolithic art.

All of these artefacts have been confirmed and recently embodied in the Stone Age chronology of Abbé Henri Breuil (December 1929). Breuil not only accepts the Tertiary age but also in his latest paper (December 1929) shifts the entire pre-Chellean and Chellean flint industries from mid-Quaternary down into the base of Quaternary time, namely, into the first Interglacial or Mindel-Riss stage ; this obviously shifts the pre-Chellean and Chellean flint-making design and intelligence down close to Tertiary time—in fact, some of Reid Moir's flints are identical with the Chellean artefacts.

Meanwhile Osborn, by world-wide study of fossil elephants and mastodonts, has firmly established these Reid Moir flint beds as of Upper Pliocene or close of Tertiary time, against the contention of the late Ray Lankester that these flints were early Pleistocene. Scarcely less positive is Osborn's determination, with the aid of Reid Moir, Freudenberg of Heidelberg, Matsumoto, and Bather and Hopwood of the British Museum, that the Piltdown race—*Eoanthropus dawsoni* of Smith Woodward—is of Upper Pliocene Tertiary age rather than of Quaternary age as formerly supposed.

Both the Red Crag of Suffolk and the Piltdown beds of Sussex yield a very primitive species of elephant generally known as *Elephas planifrons* (first discovered (1858) by Falconer in the upper Siwaliks of India), the migrations of which are now traced (Broom) from the Vaal River of South Africa northward into Italy and England, far eastward into India, with absolutely definite measurement and form of the enamelled ridge-plates of the grinding

teeth which in the elephants and mammoths give us *a new and quite dependable means of dating all the fossil man discoveries of Upper Tertiary to recent time.* Upper Tertiary man is thereby shown to have been an elephant hunter, probably for bone and ivory as well as for flesh, more than a million years ago. This discovery also paves the way for the great inter-continental migration routes and the African-Eurasian dispersal of man even in as remote a period as the Upper Pliocene.

In view of the fact now established that even in the Upper Pliocene man was an extremely adept flint worker, with deft hands and fingers guided by an imaginative and intelligent forebrain, it seems probable that Upper Pliocene man, like his companion the Upper Pliocene elephant, was already a nomad and needed long and agile lower limbs as his only means of distant transportation. We are thereby forced to reconsider Darwin's concept of the primitive ape-man as inhabiting a " warm, forest-clad land ".

Travelling Limbs and Tool-making Hands.

Fifty-eight years of incessant zoological and comparative anatomical research have been focused upon the anatomy and embryology of the apes and man to find out the bearing of the recapitulation or biogenetic principle of Haeckel on the ancestral Tertiary hands and feet of man. Recently, Morton (1927), Schultze (1925–29), Straus (1927), Gregory (1925–29), Hrdlička (1928), have devoted special memoirs to this problem, Straus summing up in the paraphrased words : The foot of embryonic man is of a structure unfitted for an upright terrestrial existence. It is in most characters not unlike that of an adult gorilla, although in some respects even more primitive than that of the largest anthropoid apes. The chief point of embryonic resemblance is in what Darwin termed ' the prehensile big toe ', but the palæontologist Matthew (1928) has pointed out that all primitive Eocene mammals, both arboreal and terrestrial, had the big toe well set apart from the others. This stronghold of ' prehensile big toe ' evidence, therefore, carries man far back of the highly specialised anthropoid ape big toe stage and tends to sustain the ' dawn man ' contention that even the embryonic foot of man may date back to the more remote Upper Eocene time.

This contention is even more strongly borne out by the embryonic human hand, in which there is no evidence whatever of having passed an anthropoid ape limb-grasping stage. While the newest analysis of the embryonic hind limbs may leave us in doubt as to a possible case of reversed evolution from the Miocene ape leg to the human stage, the human hand and the human brain, especially in the light of *Eoanthropus* discoveries, seem to dissipate some of the doubts raised by the feet and strengthen the new ' dawn man ' hypothesis of a very remote separation of our running and tool-making ancestors of the plateaux and savannas from the same great stock (Anthropoidea) which independently gave rise to the tree-loving anthropoids of the tropics.

No one should misunderstand the ' dawn man ' hypothesis I have been advocating in a series of papers and addresses since April 7, 1927. I am not ignoring the strong evidence for an Eocene arboreal stage in our ancestry ; I am not ignoring the overwhelming evidence of a remote community origin between man and the anthropoid apes ; I am combating the special feature of the Lamarck-Darwin hypothesis that man once passed into highly specialised arboreal adaptations attained by the Miocene apes ; finally, I am inclined to separate the human stock at a geologically earlier pre-Miocene period of anthropoid evolution. In the geological remoteness of this momentous separation of the ' dawn man ' stock, we are aided by a mass of collateral evidence utterly unknown in the time of Darwin.

This brings us back to the sub-science of phylogeny spoken of above, which, in popular terms, aims at the reconstruction of the family tree of man by principles recently discovered in the family trees of other mammals.

New Principles of Phylogeny applied to Man.

First, we have discovered that the geological period of separation of the adaptively radiating branches in many families of mammals is of an antiquity undreamt of even a few decades ago. Even in Lower Eocene time, all the existing families of hoofed mammals, such as the horses, tapirs, rhinoceroses and titanotheres, had widely separated from each other in tooth, limb, hand, and foot structure. Before the close of Eocene time, these branches were further subdivided into forest-loving and plateau-loving types ; in every branch the forest-loving types were stationary or regressive. Similarly, by the close of Eocene time the mastodont and elephant families are found widely separated into five greater branches (in Oligocene time there were numerous sub-branches and in Miocene time eighteen distinct branches). In the succeeding Oligocene time, we discover a sharp and world-wide division between plateau-loving and forest-loving types ; in the forests remain all the backward conservative types ; on the plateaux and uplands are found the alert progressive forward-looking types, including all the long hind-limbed bipedal animals adapted to rapid progression in an open or partly forested country. It is no exaggeration to say that at the dawn of Oligocene time all the plateau-loving animals are distinctly modernised both in habits and in bodily proportions.

Is it likely that the primates alone escaped this divorce between backward, forest-loving life and forward, plateau, savanna and upland life, especially as Eocene forest areas in every continent began to contract and upland open plains and plateaux began to expand ?

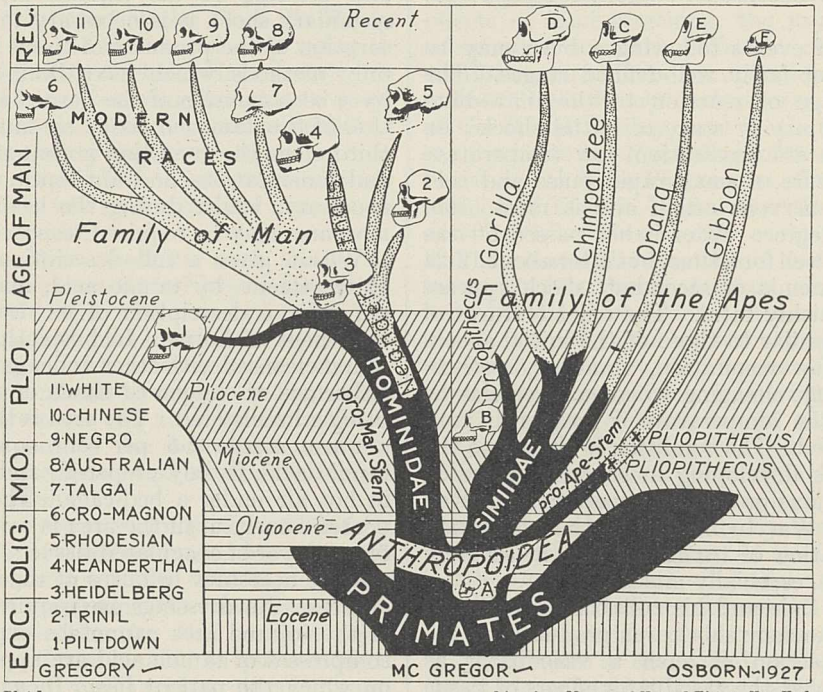
A second principle of modern phylogeny is that every ancestral stage, whether of horse, rhinoceros, or elephant (the three kinds of animals I have most intensively studied for the past thirty years), preserves the hundred per cent *structural equipment* for giving rise to its more recent or modernised descendants ; each branch has the potentiality of the remotest twigs of descent. Through change of function Nature may transform an organ, but it

can never restore a single lost part, whether it be a lost tooth, a lost digit, a lost ankle bone or rib, a lost tendon or nerve. This is Dollo's principle that *the evolution of anatomical organs is never reversible even though the evolution of functions and habits is frequently reversible.* On this principle the human hand could never reacquire the nerves, muscles, functions, freedom, flexibility, and separate innervation lost in the highly specialised arboreal ape hand; the opposable human thumb could not spring back from the partly atrophied anthropoid ape thumb. Our quadrupedal ancestors certainly had a forefoot capable of developing into the human hand with its long flexible fingers separately innervated and its thumb which, as Erasmus Darwin postulated, could reach the tip of each finger in turn, all depending upon separate innervation from special cell centres in the spinal cord and brain. Primitive man is not only a tool-making animal, he is also a music-making animal; consider 'Blind Tom', the negro musical genius of his day, who not only possessed an excellent finger technique but also a marvellous musical memory that enabled him after a single hearing to repeat elaborate piano compositions. In this human hand connexion let us recall also the researches of Sir Richard Paget in advocating the gesture origin of human speech, as gesture demands flexible fingers.

Third, to this hundred per cent structural equipment of our remote ancestors phylogeny adds a hitherto unperceived germinal potentiality of specialisation along certain predetermined directions rather than others in adaptive reactions to changes of environment; this *teleogenesis* rests upon thousands of observations among primates, horses, titanotheres, and elephants which prove that parallel anatomical and psychical progress is traceable to germinal community of origin. The psychic resemblances of the apes to man are partly parallelisms, partly common inheritance (Yerkes). Teleogenesis is not to be confused either with the old 'teleology' nor is it a revival of a hypothetical vitalism or internal perfecting tendency.

Finally, and perhaps from glandular impulses (Keith), phylogeny proves that independent of selection, of environment, of habit, certain phyla exhibit rapid or accelerated physical and mental adaptation, while others are held back. The creative brain, the tool-making hand, the fleet hind limb of man apparently combine in accelerated adaptation, while forest-loving primates advance much more slowly.

Does not this unbiased survey of recent discoveries in archæology, human and comparative palæontology, human and comparative anatomy, compel us to reconsider the classic Darwin-Lamarck hypothesis and to substitute a new hypothesis? The new hypothesis carries us into a geological antiquity hitherto undreamt of. Anthropology is forced to share with chemistry and physics entirely new notions of space and time. To my mind, the human brain is the most marvellous and mysterious object in the whole universe, and no geological period seems too long to allow for its natural evolution.



Photo] [*American Museum of Natural History, New York.*

FIG. 2.—Osborn's present theory of the ascent and phylogeny of man.

Left: Family of man (Hominidæ), dividing into the Neanderthaloid and modern racial stocks; present geological location of the Piltdown, Heidelberg, Trinil, Neanderthal, and Rhodesian fossil races. Right: Family of the apes (Simiidæ), including the Pliocene and Miocene dryopithecoids nearest the ancestral stock of the Anthropoidea, also the lines leading to the gorilla, orang, chimpanzee, and gibbon. Below: Anthropoidea, the common Oligocene ancestors of the Hominidæ and of the Simiidæ.

The Tannic Acid Treatment of Burns.

BURNS or scalds of relatively small areas of the body frequently have a fatal ending, especially in children, so that any method of treatment which will reduce this mortality requires careful examination and adoption if proved successful. In 1925, E. C. Davidson described a method of treatment by means of tannic acid which he had found reduced the mortality from these injuries, and the treatment has been put to a critical test by W. C. Wilson in the wards of the Royal Edinburgh Hospital for Sick Children and the Royal Infirmary, Edinburgh, with the result that the mortality has been reduced to little more than a quarter of that observed in another comparable series of cases.[1]

The course of events following a burn may be divided into four fairly well-defined stages. The first is the stage of reaction to the immediate effects of the injury or stage of initial shock; its clinical features are prostration, low temperature and blood pressure, a small rapid pulse and cold skin. It is of nervous origin and is most often only slight in degree. After it has passed off the patient appears well for a time, but after about 12-24 hours acute toxæmia or secondary shock appears and may be quickly fatal. The chief features of this stage are similar to those of the initial shock, but rapid shallow respiration, vomiting, restlessness, and anxiety, changing to coma, may also be observed, and the temperature is frequently considerably elevated. The condition is similar to the secondary shock developing in severely wounded patients, which was proved by experiments carried out during the War to be due to the absorption into the circulation of toxins set free in severely damaged tissues, especially muscle.

The work of Dale and his collaborators showed that typical secondary shock was produced by the intravenous injection of such a vasodilator as histamine, and that the vasodilator effects of tissue extracts could be matched by the injection of histamine and choline together. The isolation of histamine from muscle by W. V. Thorpe (*Biochem. Jour.*, vol. 22, p. 94; 1928) was the final confirmation of these experiments, whilst the work of Lewis and his collaborators showed that the responses of the skin of man to injury and to the injection of minute doses of histamine were identical. It may be considered as certain that secondary shock is due to the absorption into the blood stream of some substance which is formed at the injured area itself; Wilson suggests that it is probably a product of protein lysis; it may quite possibly be histamine itself.

The third stage is that of septic toxæmia and is only well developed clinically when there is severe infection of the injured area. The fourth and final stage is that of healing, and its duration depends largely on the depth of the lesion. First and second degree burns heal quickly and without the formation of scar tissue; in the third degree lesions the surface becomes covered with granulations over which the epithelium grows, leaving a supple and greyish-white scar: in deeper burns, or where sepsis has been a prominent feature, scar tissue development is more marked, and owing to its subsequent contraction, deformities and disabilities may follow.

Each of the four clinical stages requires its own treatment. For a slight degree of primary shock no special treatment is necessary, but where it is severe, morphine should be given, artificial heat applied, and fluids administered. Local treatment is begun at the same time and involves cleansing and dressing of the injured area. To prevent secondary shock it is necessary to prevent the absorption of the products of tissue breakdown: the only methods which have been at all successful have been excision of the burned area and coagulation of the damaged tissue by tannic acid. In the third stage the condition is that of a septic wound and fomentations and antiseptic dressings will be necessary, whilst during the healing stage special measures may be required to prevent contraction.

Wilson gives a full description of the method of treatment by tannic acid, and includes in an appendix a description of its use in the first aid treatment of burns. In hospital the burned area is first cleansed with ether under general anæsthesia, either gas or oxygen (if shock is marked) or ether being administered. The area is then sprayed with a warm sterile 2·5 per cent aqueous solution of tannic acid, freshly prepared, and the parts dried in hot air under a bed-cage. The spraying is repeated hourly until the area is covered with a firm brown layer of coagulated tissue: 8-12 applications may be necessary in burns of the second and third degrees. No dressings are required: if the whole of the injured area cannot be exposed to the air, compresses of tannic acid are applied to the parts on which the patient lies. In most cases the coagulum is left until it peels off, leaving either a healed area or healthy granulations according to the depth of the burn. In no circumstances should a moist dressing be applied, since this procedure results in the appearance of toxic signs and symptoms.

In this study 117 children were treated by the tannic acid method between November 1925 and January 1929. The mortality was 11·1 per cent, or in 105 children under ten years of age 10·5 per cent. In 300 cases under ten years treated by other methods, the mortality was 38·7 per cent. The percentage distribution of the mortality over the first three stages was, in the present series, 30·8, 23·8, and 23·8, and in the previous series 2·5, 80, and 15 respectively. Thus the tannic acid method of treatment controls the acute toxæmia of the second stage, and by reducing the mortality due to it, brings into greater prominence the fatalities which occur at other stages: and in some instances these deaths were not directly connected with the injury.

Besides reducing mortality, the treatment lessens

[1] "The Tannic Acid Treatment of Burns", by W. C. Wilson. Medical Research Council; Special Report Series, No. 141. Pp. 34. (London: H.M. Stationery Office, 1929.) 1*s.* net.

the severity of the symptoms at all stages and promotes rapid healing: at the same time it permits of the recovery of patients with involvement of a considerable area of the body surface. Previously it was considered that burns of 30 per cent of the body surface in an adult and of 11-12 per cent in a child were almost certain to prove fatal. From the results obtained in this series of cases it may be concluded that involvement of more than 60 per cent of the surface in children will cause death from shock in a few hours: when between 35 and 60 per cent of the surface is affected, the outcome depends mainly on the degree of sepsis which develops and therefore on the depth of the lesion. With less than 35 per cent of the surface involved the prognosis is good, provided treatment is begun within a few hours of injury.

The results of this method of treatment have been so successful in the hands of Davidson and Wilson that it is to be hoped that many other clinicians will try it out and find it equally satisfactory.

Obituary.

Sir Henry Jackson, G.C.B., K.C.V.O., F.R.S.

THE death of Admiral of the Fleet Sir Henry Jackson on Dec. 14 has caused deep regret in both naval and scientific circles. His courtesy, his charm of manner, his unswerving devotion to duty, and the sweet simplicity of his nature endeared him in an extraordinary degree to all with whom he came into contact. The recollection of their association with him will be a treasured memory to many throughout their lives.

Henry Bradwardine Jackson was born at Barnsley in 1855 and entered the Navy in December 1866. During 1878 and 1879 he served on the African station and took part in the Zulu War. On returning to England he was appointed to the *Vernon*, where he qualified as a torpedo-lieutenant and remained there three and a half years. About this time he was sent by the Admiralty to study torpedo design and construction at the Whitehead establishment at Fiume.

In 1891 the Navy was seeking some means by which a torpedo boat could announce her approach to a friendly ship, and the idea first came to Sir Henry Jackson of employing Hertzian waves as a means of communication for this purpose. He was then at sea and was unable to put his ideas into a practical form until in 1895, when in command of the *Defiance*, he read of some experiments by Dr. (now Sir Jagadis) Bose on coherers. Having obtained a satisfactory coherer, he managed in this year to effect communication by electromagnetic radiation from one end of his ship to the other. During the next two years he continued his experiments with increasing success. On Sept. 1, 1896, he first met Mr. Marconi, and the two pioneers of radio-telegraphy kept in close touch and gave each other much mutual assistance until Sir Henry Jackson was appointed Naval Attaché in Paris early in 1897.

In 1899 Sir Henry Jackson was appointed to command the *Vulcan*, and in 1900 wireless telegraphy received definite recognition in the Navy, a contract being placed with the Marconi Company for the supply of installations to a number of His Majesty's ships. The new means of communication was employed with considerable success in naval manœuvres in that year. From this time to his promotion to flag rank in 1908, Sir Henry Jackson remained generally responsible for the development of radio-telegraphy in the Navy. His own researches were mainly on the lines of improving methods of tuning and the study of the effects of land screening, the interference of atmospherics, and the influence of meteorological conditions on radio communications.

In 1901 Sir Henry Jackson was elected a fellow of the Royal Society, and in the next year communicated to the *Proceedings* of the Society a paper entitled "On Some Phenomena affecting the Transmission of Electric Waves over the Surface of Sea and Earth". This is now a classical paper and well illustrates the careful and methodical manner in which Sir Henry Jackson always made and recorded his observations. In modern radio research, in particular on wave propagation, much attention is given to the results of the mutual interference of several waves arriving at a point with various phase differences. In this connexion it is interesting to note that Sir Henry Jackson observed the zones of weak signals; for he wrote: "This phenomenon manifests itself by the gradual weakening and occasionally by the total cessation of signals, as the distance of two ships increases, up to a certain point, and their reappearance as the distance is further increased". He went on to say that he considered this effect was due to want of synchronism in the oscillatory discharge between the spark balls of his transmitter, so that there was a change in frequency between the successive discharges of the transmitter. This, he pointed out, would produce successive oscillations out of phase with each other which would at one point annul each other, while at a further distance they would reinforce each other.

In 1905, Lord Fisher, under whom Sir Henry Jackson had served in the Mediterranean, appointed him Third Sea Lord and Controller. In this post his scientific qualifications made him specially suited to take charge of the application of science to the practical work of the Fleet at a time when the design and equipment of warships were undergoing rapid development and improvement.

At the beginning of the War, Sir Henry Jackson was retained at the Admiralty, working in conjunction with the War Staff, and was appointed First Sea Lord on May 23, 1915, when Lord Fisher left the Admiralty. He held this high office until December 1916. During this period he worked n complete harmony with Lord Jellicoe, and the foundations were laid for various schemes for fighting the submarine menace, including the raid

on Zeebrugge, which were to be brought to fruition later. During Sir Henry Jackson's period of service as First Sea Lord the Battle of Jutland was fought. In this connexion it is interesting to notice the faith he always had in wireless methods. During the discussion at the Institution of Electrical Engineers of a paper by Capt. Round on radio direction-finding, he revealed that the evidence which finally convinced him that the German High Sea Fleet was really coming out was the observation made by a radio direction-finding station of a change of bearing of 5° in the position of a German battleship.

After rendering invaluable service to the nation, Sir Henry Jackson was promoted Admiral of the Fleet in 1916. From April 1917 to July 1919 he had the honour of serving as First and Principal Aide-de-Camp to the King. He retired from the Navy in July 1924.

In 1920 the Lord President of the Council appointed Sir Henry Jackson as the first chairman of the Radio Research Board of the Department of Scientific and Industrial Research. At the time of the formation of the Board the rapid development of radio communications had caused technical application to outstrip fundamental knowledge of the subject. The taking up once more of the scientific aspects of radio-telegraphy was a task which was completely congenial to Sir Henry Jackson. Under his guidance, more than one hundred important papers have been published dealing with such subjects as the propagation of waves, the nature and origin of atmospherics, radio direction-finding, and the measurement of electrical quantities at high frequencies. It is characteristic of him that although he gave his personal attention to the work described, yet he never desired to claim personal scientific credit for any of the results obtained. His helpful and kindly criticism, and his generous spirit, had the inevitable result of creating feelings of the utmost devotion in the staff whose work he supervised. In 1926 the Royal Society awarded him the Hughes medal in recognition of the high merit of his work. This honour gave him very great gratification.

In addition to supervising the work of the Radio Research Board, Sir Henry Jackson did much private experimenting. With apparatus of his own design and manufacture he carried out pioneer work on the reception of short waves. Some of his most striking results in this connexion were referred to by him in a contribution to a discussion arranged by the Royal Society on the electrical state of the upper atmosphere.

Sir Henry Jackson was secretary, and later chairman, of the British National Committee on Radio-Telegraphy formed a few years ago under the auspices of the Royal Society, in connexion with the International Union for Scientific Radio-Telegraphy. His contributions to the meetings of the general assemblies of the Union had the result of placing British prestige in the scientific aspects of radio-telegraphy on a very high level.

In 1890 Sir Henry Jackson married Alice, daughter of Mr. S. H. Burbury, F.R.S. The Burbury family were also pioneers in radio-telegraphy, and many early experiments were carried out by them and Sir Henry Jackson in the grounds of their house in Yorkshire.

Sir Henry Jackson was a member of the Institution of Electrical Engineers, honorary vice-president of the Institution of Naval Architects, honorary D.Sc. of the Universities of Oxford and Leeds, honorary LL.D. of the University of Cambridge, and vice-president of the Seamen's Hospital Society. He was created K.C.V.O. in 1906, K.C.B. in 1910, and G.C.B. in 1916 on his retirement from the post of First Sea Lord.

MR. P. H. HEPBURN.

PATRICK HENRY HEPBURN was born in 1873 and educated at Charterhouse and at Amersham Hall School near Reading. He obtained a First Class Honours for the London LL.B. degree and followed his father's profession as a solicitor. He was a man of many interests. In 1902 he made a large collection of photographs of Norman churches round Caen to test a theory that the Gothic cross vault was a development of the Angevin dome. Before the War he was fond of boating and swimming, and bicycled all over England and Scotland and large parts of France and Belgium. Until recently he frequently bathed in the middle of winter in the Serpentine. He would take lonely walks over mountains and fells at night, and only two years ago was found in an exhausted condition and taken to a neighbouring inn. This pursuit led to the accident which caused his death. Walking by night in the Lake district, he fell into a river and apparently struck his head on a rock and was drowned. During the War his adventurous spirit led him to join the balloon section of the Naval Air Service. An exciting incident occurred on one occasion. Going up at Richmond to a 'blimp' stationary balloon with a mechanic to make some repairs, they were caught by a line squall and the balloon was torn from its moorings and turned completely over. The occupants managed to hold on; the balloon righted itself and came down safely in Suffolk. He served in East Africa, where he was disappointed in not being able to climb Kilimanjaro, and afterwards in the Mediterranean. In Gibraltar he was a friend of the padre and used his library to learn Hebrew.

Mr. Hepburn's interest in astronomy began in the early 'nineties with the purchase of a 3-inch telescope. He was interested in eclipses and went to Vadso in 1896, to Spain in 1900 and 1905, and to Normandy in 1912. In 1914 he went with the Greenwich observers, Dr. Jones and Mr. Davidson, to Minsk. He was a great help to them in all ways, especially as, owing to the outbreak of war while the observers were in Russia, they were deprived of other assistance which had been promised. In 1927 he observed the eclipse with Dr. Merton from an aeroplane.

Mr. Hepburn took charge of the Observatory of the Hampstead Scientific Society at its opening in

1910 and showed Halley's Comet to many people. He was always helpful to amateur astronomers and never spared time or trouble when he could assist them. He joined the British Astronomical Association in 1896, and took an active part in the meetings from 1912 onwards, contributing numerous papers. He served on the council for many years and was director of the Saturn Section. He was president in the years 1921–2 and 1922–3, giving addresses on "The Masses, Densities, and Surface Brilliancies of Stars", and a brief summary of the history and recent developments of astronomy. He was on the Council of the Royal Astronomical Society and treasurer for the year 1927. In 1911 he purchased a 13-inch reflector and made numerous observations of the surface features and rotation of Saturn. He was a most energetic observer, and when a larger telescope than his own was required would come on Sunday nights to Greenwich and use the 28-inch refractor, for which he was well qualified by his remarkably keen sight. He would sometimes sit up the whole night, and go to his office in the morning and do his regular day's work, apparently without feeling any effects. He was extremely modest about his astronomical work. He had a large circle of friends among astronomers, who are deeply grieved by his sudden death, and wish to convey to his widow and children their respectful sympathy. F. W. D.

WE regret to announce the following deaths:

Dr. R. Wilfred Balcom, chemist in charge of food control of the Food, Drug, and Insecticide Administration of the U.S. Department of Agriculture, on Oct. 17, aged fifty-one years.

Prof. Ludovico Marini, professor of terrestrial physics in the Universities of Rome and Naples and author of many papers on the climatology of the Mediterranean, on Oct. 6.

Dr. Jan Metzelaar, of the University of Michigan Museum and fisheries expert of the Michigan State Department of Conservation, on Oct. 4, aged thirty-seven years.

Prof. P. J. White, professor of zoology in the University College of North Wales, Bangor, and director of the Puffin Island Biological Station, on Dec. 26, aged sixty-seven years.

News and Views.

ONE of the realisations which have crept into the biological thought of the last decade is that the starting points of the main groups of animals are far more remote in time than had been supposed; and what is true for the great phyla would seem also to be true for many lesser stocks. Since the ancestral forms of present-day families of hoofed mammals had already attained the characteristic specialisations of their kind in Lower Eocene times, how much more remote must have been the critical point where the common history of the ungulates began. Struck by this and other recent discoveries in the principles of phylogeny, Prof. Henry Fairfield Osborn has re-examined the story of the origin of man in the new light, and has summarised his conclusions in an address delivered at the close of the year to the American Association for the Advancement of Science, under the title, "The Discovery of Tertiary Man". The address, which appears elsewhere in this issue of NATURE (p. 53), will be welcomed, since it clearly defines Prof. Osborn's position, and must remove the misconceptions to which some of his pronouncements have given rise amongst those anxious to regard every scientific dispute as a nail driven into the coffin of man as a product of evolution. He states his case in a nut-shell: "No one should misunderstand the 'dawn man' hypothesis I have been advocating in a series of papers and addresses since April 7, 1927. I am not ignoring the strong evidence for an Eocene arboreal stage in our ancestry; I am not ignoring the overwhelming evidence of a remote community origin between man and the anthropoid apes; I am combating the special feature of the Lamarck-Darwin hypothesis that man once passed into highly specialised arboreal adaptations attained by the Miocene apes; finally, I am inclined to separate the human stock at a geologically earlier pre-Miocene period of anthropoid evolution."

THE study of prehistoric man himself, thanks to many discoveries, has made great strides in recent years. Fossil remains of more than a hundred Quaternary individuals have now been found, and they show indubitably that in size of brain (apart from the arrested development of the Trinil man of Java) Quaternary man equalled or exceeded modern races of mankind. The suggestion clearly is that the early development of the brain of modern man must be looked for in deposits earlier than Quaternary. Prof. Osborn traces the evidences which point to the existence of Tertiary man; the presence of artefacts in the Upper Pliocene strata of the Red Crag and sub-Red Crag; the actual discovery of the Piltdown man, whose association with *Elephas planifrons* indicates his Upper Tertiary origin; and the indirect evidence of the embryonic structures of foot and hand, which carry man far back beyond the specialised anthropoid apes of the present day. Prof. Osborn is almost overwhelmed by the results of his consideration, for he concludes: "To my mind, the human brain is the most marvellous and mysterious object in the whole universe, and no geological period seems too long to allow for its natural evolution". The real conclusion is, not that infinite time must be postulated, but that we have still much to learn about the processes of natural evolution. However that may be, we can agree with Prof. Osborn that as the discovery of Quaternary man was the central biological achievement of the nineteenth century, so the running down of his Tertiary forbears is likely to be a triumph of the twentieth.

DURING 1928 abundant evidence that orang-utans were being captured and exported on an unprecedented scale from Sumatra, one of their two island strongholds, aroused concern lest this interesting and

scarce anthropoid ape should be exterminated. The capture was illegal, for already in 1924 and 1925 the Government of the Netherlands East Indies had declared it to be a punishable offence to hunt, catch, kill, or to possess or to keep, either dead or alive, the orang-utan within the whole area of the colony. But the law was difficult to enforce, especially in face of the demand abroad for living specimens and the large prices which were being offered. The wholesale exports of 1928, however, brought the matter to a climax, and widespread protest was made by naturalists and scientific societies in Great Britain against the obnoxious trade. We are pleased to be able to report that the agitation on behalf of the orang has had a successful issue. From the *Times* of Dec. 31 last we learn that Lord Passfield, Secretary of State for the Colonies, in reply to a dispatch sent from Sir Hugh Clifford before he left Singapore, has approved the introduction of legislation to prohibit the importation of orangs into the Straits Settlements and the Federated Malay States. The question was taken up at the request of the Netherland Indian Government, and Sir Hugh Clifford and his executive council agreed that British Malaya might properly co-operate with the Government of the Netherlands East Indies to prevent the extinction of the species. Now that the approval of the Colonial Office has been given, a Bill will speedily be introduced to make the agreement effective.

THE New Year honours list contains the names of the following men of science and others associated with scientific work :—*Baronets* : Sir Gregory Foster, who has just retired from the post of Provost of University College, London, and was recently Vice-Chancellor of the University ; Sir Eustace Tennyson-D'Eyncourt, at one time Director of Naval Construction, Admiralty. *K.C.M.G.* : Lieut.-Col. Andrew Balfour, member of the Colonial Advisory Medical and Sanitary Committee and Director of the London School of Hygiene and Tropical Medicine. *Knights* : Prof. T. P. Nunn, Principal of the London Day Training College, and professor of education in the University of London ; Mr. Archibald Page, Chief Engineer and Manager of the Central Electricity Board and a past president of the Institute of Electrical Engineers ; Mr. Alexander Rodger, Inspector-General of Forests, Government of India ; Prof. T. Zammit, Curator of the Museum, Malta. *C.I.E.* : Mr. B. C. Burt, Imperial Council of Agricultural Research, India ; Mr. H. L. Newman, Chief Conservator of Forests, Bombay ; Mr. S. Walker, Chief Engineer and Secretary for Irrigation, North-West Frontier Province, India. *C.B.E.* : Prof. J. S. S. Brame, professor of chemistry and metallurgy, Royal Naval College, Greenwich ; Mr. G. E. S. Cubitt, lately Conservator of Forests, Straits Settlements and Federated Malay States ; Capt. A. T. A. Dobson, Assistant Secretary, Ministry of Agriculture and Fisheries. *O.B.E.* : Mr. Joseph Jones, formerly Curator of the Botanic Gardens, Dominica ; Mr. W. A. S. Lamborn, medical entomologist, Nyasaland Protectorate ; Capt. R. N. Liptrot, principal technical officer, Air Ministry ; Mr. W. R. Mustoe, Superintendent of Horticultural Operations, Delhi ; Dr. E. S. Russell, Director of Fishery Investigations, Ministry of Agriculture and Fisheries. *M.B.E.* : Mr. John Aikman, Assistant, Royal Botanic Gardens, Kew ; Mr. E. A. Bearder, technical adviser, Dyestuffs Advisory Licensing Committee ; Mr. A. A. Gomme, Librarian, Patent Office, Board of Trade.

THE French Society of Chemical Industry holds its annual meetings alternately in France and a foreign country ; since foreign participants are invited, the meetings rank as congresses. Last year's meeting, held at Barcelona in October, was attended by some 270 French and 400 Spanish chemists, and altogether about 17 foreign countries were represented. The opening address was delivered by Prof. H. E. Armstrong under the title : " Structure moléculaire. La vie et la couleur. Pensées allégoriques d'un chimiste en Espagne." In a recent issue of the *Journal of the Society of Chemical Industry* (Dec. 13, 1929, p. 1198) Prof. Armstrong records some interesting ' afterthoughts ' on the congress. For example, in the course of a journey across Andalusia, from Seville to Granada and back to Cordova, he was impressed by the innumerable rows of olive trees covering the hills. " The labour entailed in plucking the fruit must be enormous —the industry can only be possible in a country where the cost of living is very low. Travelling hour by hour through such country, the chemist, if taking notice, can but wonder how so modest looking a tree does the trick of making oil. . . . Heaven save us, however, from ever manufacturing the oil synthetically and so destroying the peace of mind and rational occupation of multitudes of happy beings engaged upon healthful work consonant with their intelligence. Our modern lust to manufacture must be curbed."

A VISIT to the cathedral at Burgos was the immediate cause of a train of reflections which Prof. Armstrong expands under the text : " We too must build our Cathedrals with utmost magnificence and make them full of clear meaning ". He regards it as the province of the man of science to proclaim the infinite wonder and glory of the cosmos and to provide for humanity a living soul, rather than to follow the cult of the world, the flesh, and the devil. " Saints enough we already have to range in effigy behind many altars—the story of whose wondrous deeds and prophetic powers may well be told in ways to evoke interest and thankfulness even in the masses. Why should we not have our Columbus, our Darwin, our Liebig, our Pasteur, our Volta day ? A full calendar of saints who have rendered worshipful service to mankind and set worthy example? Decorative work would be found for artists in every direction : a new era would arise from our action ; music would flourish and all the arts. Unless and until science become thus militant, we shall be little more than slaves of society, mere mechanics. Unless scientific workers take constructive action, there will be little or no moral progress ; nay, worse, our civilisation may go under. There is grave danger that the Churches of to-day may lapse into the hands of the ignorant, as knowledge spreads and the more intelligent can no longer follow their doctrines." Like Kekulé, the doyen of British chemistry has learnt to

dream ; and his waking thoughts, always interesting, are often provocative. The views upon synthesis, religion, and other matters which he unfolds in this contribution will perhaps be held by the orthodox to bear the taint of heresy ; nevertheless, they are bound to meet with a good deal of general sympathy and to stimulate thought and discussion.

THE Empire Marketing Board has appointed a Committee to advise on the " Infestation of Stored Products by Insects and Fungi ", of which the membership is as follows : Mr. E. M. H. Lloyd (chairman), Mr. H. Brown, Dr. E. J. Butler, Dr. P. A. Buxton, Mr. J. C. F. Fryer, Mr. F. Laing, Mr. T. W. Macara, Dr. J. W. Munro, Dr. J. G. Myers, Mr. H. C. Sampson, Prof. V. H. Blackman, Mr. W. S. Thomson (secretary). By a series of grants made to the Imperial College of Science and Technology, the Board has enabled the College to establish at Slough a station for the conduct of research on the infestation of stored products. This work is under the direction of Dr. J. W. Munro, assistant professor of entomology in the College, and has been planned along lines similar to those laid down in the Tenth Report of the Royal Society (War) Committee on Grain Pests for the continuance of the work on grain pests which it had begun, but which terminated shortly after the conclusion of the War. Thus, the work is considered as comprising three main activities : survey or intelligence work, biological and mycological research, and the application of research results to the control of insects and moulds. The survey or intelligence work is carried out mainly at the London docks, with occasional work at Bristol and Liverpool. The biological and chemical research work is carried out at the Biological Field Station at Slough, but the application of results to practice has not yet been carried out except on a small scale, because, as is obvious, successful application requires fuller knowledge than can be obtained in the short space of time during which work has been in progress. For the present, the research in progress is concentrated on cacao, copra, and dried fruits, but other products are also receiving attention, and the whole field of stored products in entomology and mycology will be explored as time and opportunity permit.

SIR HUBERT WILKINS has made further discoveries in Antarctica to the south of Graham Land. In a recent dispatch to the *Times*, he describes how he launched his aeroplane from the research vessel, *William Scoresby*, to the west of South Graham Land. The first attempt on Dec. 28 was a failure owing to a heavy snowfall obscuring visibility and necessitating a return. Three days later a start was made from the ship at the edge of the pack-ice 115 miles from the nearest land. The exact location is not given. Charcot Land was found to be an island, as was expected, and the monoplane continued to the westward along Hearst Land, charting a new stretch of the coastline of Antarctica for about three hundred miles. A later dispatch from the expedition records a severe earthquake at Deception Island on Jan. 3. The aeroplanes of the expedition escaped damage.

CONSIDERABLE progress has been made with electrical heating during recent years, although the cost of electrical energy is higher than the cost of solid and liquid fuels. In many cases the advantages of cleanliness, convenience, and efficiency more than outweigh the increased cost. Some of the London supply companies charge only a halfpenny per unit when the supply is used purely for heating or power. This charge could be considerably reduced if the limitation that the supply must be continuous were removed. Continuous availability necessitates that any such supply must bear its proper proportion of the overhead charges of the power system. If this supply were confined to the ' off-peak ' hours only, the load on the station would be more constant and an appreciable reduction in the price could be made. In a paper read to the Institution of Electrical Engineers on Dec. 19 on the heating of buildings electrically by means of thermal storage, Colonel Monkhouse and Mr. L. C. Grant described practical installations where this method has been adopted. Water contained in tanks suitably lagged so as to have high thermal insulation is heated during the ' off-peak ' hours, which are usually a few hours on either side of midnight, and the heat is retained for use until the next heating period comes. They laid stress on the fact that buildings which are to be heated in this way can be built without flues or smoke stacks. Figures were given showing the saving this effects in capital costs in certain cases. At Carliol House in Newcastle, the estimated annual cost for heating by coke in a normal winter was £1882, and for heating electrically it was £1904. In the latter case a saving on the capital cost of £2000 could have been effected by having no chimneys. This is not taken into account in the estimate, neither is the fact that the capital cost of the electrical installation is very high owing to the duplication of all the plant.

THE design of pendants and fittings for lighting rooms is gradually undergoing a change. The general public are becoming accustomed to the new systems which are exemplified in modern kinematograph practice and in stage decoration. A. B. Read, in the *Electrician* for Dec. 27, points out that tubular forms of lighting have developed from the use of tubular and ' striplite ' lamps. The greatest use has been made of this system of lighting in Germany, where fittings of one tube, long lines of tube and groupings of tubular shapes have been employed with conspicuous success. Double-ended ' striplite ' lamps of large diameter are common in Germany. They can be mounted cheaply and produce a pleasing effect. In the old days, electric light fittings were often made to resemble a flower ; now more simple and direct designs are used. In modern life, rooms are not decorated to last as long as a life-time. It would be advantageous to devote some of the money expended on redecoration to obtain effective decorative lighting. Lighting from large surfaces and panels has been used fairly extensively recently, but a good deal of the interest of the lighting is lost by not having a fitting as a definite source of light. Indirect lighting often fails to produce the pleasure that a well-designed fitting does. A well-designed modern fitting consists of

four vertical tubes of light with a black mirror centre tube. Another consists of three cylinders of glass, the metal-work being practically concealed.

IN the next century commentators will scarcely fail to remark on the fact that in the nineteenth and twentieth centuries, cultivated and intelligent people remained apathetic towards the pollution of the atmosphere by smoke. They will note the display of resistance, active and passive, towards this hygenic reform, characteristic of slum dwellers, yet exhibited by even the most refined who would never tolerate the least defect in sanitation, public and domestic. That reform is in train can scarcely be denied, and one sign is the appearance of a quarterly periodical, *Clean Air*, issued by the National Smoke Abatement Society, 25 King Street, Manchester, for an annual subscription of 2*s*. 6*d*. This reveals the existence of a body of opinion interested in a wide range of activities. The first number brings to notice various technical aspects of the question, the use of gas, electricity, smokeless fuels, and smoke-reducing accessories to plant. A section reporting activities in the municipalities brings to light differences in the stages of advancement of public opinion. Some have already in being regional smoke abatement committees, while some of these are in process of formation. In the West Riding of Yorkshire such a committee is setting up a scheme of training for stokers and an examination board for their certification. The advantages of bringing these activities into a common focus is undeniable.

THE Society for Experimental Biology held a conference at the new building of the London School of Hygiene and Tropical Medicine on Dec. 20 and 21, 1929. A number of interesting papers were read, including studies on reflex movements in the scallop, by Dr. A. D. Ritchie ; the production of formaldehyde during photosynthesis, by Dr. M. C. Pratt ; the action of acriflavine on the Protozoan *Bodo caudatus*, by Dr. Muriel Robertson ; differentiation and growth of the skeleton of the rabbit, by Dr. A. B. Appleton ; histological methods for exploring the distribution of biological activity in the anterior pituitary, by Dr. E. A. Spaul ; a new hormone from the anterior pituitary, by Dr. B. P. Wiesner ; fertilisation and segmentation of rabbit eggs *in vitro*, by Dr. G. Pincus ; the physiology of colour change in Crustacea, by Miss E. M. Stephenson ; and the biology of the parasite *Tylenchus dipsaci*, by Dr. G. Fox Wilson. In the second session a number of excellent exhibits were given, including demonstrations of methods devised for various experimental researches in progress at the London School of Hygiene and Tropical Medicine.

AN ingenious device for a self-operating meteorological observatory was briefly described by Dr. F. Nansen at a recent meeting of the International Society for the Exploration of the Arctic Regions by means of Aircraft. According to a report that appeared in the Copenhagen newspaper *Politiken*, the Meltchaneff apparatus consists of a small balloon to which are attached thermometer, hygrometer, and barometer constructed of very light materials. These instruments record by means of small short-wave transmitters which, with a life of about two hours, automatically send out signals. Records have an accuracy to within one-tenth of a degree. The apparatus with a weight attached will be dropped from an airship. On striking the ice the weight is detached and the balloon with its instruments rises. The wireless signals are received by the airship, which is thus enabled to obtain records of a vertical section of the atmosphere whenever it is desirable. A further development is even more ingenious. Prof. Meltchaneff is at work on the details of an automatic observatory weighing 1½ tons which is to be dropped from the airship on to the ice whence it will transmit observation three times a day and function for an entire year. He suggests that an airship should be able to carry ten of these automatic observatories on a journey and place them in desirable sites on the land or pack-ice. An annual visit, presumably by airship, would keep them in repair.

AT the meeting of the London Mathematical Society on Thursday, Feb. 6, at 5 P.M., at Burlington House, Mr. J. Hodgkinson will deliver a lecture on " Conformal Representation by Means of Lamé Functions ". Members of other scientific societies who are interested are invited to attend.

AT the instance of the Research Co-ordination Sub-Committee of the Committee of Civil Research, the Forestry Commissioners have constituted an Advisory Committee on Forestry Research. The members of the Committee are as follows : Mr. R. L. Robinson (chairman), Dr. E. J. Butler, Dr. A. W. Hill, Dr. A. S. Joseph, Dr. Guy Marshall, Mr. R. S. Pearson, Prof. R. S. Troup, Prof. Wright-Smith, Mr. W. H. Guillebaud (secretary).

AT each of its annual meetings, the American Association for the Advancement of Science gives a prize of 1000 dollars for the most noteworthy contribution to science made at the meeting. The New York correspondent of the *Times* announces that the prize for the recent meeting at Des Moines has been awarded to Prof. A. J. Dempster, of the University of Chicago, for a paper showing that protons have wave characteristics. Prof. Dempster describes some of his work in a communication which appears elsewhere in this issue of NATURE (p. 51).

THE fourth General Assembly of the International Union for Geodesy and Geophysics will take place at Stockholm on Aug. 15–23, all the meetings being held in the Parliament House save the inaugural meeting, on Aug. 15, in the Great Hall of the Concert House. The main work of the Union will be accomplished in the meetings of the separate sections, devoted to geodesy, meteorology, terrestrial magnetism and electricity, seismology, oceanography, hydrology, and vulcanology. Among the important matters requiring international co-operation to be considered at Stockholm will be the organisation and objects of the scheme for a new 'polar year' in 1932–33. The local committee organising the Stockholm meetings has made arrangements for various social and scientific gatherings and excursions during the period of the Assembly, and for more extended excursions, after its conclusion, to the north and south of Sweden.

A SPECIAL advance overseas edition of the catalogues of the 1930 British Industries Fair, to be opened in London and Birmingham on Feb. 17, is already available, and is being issued immediately to business men in Europe, North America, South Africa, and the eastern coast of South America, including all those buyers who have notified the Department of Overseas Trade of their intention of attending the Fair. By this publishing feat, which has only been made possible owing to the keenness of British manufacturers to participate in the Fair, trade buyers in cities so far apart as Istambul, Cape Town, and Vancouver will be able to receive copies of the Fair catalogues before commencing their voyage to England. The catalogues, apart from containing descriptive entries of the exhibits of some 1800 British manufacturers, embody a complete classification of the exhibits by trades, and indexes in nine languages.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A technical assistant and a senior technical assistant in the Admiralty Technical Pool, for the Admiralty Compass Department, Slough—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Jan. 13). A lecturer in chemistry at the Stockport College for Further Education—The Principal, College for Further Education, Stockport (Jan. 17). A senior assistant in charge at the Experimental Station of the Ministry of Transport, Harmondsworth, near Colnbrook, Middlesex—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Jan. 18). An inspector under the Ministry of Agriculture and Fisheries, for the purposes of the Diseases of Animals Act, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Jan. 20). A head of the Agricultural Department of the Seale-Hayne Agricultural College—The Principal, Seale-Hayne Agricultural College, Newton Abbot, Devon (Jan. 20). A lecturer in dental histology in the University of Manchester—The Registrar, The University, Manchester (Jan. 24). An assistant in the Library of Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (Feb. 1). A junior assistant under the directorate of metallurgical research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A trained attendant in the Physiology Department of University College, Cork—The President's Secretary, University College, Cork. A junior professional assistant in the Meteorological Office—The Secretary (S.1), Air Ministry, Adastral House, Kingsway, W.C.2. A laboratory assistant under the Government of Iraq for the Health Department — The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/1546). Junior draughtsmen at the Royal Airship Works, Cardington—The Director of Airship Development, Royal Airship Works, Cardington, Bedford. Two posts for the regional organisation and development of broadcast adult education under the British Broadcasting Corporation — The Secretary, Central Council for Broadcast Adult Education, B.B.C., Savoy Hill, W.C.2.

Our Astronomical Column.

Wilk's Comet.—The comet is a very easy telescopic object, being visible on Jan. 5 through considerable mist. The following observation was obtained by Dr. A. C. D. Crommelin at Greenwich :

U.T.	R.A. 1930·0.	N. Decl. 1930·0.
Jan. 5^d 17^h 48^m 53^s	20^h 38^m $3{\cdot}92^s$	15° 24′ 13·7″

The comet is keeping near the ephemeris deduced from Prof. Banachiewicz's elements ; the ephemeris for 18 hours U.T. is continued :

	R.A.	Decl.	log r.	log Δ.
Jan. 13.	21^h 19^m 45^s	N. 5° 18′	9·8430	0·0679
17.	21 34 51	N. 1 3	9·8328	0·0990
21.	21 47 33	S. 3 2	9·8285	0·1289
25.	21 58 0	S. 6 37	9·8309	0·1557
29.	22 6 55	S. 9 53	9·8399	0·1797

Prof. G. van Biesbroeck at Yerkes Observatory observed a slender tail, 20′ in length, in a direction opposite to the sun. A photograph by Dr. Waterfield at Baltimore showed traces of the tail.

Relation of Light Changes to Velocity Changes in Variable Stars.—Mr. D. B. McLaughlin discusses this question in *Astr. Jour.*, No. 932. He begins by directing attention to the facts that in the Cepheid variables the light maxima nearly coincide with the minima of radial velocity, while in the Mira Ceti type the two maxima nearly coincide. He has accordingly tabulated the amount of the lag of velocity minimum after light maximum, and expressed the lag as a fraction of the period of the star. The results are plotted in a graph, with the logarithm of the period as abscissa and the lag ratio as ordinate. The resulting points group themselves along a parabola with axis vertical and vertex on the X-axis at a point corresponding to a period of a week, which is noted to be near the position of maximum frequency of the Cepheid variables.

The author concludes that all the variables other than the eclipsing ones form a connected sequence, and that the Cepheid type occurs at the point of maximum stability of the pulsations of the stars, which are supposed to produce the variations of light. There is one star that deviates widely from the curve ; this is *R U* Camelop. ; the author points out that this star is peculiar in many ways ; the shapes of its light and velocity curves are unusual, and its spectral class varies from *K* to *R*.

Minor Planets.—The issue for 1930 of "Kleine Planeten", the annual handbook issued by the Berlin Rechen-Institut, has just appeared. It contains ephemerides of all the planets that pass opposition during the year, also of 433 Eros from Oct. 1 to the end of the year. The nearest approach of the latter does not occur until the end of January 1931, but observations will begin some time before this ; it will approach the earth within some 15½ million miles, which is much the closest approach since its discovery in 1898.

The planets to which permanent numbers have been assigned now extend to No. 1113. It is satisfactory that several of the planets noted as new in the last two years prove to be identical with planets recorded in former years, but not previously observed sufficiently to receive numbers. Many of these identifications, which involve great labour, were made by Mr. B. Asplind ; others by L. Fabry and S. Beljawsky ; planet 1074 has been named Beljawskya in honour of the latter.

Research Items.

Prehistory of the Eskimo.—In vol. 81, No. 14, of the *Smithsonian Miscellaneous Collections*, Mr. Henry B. Collins, jr., describes and figures a number of specimens of the prehistoric art of the Alaskan Eskimo and discusses their relation to the culture and distribution of the modern Eskimo. The researches of Boas and Wissler, reinforced and extended by the results of the Mathiassen First Thule Expedition (1922–24), showed that the ancient eastern culture, now known as the Thule culture, must have originated in Alaska. In 1926 the survey by Hrdlička of the Alaskan coast from Norton Sound to Point Barrow, and the archæological investigations of Jenness in the Bering Sea region, showed that underlying the existing culture of north and north-western Alaska was an earlier and generally more advanced culture, marked especially by elaborately carved and ornamented objects of old ivory. This was distinct and new, though some harpoon-heads corresponded with Thule types of the east. Excavations by the author on St. Lawrence and Punuk Islands, Alaska, in 1928 showed successive stages of art development of the ancient Bering Sea culture. This culture is the oldest that has yet come to light in the Eskimo north-west. It differs entirely from the art of the modern Eskimo, consisting essentially of circles and lines and showing no internal evidence of ever having been associated with realistic patterns, although carved representations of animals are not lacking. Nor is there any real resemblance to the art of the north-west coast, though there is a vague general similarity which may point to a common ancestry. The finds on Puruk and St. Lawrence Islands, however, have revealed a transition stage which justifies the view that modern Alaskan Eskimo art, notwithstanding its differences and its greater simplicity, is directly descended from the old Bering Sea art. While the discovery of this ancient art, which is not primitive, has not clarified the origin of Eskimo culture, it points to the necessity for going further back before that origin is revealed. Yet it is probable that its roots lie in eastern Asia.

Skull Ornamentation in the Naga Hills.—In *Man* for December, Mr. J. H. Hutton describes a method of ornamentation of the skull of a dead chief which is practised among the Konyak Nagas of Assam. Some of the hair of the dead man is stuck on the forepart of the skull, in front of the spot where the hair was parted in life, to form a sort of fringe. The orbits are filled with white pith in the centre of which the eye is represented by a piece of looking-glass, and a nose of pith is also provided. The whole is painted with a blue pigment. The skulls are probably kept in pots covered with flat stones, but produced on special occasions and feasted. If so produced they are probably placed on a sort of a seat and covered at the back with a cloth, as is done at Namsang, where, however, the skull is not given artificial eyes and nose and the forehead is provided with a miniature of the chest tattoo pattern. In Kongan, paint seems to be used to represent the hair. The practice of providing artificial eyes and nose is comparable with that of Oceania. The specimen obtained lacked the lower jaw. This was due to its sanctity, which was such that the individual who obtained the specimen for the author did not dare abstract the jaw as well. The sanctity of the jaw may be noted in many parts of the Naga Hills. The jaw of an enemy head is separately dealt with in many Konyak villages and does not come with the rest of the skull to the chief's verandah ; nor is it separated from the ancestors' skulls. In the Khasi Hills, as in Borneo, the jaw of an animal slain at the funeral feast is the part specially associated with the remains of the deceased. The explanation may be that the ghost attaches specially to the lower jaw.

Bionomics of the Liver Fluke.—I. Clunies Ross records (*Bull.* 43, Council for Sci. Ind. Res., Commonwealth of Australia, 1929) observations on the bionomics of the liver fluke (*Fasciola hepatica*) of the sheep in New South Wales. The miracidia may remain alive and active for twenty-four hours after hatching—hatching occurs during the warmth of the day and the miracidia may survive and swim through the night. At 8°-11° C. they may survive for three days. The intermediate host is *Limnæa brazieri*—no other snail was found naturally infected or could be infected experimentally. The cycle of development of *F. hepatica* in this snail is completed in a minimum of forty-nine days in summer. So many as 850 cercariæ were found to issue from one naturally infected snail. The majority of the cercariæ encyst on water weeds near the surface of the water, but some at depths of 2 cm. Many cercariæ resisted desiccation in the shade for seventeen days. After entering a new host the cercariæ penetrate the wall of the intestine and enter the liver. Destruction of the liver tissue increases progressively as the flukes grow therein. There is evidence of a protracted stay in the liver tissue—flukes were present there thirty-nine days after infestation of experimental animals and none was found in the bile ducts in this period. Development of *F. hepatica* will take place in *Limnæa brazieri* of all ages from a fortnight old to mature specimens. The snail occurs in varied habitats—shallow, marshy areas and swift-flowing rivers—and has two breeding periods—spring and summer. It resists desiccation feebly and hence drought exercises a marked influence. The snail is killed in the laboratory by exposure overnight to copper sulphate in dilution up to 1 in 150,000,000, and eggs are usually killed within twenty-four hours in 1 in 1,000,000 copper sulphate. Destruction of the snails has been effected by broadcasting, while light rain is falling, copper sulphate (25-30 lb. to the acre of pasture) mixed with four times its weight of sand. Drainage of the pasture is also helpful.

The 'German' Carp.—Prof. W. M. Smallwood and Mary M. Smallwood discuss the problem of the European carp as an American immigrant in the November number of the *Scientific Monthly*. In 1831, carp were first brought from Europe and introduced into New York waters. Since then they have taken so kindly to America that in some parts they are regarded as a menace. The reason for their success appears to be largely in the feeding habits, for they may be said to be practically omnivorous and often feed in polluted areas which other fishes find impossible. They can live and reproduce in lakes, streams, ponds, and canals in very variable conditions, and are usually wonderfully free from disease. Except for a few Acanthocephala, parasites appear to be absent, the reason probably being that they have left behind their intermediate hosts in Europe. There is in this paper an interesting account of the life-history of the carp from egg to adult, with notes on their feeding habits.

Growth of Hawaiian Corals.—Under this title Mr. Charles Howard Edmonson has described the continuation of his experimental work on the bionomics of South Sea corals (Bernice P. Bishop Museum, *Bulletin* 58, Honolulu, Hawaii ; 1929). In his former paper in the same publication (No. 45; 1928), "The

Ecology of an Hawaiian Coral Reef", many interesting experiments were described, and in the present part it is shown that still more have been successfully carried out. Much of the new work is in connexion with the planulæ and their post-larval development, and three species have been studied, *Dendrophyllia manni*, *Pocillopora cespitosa*, and *Cyphastrea ocellina*. As was previously observed, the planulæ are more resistant to abnormal conditions than the adults of the same species, and they settle and become fixed under a wide range of conditions in the laboratory, frequently in clusters. The species vary in their rate of development, *Pocillopora* before fixation being more rapid than *Cyphastrea*. *Dendrophyllia* can develop even in the total absence of light. In its natural surroundings it thrives under ledges of rock where the light is subdued. The planulæ of *Cyphastrea* were much more easily obtained than the other two, and colonies could almost always be made to release them by gently heating the water surrounding the corals or by plunging them into water of about 35° C. Besides the work on the planulæ, the growth of the shallow water corals was studied. These growths are usually very irregular, although they may be large at times. *Porites* in both massive and branching forms may gain so much as 10 mm. in height annually, the massive form 60 per cent, the branching form 80 per cent in weight. *Pocillopora* increases on an average about 15 mm. in height annually, and more than 100 per cent in weight. The variety *nobilis* can increase in height at the rate of about 40 mm. in a year.

Observations on Living Chromosomes in *Obelia*.—The oocytes of *Obelia geniculata* prove to be exceptionally favourable for the study in life of the prophases of the first oocyte division. Miss G. H. Faulkner (*Quart. Jour. Micr. Sci.*, vol. 73, Part II., 1929) records that, owing to the transparency of the medusa and of the yolk of the oocyte, the whole of the nuclear cycle can be examined in detail in living specimens, and that isolated individuals can be re-examined from day to day. In the young resting oocytes the nucleus is almost entirely filled with the nucleolus, which represents a condensed chromatic spireme and includes the whole chromosomal content of the nucleus. During the early growth phases of the oocyte, the nucleolus elongates and fragments, and each fragment has been identified as a pair of homologous chromosomes indistinguishably united. Later, each of these bivalent elements divides into two individual chromosomes. The two components of the largest bivalent element are unequal in size and probably represent an $X\,Y$ pair. The chromosomes at the bivalent and at the univalent phase are seventeen and thirty-four respectively. At a still later stage, the chromosomes fragment into numerous small globules which become evenly distributed throughout the nucleus, and the latter is then seen as a clear vesicle. These observations made on living oocytes have been confirmed in sections of fixed specimens.

Fossil Brachiopods.—An alphabetical list of all the known genera of fossil Brachiopods, with their genotypes, synonyms, systematic position, and geological distribution, has been brought together by C. Schuchert and C. M. Le Vene (*Fossilium Catalogus*, I, Animalia, Pars 42. Berlin: W. Junk, 1929). 702 genera are known, of which 456 are found in the Palæozoic, 177 in the Mesozoic, and 74 in the Cainozoic and Recent. A revised classification of the Brachiopoda is given but without diagnoses of the groups. The order Palæotremata, established by Thomson, is adopted.

Form of Volcanoes.—Most Japanese volcanoes, as Prof. T. Terada remarks, in an interesting paper (*Earthq. Res. Inst. Bull.*, vol. 7, pp. 207-221; 1929), are surrounded by a conspicuous zone of depression. To compare the forms of different volcanoes, he takes the average heights of the surface at given distances from the summit in the sixteen principal directions, and from these he obtains the mean profile of nine Japanese volcanoes. This shows that there is a zone of depression at the foot of the cone, while the land beyond it, between 15 miles and 25 miles from the summit, is generally uniform in level. The depth of the zone of depression below the surrounding ground varies from about 20 ft. to 84 ft.

Origin of Graptolitic Shales.—The view put forward by Marr and by Ruedemann that black shales, containing numerous graptolites with but few other associated organisms, were deposited in the deeper parts of seas similar to the Black Sea, is disputed by Dr. A. W. Grabau (*Mem.*, VII, Inst. Geol., Nat. Research Inst. China, 1929). The view that he proposes is that normal graptolite beds were formed on fluviatile plains of the type of the Huang-ho of China, the Indo-Gangetic plain of India, the Euphrates-Tigris plain of Mesopotamia, etc. Such plains could exist in all parts of the world in former times, as they do to-day, and simultaneous rise of sea-level would inundate them, leaving stranded planktonic organisms like graptolites. During the intervals, only fluviatile terrestrial organisms would be buried in the sediments. No evidence is given of this assumed world-wide and oft-repeated rise of sea-level, nor are any deposits of freshwater origin known to be associated with graptolitic shales.

Ice of North-East Land.—During the Oxford Expedition to Spitsbergen in 1924, Dr. K. S. Sandford made a study of the glacial conditions in North-East Land. He has published the result of his observations in articles in the *Geographical Journal* for November and December. The ice sheet consists of three domes, two in the northern part and one in the south-west. These domes merge in the regions of highland ice, the normal conditions of land ice in Spitsbergen where underlying topographical features have a marked effect on the configuration of the ice and the direction of its flow. The ice-free margin to much of the land indicates in its erratic blocks and topography a former greater extension of the ice. A long period of subaerial denudation has left its marks on the glacial topography of this margin. Some pre-glacial river valleys have again been occupied by streams. There seems, however, to be no evidence of a further and recent retreat of the ice on such a scale. In fact, much of the ice seems to be in a carapace stage, neither gaining nor losing and not in active movement. No glacier shows signs of a marked advance, but at the head of Wahlenberg Bay there is evidence of a fairly recent retreat with a zone of fresh boulder clay in front of dead ice. Raised beaches around the island bear witness to past uplift. This was at least 200 feet and is still in progress.

Vibrations in the Atmosphere.—There is some indication from the daily fluctuations in the height of the barometer that the atmosphere may have a natural period of vibration of twelve hours. A fresh attempt to obtain this result from dynamical considerations has been made by Prof. G. I. Taylor in a paper in the December number of the *Proceedings of the Royal Society*, on waves and tides in the atmosphere. On the assumption that the temperature falls off with height at half the adiabatic rate, from 20° C. at the surface to −68° C. in the stratosphere, Prof. Taylor, extending an earlier analysis by Dr. H. Lamb, obtains a value of 1065 feet per second for the speed of long gravity-controlled waves in the air.

The waves set up by the eruption of the volcano Krakatau in 1883 had actually a speed of 1046 ± 9 feet per second, and it follows from this agreement with theory that their propagation must have been adiabatic. Isothermal changes would, however, give a value not far from the 910 feet per second required by the semidiurnal barometric wave. Prof. Taylor has also analysed Strachey's curves, showing the first passage of the Krakatau wave round the earth, and has found that the lobed form assumed by the wave-front can be explained by the existence of a typical east wind of 12 feet per second, passing continuously into a west wind with a maximum of 31 feet per second at lat. 57° N. or S. He also finds that the equivalent depth of the atmospheric ocean is not more than 5 per cent less at the poles than it is at the equator.

Electron Diffraction by Mica.—In a paper in the *Zeitschrift für Physik* for Dec. 9, on the diffraction of electron waves by mica, Dr. E. Rupp discusses some of the earlier results obtained by Kikuchi in this connexion (see NATURE, Feb. 9, 1929, p. 224). With thick sheets of mica, Kikuchi had obtained the diffraction patterns of a three-dimensional array of atoms, and with thin sheets the patterns of a two-dimensional lattice; some of the thin sheets which he used were, however, of the order of a hundred atoms thick, and it is not obvious why these should not have produced the same results as thicker sheets. Dr. Rupp attributes the effect to a generation of heat in the mica when it is bombarded by electrons. He supposes that the planes of atoms which produce surface effects are relatively little affected as individuals by an increase in thermal motion, but that they undergo sufficiently large shifts with regard to one another to destroy regular volume interference. Dr. Rupp supports this explanation by experiments in which he has been able to produce either type of pattern with a single specimen of mica simply by varying the electron current to it. With the very considerable disengagement of heat that occurs when electron currents of about 0·1 ampere are supplied at a power of 3 kilowatts, it is possible to obtain the patterns from the plane gratings even with a sheet of mica 10^{-4} cm. in thickness.

Oxide-coated Filaments.—It is well known that the electron current from a hot wire can be increased enormously in certain circumstances by coating it with the oxide of an alkaline earth metal, but that the factors which control the emission are complex. Some important investigations on these filaments are described by J. A. Becker, of the Bell Telephone Laboratories, in the second November number of the *Physical Review*. It appears probable that high activity is associated with adsorption of the alkaline earth metal at the surface, and that many of the changes which occur in the emission are brought about by electrolysis of metal or oxygen atoms through the oxide, the value of the filament as a source of electrons, as with composite filaments of tungsten and thorium or cæsium, depending on the fraction of the surface covered by the active metal. The efficiency of the latter is reduced if it is covered with oxygen atoms, but is increased if it is free on the side facing towards the vacuum, but anchored by oxygen atoms to the main surface. By appropriate control of temperature and electron current, either the alkaline earth metal or the oxygen can be made to evaporate. The probable process of electrolysis in the oxide is also described in some detail, and it seems that Ohm's law is not valid, although most of the current is carried by electrons, and a relatively small part by ions.

Transmission Line Surges.—The extending use of overhead wires for power transmission and for working electric railways has made the problem of protecting the network from interference by lightning and by sparks caused by atmospheric electricity one of considerable commercial importance. The earlier methods of dealing with surges of electricity due to lightning discharges are now quite unsuitable and the whole problem has to be solved by purely scientific methods. The development during the past fifteen years of high vacuum technique has led to the construction of apparatus which can record the effects of lightning on the overhead wires. In particular, the cathode ray oscillograph has proved of great value. In a lecture on transmission line surges given by Dr. H. Norinder to the Institution of Electrical Engineers on Dec. 5, he described the valuable work that has already been done in Sweden by the oscillograph, both on the surges caused by lightning flashes on actual circuits and in an artificial way in the laboratory. The construction of these laboratory surge generators has been made possible by the use of kenotrons which give a pressure of 200 kilovolts. By connecting the condensers in series, pressures of ten times this value have been obtained. Dr. Norinder emphasised the great difference in the effects produced by direct strokes and those produced by induced charges. He gave experimental data on the rate of cloud discharge, together with characteristic records of the discharge rate. He considered that it is not yet possible to deduce definite conclusions as to lightning surges from the records obtained. Further research is urgently required. In the discussion, Mr. Goodlet, of Metropolitan-Vickers, mentioned that his firm has made elaborate researches at Trafford Park with impulse generators producing 1,500,000 volts.

X-Rays in the Examination of Coal.—Röntgen's discovery of X-rays was quickly applied to the needs of clinical medicine and surgery, where a method of examining an opaque living object without disturbance received immediate recognition. As time went on, industrial applications were developed in one direction after another. Mr. C. N. Kemp's application of X-rays to the examination of coal and coke for incombustible impurity may become one of the most important of these. It was described in a recent lecture before the Royal Society of Arts (*J. R. S. Arts*, p. 114; 1929). Coal is not only opaque but also relatively inert to reagents and solvents. Quick analytical separations are precluded. The normal mode of determining ash is such as to be incapable of giving an indication of the way in which the ash is distributed in a lump. Yet this information is vital to a decision as to the feasibility of coal cleaning. Mr. Kemp has devised a technique which may well bring an X-ray apparatus into every coal-cleaning plant and coal-testing laboratory in the near future. If the retailer of footwear can use X-ray apparatus, why not the colliery?

Synthesis of Glycine.—Methyleneaminoacetonitrile $(CH_2 : N . CH_2 . CN)_3$, which can be prepared from formalin, ammonium chloride, and alkali cyanide, when treated with acid is converted into aminoacetonitrile, which is best separated as the acid sulphate. This method of preparation is due to Klages (1903). There is some difficulty in obtaining free glycine from the salts, but in the November number of the *Journal of the Chemical Society*, H. King and W. K. Anslow describe a method which gives a yield of 83 per cent, calculated on the nitrile, of the recrystallised glycine, which consists in boiling the acid sulphate with 27 per cent barium hydroxide solution until evolution of ammonia ceases.

The Fifteenth International Geological Congress, South Africa, 1929.

THE recent meeting of the Fifteenth International Geological Congress during July and August of last year (under the presidency of Dr. A. W. Rogers), with Pretoria as its headquarters—the first occasion on which the *venue* was in the southern hemisphere—brought together from all parts of the world a large number of geologists, whose eloquent appreciation of the arrangements made for them must have been most gratifying to the organising committee after its two years of labour in carrying through the intricate work of organisation.

The experiment of assembling such an international gathering in a country so far removed from the centres of geological progress in Europe and the United States was not viewed without some misgivings. Though Nature has lavishly endowed southern Africa with many geological features of exceptional interest and wide significance, besides enriching it with great mineral wealth, the sub-continent is essentially a region of wide spaces, requiring a large canvas for their geological portrait; in South Africa, indeed, 'regional' geology seems written in very large letters, so that the visiting geologist needs much time and a longish purse to travel the enormous distances that have to be covered before he can encompass the main designs of the geological structure. Moreover, South Africa is a young country in which systematic geological work has been in progress only for a relatively short period, and is being carried on by a comparatively small band of geologists. These are some of the difficulties that faced the organising committee when designing the detailed programme.

Now that the fifteenth session has passed into history, it is a pleasure (and a relief) to be able to record the complete success of the experiment. The total membership was 575, out of which number 300 were present. Considering the obvious difficulties and cost involved in participating in the South African meeting, this attendance was very gratifying, specially as it compares favourably with some of the earlier sessions that were held in Europe. The 117 delegates who represented geological surveys, museums, scientific societies, and other institutions, included some seventy official delegates of governments, while no fewer than 22 directors of geological surveys were present.

Since the geology of South Africa is still relatively little known from an international point of view, the organising committee had designed a series of 22 excursions, covering visits to almost all the most attractive geological areas, as well as introducing the members to all the principal types of mineral deposits; fortunately, the generous support from the South African railway administration, the mining industry and other bodies, allowed the visitors to take part in these excursions in favourable financial and other circumstances. The remarkable extent to which members seized these opportunities was certainly a notable feature of the South African meeting, the membership of some of the excursions exceeding a hundred, and many others were fully booked up.

The official programme being based on the arrival of the bulk of the Congress at Cape Town before the opening session at Pretoria, two long excursions were provided to demonstrate some of the most important geological features in the Cape Province, such as the structure of the Hex River Mountains, the Karroo geology round Laingsburg, etc., the Kimberley diamond mines and the unique glacial pavements of the Dwyka period near Kimberley; one of these excursions was specially designed for economic geologists and included several days spent in the Witwatersrand goldfields.

During the ten days of the session at Pretoria there were several short excursions, all of which were well attended; here the members saw, for example, the beautiful suite of alkaline rock masses near the capital and in the Pilandsberg (Western Transvaal) with its remarkable ring intrusions, and the great opencast workings of the Premier Diamond Mine, visited by 150 members, or the peculiar crater-like depression of the Salt Pan in the Bushveld granite north-west of Pretoria, first described by the late Prof. E. Cohen.

After the session at Pretoria there were provided eight long excursions, occupying from three to fourteen days and offering an extensive field of choice from Durban and Port Elizabeth on the east to Windhuk, Lüderitzbucht and Tsumeb on the west, and up to Livingstone and Broken Hill in the north; the programme included a visit to the far-famed Devil's Kantoor in the great eastern escarpment of the Transvaal Drakensberg, which affords one of the most comprehensive object-lessons to be found in the whole of the sub-continent for studying the relationship between the interior plateau region and the low-lying coastal belt. The unique Vredefort Dome with its puzzling tectonics, remarkable overtilting of thousands of feet of the encircling intensity metamorphosed sediments, together with its peculiar ring dykes and startling crush phenomena (profusion of flinty crush rocks), was also included, and gave rise to some interesting discussions in the field. The long excursion through Southern Rhodesia to the unique feature of the Great Dyke, etc., and culminating in a visit to the Victoria (Zambezi) Falls, proved of special interest, and nearly a hundred geologists took part in it; it was a happy thought of the Northern Rhodesian Administration to organise a geological tour through that country, so as to enable members of the Congress to see something of its wonderful copper-bearing formations that seem destined to develop into one of the most valuable of the Empire's mineral assets. Through the hospitality of the Union Minière du Haut Katanga, a special excursion was provided over the remarkable copper fields of the Belgian Congo.

Other sections of the official programme took members across the Orange Free State to Durban and into Zululand with its rich cretaceous fauna, to Port Elizabeth, etc., or across South-West Africa with its fascinating physiographical problems, etc. Another excursion was across the eastern section of the unique Bushveld Complex (including the remarkable tin pipes near Potgietersrust)—embracing an itinerary well away from a railway line under conditions somewhat novel to some of the members—and attracted a very fine membership, including several outstanding workers in magmatic geology. Excellent opportunities were offered for seeing the remarkable results of the extreme phases of differentiation in the great norite Lopolith, as illustrated by the chromite and magnetite bands, the anorthosites, etc. This itinerary followed very closely that of the Shaler Memorial Expedition of 1922 (under the leadership of Prof. R. A. Daly).

Sectional Discussions.

The subjects put forward for discussion were chosen, so far as possible, with reference to phenomena of special importance in the geology of South Africa: magmatic differentiation; pre-Pleistocene Glacial periods; the Karroo System, its stratigraphy, palæontology, and world distribution; the genesis of petroleum; the geological work of micro-organisms. There was also a general section. Having come so far to attend the Congress, the visiting geologists were eager to see as much as possible of South African

geology, so that the excursions were naturally a great attraction to most members; hence it is not surprising that only some seventy papers were communicated; many of these, however, are valuable contributions to matters of wide interest.

In the Section dealing with Magmatic Differentiation there were (among other contributions) two papers by Dr. E. Reuning on "The Differentiation of Karroo Eruptives in South-West Africa" and on "Differentiation of South African Rock Magmas", and another by Prof. P. Niggli on "Some Principles in the Problem of Magmatic Differentiation". The proceedings of this section were most instructive, and very much apropos, in view of the splendid display of magmatic phenomena on the long excursion across the Bushveld, and on that to the Rustenburg Platinum Fields.

The remarkable Pre-Pleistocene Glacial Deposits of South Africa were discussed in three most useful summaries by Dr. A. W. Rogers (Pretoria), Dr. S. H. Haughton (Cape Town), and Dr. A. L. du Toit (Kimberley). Prof. Gortani (Bologna) had a paper on "Continental Drift and Glacial Epochs", while the late Palæozoic tillites in Central Asia and the northernmost Ural were dealt with by E. Norin and H. G. Backlund.

A large number of contributions were to the subject of the Karroo System both in its stratigraphical and palæontological aspects; these add much of importance to our knowledge of that system, more especially in its African developments. H. Besairie ("The Stratigraphy of the Karroo System in Madagascar"); F. Dixey ("The Karroo of the Lower Shire-Zambezi Region"); A. B. Walkom ("A Comparison of the Fossil Floras of Australia with those of South Africa"); P. Fourmarier ("Karroo System of Belgian Congo"); F. Mouta and A. Borges ("Sur l'Existence et la Distribution du Karroo dans l'Angola"); G. Stefanini ("On the Sequence and Age of the Lugh Sandstones, Italian Somaliland") and F. P. Mennell (Bulawayo), ("The Karroo System in East and Central Africa") are some of the principal contributions.

The Rift Valleys Section attracted much interest and brought out some good discussions. One of the more notable contributions is by E. J. Wayland (Entebbe), "The Albertine Rift; a Compressional Phenomena", in which a tectonic parallel is drawn between Lake Albert and the Dead Sea. Prof. H. Cloos (Bonn) gave a thoughtful address on "Tectonic Experiments and the Origin of Fracture Zones"; there were also papers by E. Seidl (Berlin), J. J. Pannekoek van Rheden (Haarlem), D. Johnson (New York), etc.

A great variety of subjects were presented in the General Section; for example, Prof. G. Gürich (Hamburg) directed attention to the traces of the oldest organisms hitherto found in South Africa; Dr. N. R. Junner (Freetown) gave a useful account of the norite of Sierra Leone; M. H. J. Schuiling (Panda) read a valuable paper on the Kambove Copper Mine (Katanga), while Dr. O. Pratje (Königsberg) delivered an illustrated address on the results of the geological investigation of the South Atlantic Ocean. Other attractive papers were by Prof. A. Demay (St. Etienne) on Hercynian tectonics in France; C. Freire d'Andrade (Lourenço Marques) on Portuguese East Africa; P. Kovaloff (Johannesburg) on the beryl finds in Namaqualand; A. O. D. Mogg (Pretoria), who discussed the connexion between flora and geology in the Vryburg district, etc.

The great interest aroused by recent advances in geophysical methods of prospecting led to a special meeting for this branch of geology, in which Dr. J. G. Sineriz (Spain), Dr. D. Mushketov (U.S.S.R.), and Dr. J. W. Evans (Great Britain) took a prominent part.

Following the example set at previous meetings—which resulted in valuable compilations on the world's supplies of, for example, pyrites, coal, iron, etc., it had been decided to survey the "Gold Resources of the World", a subject of outstanding international and economic importance, and specially worthy of being handled by the Congress while meeting in the greatest gold-producing country of the world. The proposal was initiated by means of a special invitation over the signature of the Prime Minister of the Union; when the session opened, reports had been received from 45 different governments. The publication of this volume will be welcomed by many students.

International Commissions of the Congress.

During the session a series of meetings were held in connexion with the various International Commissions, the work of which is an important feature in the life of the Congress. In the end, several commissions had to be reconstituted, one new commission and one sub-commission were established, while of the previous bodies, one (iron ores) was dissolved, so that the Congress now has the following commissions: Prix Spendiaroff (awarded to Dr. L. T. Nel, geologist on the Geological Survey of the Union of South Africa), Palæontologia Universalis, Lexicon de Stratigraphie, Glaciers, L'Homme Fossile, Croûte Terrestre, Géophysique et Géothermique, Carte de l'Europe, Carte de la Terre, Distribution of the Karroo (Gondwana) System; to these was added the sub-commission of African Surveys. The Council was fortunate in securing an excellent and thoroughly representative membership for most of these commissions.

Since the last meeting of the Congress, in Spain during 1926, much useful work has been accomplished by the two map commissions, under the chairmanship of Dr. P. Krusch, president of the Geological Survey of Prussia. The one for the map of Europe on the scale of 1 : 1,500,000 was founded at Bologna in 1881 and shortly after the Toronto congress in 1913 completed its task by publishing the last sheet, and the preparation of a new edition was afterwards decided upon. The indispensable preliminary work of agreeing upon the best colour scheme was completed at a meeting of the Commission held in Berlin last February, and during the South African meeting Dr. W. Schriel (general secretary of the Commission) exhibited two advance sheets of the new edition, in their original form; the great beauty of the colour scheme and the excellence of the draughtsmanship were much admired by many members. One section of the new edition is ready for the press and further sections are expected to appear at the rate of two in each year.

The publication of the International Map of the World on the scale of 1 : 5,000,000 was decided upon at the Stockholm congress in 1910, and the colour scheme drafted at the Berlin meeting referred to, two sections embracing the Union of South Africa being afterwards prepared; they were presented at the Pretoria meeting. For the next congress it was agreed to prepare a few North American sections.

The final editing is to be done at Berlin (as was formerly the case) in order to secure uniformity of issue, for which purpose a special bureau has been established at Berlin. Dr. P. Krusch (chairman of both map commissions) was able to announce the fortunate circumstance that the means for the printing of both maps have been made available by Prussia, so that in due course the sheets will be obtainable through the Geological Survey of that country.

The keen interest shown in the stratigraphy, palæontology and world distribution of the Karroo System which constituted one of the sections of the Congress (as explained above) culminated in the establishment of a new Commission on the Correlation of the Karroo (Gondwana) System; the proposal emanated from Dr. S. H. Haughton (Cape Town)—an outstanding authority on the Karroo System—strongly supported by Prof. G. Stefanini (Bologna), Dr. L. L. Fermor (Calcutta), Dr. D. Mushketov (Leningrad) and others. The Commission has Dr. A. W. Rogers as chairman and includes the directors of geological surveys (or government geologists) of all countries concerned, together with representatives for Italy, Australia, etc., with Dr. S. H. Haughton as its secretary, so that one may look to much useful work before long.

The presence at the session of representatives of practically every country maintaining some form of geological survey in Africa, led to a strong desire to make use of this unique opportunity of establishing closer co-operation between African surveys. A number of well-attended meetings were followed by the formation of a Sub-Commission of African Surveys, on the initiation of Dr. G. W. Grabham (Khartoum), supported by Dr. A. L. du Toit (Kimberley). One of the chief aims of this Commission is "to promote co-operation between all Governments in Africa, with a view to prosecuting geological mapping of the Continent". Its president is Prof. G. A. F. Molengraaff (Delft), whose name is so well known to all students of South African geology, while M. Jean Lombard (Brazzaville) is its secretary; the membership includes all the chiefs of official geological surveys and those of unofficial geological surveys or their representatives, as well as Dr. J. W. Evans. It is proposed to issue as soon as possible a "Handbook of the Geology of Central Africa" and to attack the following problems: Rift valleys, glacial periods, thrusts, changes of climate, nature of great batholiths, modern sedimentation in connexion with earth movements. When one realises the many centres at which geological work is being carried on in Africa practically in watertight compartments, one may look for important results from this new body, which was designated a *sub*-commission, in order to emphasise the facts that its work is not intended to interfere with that of any commission concerned with the map of Africa.

The general meeting of the Congress also asked the Union Government to preserve as a kind of "Glacial National Park" the beautiful and unique striated pavements near Kimberley which aroused great enthusiasm among the members, and urged the publication of the Contour Map of the Union on the scale of 1 : 1,000,000 prepared by Mr. E. H. Banks, Cartographer to the Geological Survey. The hand-coloured original was displayed at the Congress and beyond doubt forms an admirable 'pendant' to the geological map recently published on the same scale.

General Impressions.

The almost simultaneous meeting of the British Association at Johannesburg had attracted a vast gathering of overseas workers, and though it was impossible to secure a fusion between its Geological Section and the Congress, a large measure of hearty co-operation was possible, which the Geological Society of South Africa did much to secure.

For the venue of the sixteenth session, the Council had received an invitation from the Comité Géologique in Leningrad, presented by Dr. D. Mushketov, and another from the United States, presented by Prof. C. P. Berkey. Though many members would have welcomed the opportunity of visiting Russia, the general meeting decided in favour of the United States, where the next Congress is to assemble, probably in 1932.

Surveying the activities of the last session as a whole, one feels that the traditions of this international movement were worthily maintained, both as regards the organisation and general arrangements for seeing the main geological features of the country, and in the contributions made to geological science. There can be no doubt that the great success of the excursions, the keen interest taken by the visitors in all they saw, and their intense energy in collecting from the crust of the earth, will in due course result in a substantial enrichment of South African literature. Certainly the personal contact with so many leaders of geological thought, under conditions of perfect international harmony, was (and will continue) a splendid stimulus to the little handful of local geologists, whose work has to be pursued more or less in the shadows of the light that illuminates the progress of geology elsewhere.

A. L. H.

Properties of Water and Steam.

THE sixteenth Thomas Hawksley Lecture of the Institution of Mechanical Engineers, delivered by Prof. H. L. Callendar on Nov. 1, and entitled "Critical Relations between Water and Steam," takes the form of a very interesting historical survey of the development of knowledge of the physical properties of water and steam. Actual measurements of heat quantities and densities at high pressures and temperatures are so difficult and expensive to obtain that this data has always been and still is incomplete, and the physicists' attempts to bridge the gaps by establishing theoretical relations agreeing with experimental results, are described in chronological order.

The theory of the continuity of state, which assumes that "liquid and vapour are merely widely separated forms of the same condition of matter, and differ only in density", was so ingenious and attractive that it held the field for sixty years and received a tremendous amount of attention. The salient points in its development are, therefore, illustrated, but finally the assumption of identity of molecular structure of water and water vapour was generally abandoned.

Recent researches on the structure of crystals suggest the co-aggregation theory. The density of steam at low pressures shows that the great majority of the molecules are single H_2O molecules, but there is no doubt that steam contains a proportion of complex molecules which increases with the density, and this would account for the increasing defect of volume from the ideal with increasing pressure. The latent heat of co-aggregation of the complex molecules also explains the increasing defect of total heat with increase of density. As regards the water, the co-aggregation of the molecules appears to be a higher degree of multiplicity, but is apparently so mobile and irregular as to make analysis almost hopeless. However, the relative positions and distances apart of the atoms of crystalline solids, such as ice, have been determined recently with great accuracy, and this shows that their arrangement depends in many important cases on the ionic group formation known to exist in the liquid, rather than on the chemical formula for the molecule in the vapour state.

In this connexion illustrations are given of Sir William Bragg's model of the crystal structure of ice, and the continuous nature of the network is described. It is shown that there is no trace of the original vapour molecule, except that the total number of hydrogen

atoms in the crystal is exactly twice that of the oxygen atoms. The complete hexagonal molecule existing in the ice is one of the most probable types existing in the liquid, but there must be many others of greater degrees of complexity, and the reduction of the proportions of complex molecules with increase of temperature helps to explain the high specific heat of water and the reduction of the latent heat. This proportion becoming insufficient to maintain a continuous network would explain the vanishing of the surface tension at the critical point. The vapour would probably contain molecules of a small degree of complexity, but they would doubtless behave as gas molecules, having the same kinetic energy but lower velocity on account of their greater masses. This all indicates that the same type of equation cannot satisfactorily represent the behaviour both of the liquid and the vapour.

Based on this theory the following modified Joule-Thomson equation is adopted :

$$V - b = RT/P - C,$$

in which C represents the defect due to co-aggregation. The heat of water in equilibrium with saturated steam can be represented by

$$h = So\ (t - 32) + vL\ (V - v),$$

which equation has been verified by direct measurement of h up to 3800 lb. pressure. These two equations combined enable the saturation pressures to be calculated by Rankine's method, and give good agreement with observation up to 400° F. with C a function of T only. For higher temperatures it will be possible, by making C a function of P as well as of T, to obtain good agreement over the whole range, 32° to 717° F.

Densities have been determined by heating suitable quantities of water in sealed quartz glass tubes. The density of the liquid was determined by observing its expansion up to the temperature at which the meniscus vanished, which was found to be 705·2° F. The density of the vapour was determined by using smaller quantities of water and observing the temperature at which the liquid was completely evaporated. The densities did not become equal at the temperature at which the meniscus vanished but were in the ratio of 5 to 3.

A method of determining the total heats in the critical region gave values consistent to 0·1° F. and corresponded remarkably well with the density measurements. The latent heat at 705·2° F., where the meniscus vanished, was found to be 130 B.T.U. per lb. and the saturation lines for liquid and vapour do not meet at 705·2° F. but at 717° F. and at a pressure of 3650 lb., while the density curves from the quartz tube experiments do not meet at 705·2° F. in a parabola but at about 717° F. when extrapolated.

In discussing a diagram of total heat plotted to a base of log pressure, a statement is made which suggests that with steam at an initial temperature of 670° F. a higher thermal efficiency is obtained with 500 lb. per sq. in. than with 1000 lb. per sq. in. initial pressure. The reference is to the dry region, and presumably therefore only a small range of expansion is considered. However, if the comparison is made on a practical basis, with expansion to a common final pressure of such value as obtains in an ordinary steam power plant, the higher initial pressure produces a considerable gain in thermal efficiency, because not only is the available energy due to adiabatic expansion greater, but also the heat input is less. These facts are quite easily established by calculating the required values from any published tables of properties of steam, including those published by Prof. Callendar himself. It is unfortunate that this wrong impression should be created by a statement of so great an authority on the subject, particularly at a time when progressive engineers everywhere are fighting against conservatism in their effort to introduce higher initial steam pressures into large steam power plants with the object of improving the overall efficiency.

University and Educational Intelligence.

EDINBURGH.—The degree of D.Sc. has been conferred upon Prof. R. S. Adamson for his thesis on studies in plant ecology and in plant anatomy, and on Robert Neil Chrystal for his thesis on *Sirex* and the *Ibalia* parasite—the biology and post-embryonic development of *Ibalia leucospoides*.

ST. ANDREWS.—The Court has approved the nomination of Dr. E. T. Copson, formerly scholar of St. John's College, Oxford, lecturer in mathematics in the University of Edinburgh and honorary secretary of the Edinburgh Mathematical Society, as lecturer in mathematics and applied mathematics in succession to Dr. William Saddler, who has recently been appointed to the chair of mathematics at Christchurch, in the University of New Zealand.

MEMORANDA have been issued regarding the various Commonwealth Fund Fellowships available in 1930. The fellowships are open to British graduate students and tenable in American universities. As many as thirty fellowships, tenable for two years, are available to graduates of British universities who are domiciled in the British Isles, are of British descent, unmarried, and less than thirty years of age. Not more than five fellowships are also available on similar terms to graduates from any of the British Dominions. A further class of fellowships, limited to three a year, is offered to overseas government officers in the actual employ of the Government of Great Britain, India, or any of the Dominions; the age limit for these fellowships is thirty-five years and they may be married. Every fellow appointed has to submit a course of study or research, and is expected to travel about the United States in connexion with his work. There is no fixed emolument, but each fellowship is estimated to cost the Fund about £600 a year. Particulars and application forms, to be returned by Feb. 10, can be obtained from the secretary, Mr. R. H. Simpson, Commonwealth Fund Fellowships, 50 Russell Square, London, W.C.1.

THROUGH the generosity of Mr. P. F. Holmes and Mr. D. M. Henshaw of Huddersfield, there has been placed in the hands of the Institution of Gas Engineers a fund for the purpose of endowing a scholarship to be called the William Cartwright Holmes Scholarship, which shall be tenable at the University of Leeds by a student taking a course in preparation for a responsible position as a gas engineer. The scholarship is of the value of £150 per annum for three or four years. The donors of the scholarship state that "their first desire was to perpetuate the name of William Cartwright Holmes, and secondly to show appreciation of the training obtained by students of Gas Engineering at Leeds University and of the valuable research work done in the Department of Coal Gas and Fuel Industries". The foundation of such a scholarship is a very practical means of assisting to meet the national need at the present time for trained fuel technologists which was stressed by the National Fuel and Power Committee in its recent report and by Prof. J. W. Cobb in his last report as Livesey professor of the Department of Coal Gas and Fuel Industries in the University of Leeds.

Historic Natural Events.

Jan. 12, 1914. Eruption of Sakura-jima.—A violent eruption occurred in the island volcano of Sakura-jima in south Japan. It was preceded by many tremors on Jan. 11, and these led the authorities to order the removal of the inhabitants, and all of them (more than 23,000 in number) were saved. Lava flowing down the east side filled up the narrow strait and converted Sakura-jima into a peninsula. The total volume of ashes and lava ejected was estimated at one-half a cubic mile. New surveys showed that most of the volcano was uplifted, in one place by 41 feet. Outside the island, the ground was depressed by so much as 20 inches within an irregular circle about 28 miles in diameter.

Jan. 14, 1716. High Tide during Frost Fair.—The winter of 1715–16 was very cold in England and over the whole of Europe. At Paris the thermometer fell to −4° F. on Jan. 22. A fair, with booths and printing presses, was erected on the frozen Thames; on Jan. 14 there was an uncommonly high spring tide, which raised the ice fourteen feet without interrupting the progress of the fair.

Jan. 15, 1662. Mild Winter.—Under this date Samuel Pepys records in his diary: "It is a fast day ordered by the Parliament, to pray for more seasonable weather, it having hitherto been summer weather, that is, both as to warmth and every other thing, just as if it were the middle of May or June, which do threaten a plague (as all men think) to follow."

Jan. 16, 1362. Gale.—A gale began about the time of evensong and continued for six or seven days in the south of England, stronger than had been known for many years. It blew down towers, steeples, houses and chimneys, and even the buildings that were not overthrown were rendered unsafe. It was followed by a very wet season in summer and harvest.

Jan. 16, 1614. Frost.—It is recorded in Drake's "Eboracum" that on Jan. 16 "it began to snow and freeze, and so by intervals snowing without any thaw till the 7th of March following, at which time was such a heavy snow upon the earth as was not remembered by any man then living. It pleased God that at the thaw fell very little rain, nevertheless the flood was so great that the Ouze ran down North Street and Skeldergate with such violence as to force all the inhabitants of those streets to leave their houses. . . . Ten days this inundation continued at the height, and many bridges were broken down by it in the country, and much land overflown."

Jan. 17, 1830. Severe Winter.—On the continent of Europe the winter of 1829–30 was one of the most rigorous known in history. On Jan. 17 the thermometer at Paris fell to 1° F. and public 'warmers' were established in the streets. In Switzerland, instead of snow, small compact crystals of ice fell, as in polar regions. In Normandy the snow was more than six feet deep, and many wood gatherers were lost. The frost was especially severe in Spain, where communications were interrupted, many lives were lost, and many thousands of cattle. Bands of wolves, driven from the mountains by the snow, caused great ravages among the herds and killed many people. In England this winter was not especially severe.

Jan. 17, 1881. Low Temperature in Britain.—On Jan. 7–26 severe frost prevailed over the whole of Great Britain and Ireland, unequalled since the winter of 1814. The lowest temperatures occurred on Jan. 17, when the thermometer fell below zero over the south of Scotland and the north of England, reaching −22° F. at Blackadder (Berwickshire), −16° at Kelso, −15° at Stobo, and −11° at Lauder, all in the valley of the Tweed. Again on Jan. 26 a temperature of −16° F. was recorded at Blackadder, but there is some doubt whether the exposure of the thermometer at this station was satisfactory. These low temperatures all occurred during a period of light northerly winds.

Jan. 18, 1881. Great Snowstorm.—A barometric depression, which originated off the east coast of the United States on Jan. 10, crossed the Atlantic in a general easterly direction, and on the evening of Jan. 17 it traversed the Bay of Biscay. At 8 A.M. on Jan. 18 it was very intense and lay near the Channel Islands, and throughout that day it moved slowly and rather irregularly over the central parts of the English Channel before passing away to Germany on Jan. 19. Over the Midlands, east and south-east England, the most violent easterly gale on record blew throughout Jan. 18, the velocity at Yarmouth being 73 miles an hour for fifteen minutes between 3 and 4 P.M. The gale was accompanied by heavy snowstorms over nearly the whole of England, and in many places the railway lines were completely blocked for many hours. In London the snowstorm was the worst within living memory, and owing to the high wind curious drifting effects were experienced, some streets being perfectly clear on one side but heavily piled with snow on the other. The fall was especially heavy in the Isle of Wight, where it was quickly followed by a second on Jan. 20; in Cowes there were drifts in the streets 12 feet deep.

Jan. 18, 1926. Hurricane.—A very violent hurricane ravaged all the Canary Isles. Torrential rain overflowed the water-courses and a great deal of damage was done by rain and wind. At Las Palmas scarcely a house was left standing.

Societies and Academies.

PARIS.

Academy of Sciences, Nov. 25.—L. Mangin: Notice of Sir Ray Lankester, foreign associate of the Academy.—Gabriel Bertrand and L. Silberstein: The estimation of sulphur and phosphorus in plants. It was proved that the proportion of sulphur remaining in the ash is always less than that which exists in the plant, the losses ranging from 44 per cent to 76 per cent. There is also a loss of phosphorus during calcination to ash, but the losses are much less, from 0·2 per cent to 7 per cent of the amount present.—J. A. Le Bel: The sparks which are emitted by stalactites when violently struck with a steel tool. It was at first supposed that these sparks were due to the presence of quartz particles in the rock, but it was later proved that no hard particles were present. The phenomenon is probably due to triboluminescence.—G. Friedel and V. Maikowsky: Temperature measurements in borings. The thermometer consists of an ungraduated bulb with capillary tube, with the upper end open and ground to a plane face making an angle of 45° with the tube. The actual temperature at which the tube is exactly full, corresponding to the temperature attained in the boring, is easily determined in the laboratory.—Ernest Esclangon was elected a member of the Section of Astronomy in the place of the late P. Puiseux.—Herbert Ory: The extraction of roots.—H. Milloux: Some properties of meromorph and holomorph functions.—Joseph Pérès: Some results concerning the stability or the regularity of the movement of a viscous liquid.—G. P. Arcay: Contribution to the experimental study of the deformation of the flat spiral. From the experimental evidence given in the paper, it is concluded that the static deformation and the kinematic deformation of

the flat spiral, corresponding to the same position of the balance wheel, are in all cases identical. Consequently, it is legitimate to utilise the method of static deformations as a method of experimental control.—**Louis Hirschauer** and **Augustin Talon**: The auto-railroad proposition for rapid transport with high duty.—**G. Bruhat** and **R. Legris**: The rotatory dispersion of tartaric acid and of the alkaline tartrates in aqueous solution.—**Jean Thibaud** and **Jean J. Trillat**: The effects of filtration of the general radiation on the X-ray diagrams of liquids. The determination of absorption coefficients. The existence of a secondary diffraction ring due to the general radiation, shows the necessity, in researches on the molecular structure of substances radiographed in thicknesses of several millimetres, of precautions against the formation of the secondary ring. For this, either the radiation may be made monochromatic by reflection from a crystal, or an absorbing sector of aluminium may be placed near the film.—**M. Bourguel** and **Mlle. V. Gredy**: The mechanism of catalytic hydrogenation. Whatever may be the mode of working, the initial velocity of hydrogenation is, for a given substance, independent of the weight of material to be hydrogenated. The activity of the catalyst is a diminishing function of the initial concentration. The results can be best explained by the assumption of an initial action of the hydrogen on the metal (palladium).—**L. Meunier** and **K. Le Viet**: The hydrophil properties of collagen. Any substance capable of lowering irreversibly the capacity of the collagen for swelling is a tanning substance, and its astringency is measured by the intensity of this lowering.—**Jacques Bardet** and **Arakel Tchakirian**: Some combinations of germanium oxide and oxalic acid. Experimental evidence is given for the existence of a complex germano-oxalic acid: it was not possible to isolate a definite compound, but $H_2Ge(C_2O_4)_3$ is probably present in the solution.—**Mme. Ramart-Lucas** and **F. Salmon-Legagneur**: Stability in absorption spectra. The absorption in the ultra-violet of the dibasic acids of the fatty series.—**P. Mondain-Monval** and **R. Quanquin**: The temperature of spontaneous inflammation of gaseous mixtures of air and saturated hydrocarbons. The influence of the pressure and of preliminary heating. Supplementing earlier work in which the oxidation was carried out under high pressures, experiments at the ordinary pressure are described. With pentane, aldehydes were detected at 200° C., and were produced in quantity at 325° C. The presence of formaldehyde, acetaldehyde, butyraldehyde, and fatty acids was proved.—**G. Dupont** and **J. Lévy**: The autoxidation of abietic acid. The action of catalysts. In a previous communication the autoxidation of abietic acid was shown to be a typical example of autocatalysis. The influence of the addition of catalysts has now been studied: cobalt abietate proved to be the most active positive catalyst.—**Lucien Dupont**: The action of caustic alkalis at high temperatures on albumenoids. The proportions of oxalic, benzoic, and various fatty acids obtained by potash fusion at 325° C. are given for gelatine and for egg albumen.—**J. Grard**: Some reactions of propargyl acetal.—**A. Guyot** and **M. Fournier**: A new general method for the preparation of primary and secondary amines. The reaction proposed is $R \cdot CH_2OH + R'NH_2 = R \cdot CH_2 \cdot NHR' + H_2O$. This takes place in an autoclave in the presence of reduced nickel at temperatures from 150° to 190° C. If ammonia is used in place of the primary amine, both primary and secondary amine are formed in proportions depending on the temperature. The yields are high and the method appears to be general.—**D. Ivanoff**: Some properties of the true mixed organomagnesium carbonates.—**L. Royer**: New observations on the asymmetry of the corrosion figures obtained by an active isotropic liquid.—**E. Raguin**: Subdivisions of the layer of bright schists in Haute-Maurienne.—**Yang Kieh**: The massif of crushed pegmatite situated at the southern edge of the geological sheet of Aigurande (scale 1/80,000).—**Marcel Thoral**: Palæontological discoveries in the Cambrian and Silurian of the mountains of Lacaune to the north of the Montagne Noire.—**J. Thoulet**: Isothermal oceanic liquid cones of whirling.—**R. Combes** and **M. Piney**: Proteolysis and proteogenesis in ligneous plants during the summer and autumn.—**A. Orékhoff**: The alkaloids of *Anabasis aphylla*. This plant, which grows wild in Turkestan and Transcaucasia, is known to be very poisonous. A new base, anabasine, $C_{10}H_{16}N_2$, has been extracted from the dry plant and prepared pure. Other bases, not so far obtained pure enough for analysis, are also present.—**G. Nicolas** and **Mlle. Aggéry**: A new example of generalised bacterial infection in plants.—**J. André Thomas**: The phenomena of modification of toxic attack of the Convoluta as a function of their grouping.—**Jean Saidman**: Radiotherapy of ærophagy.

Dec. 2.—**Marcel Brillouin**: The dynamical tides of an ocean comprised between two parallels. Law of depth in latitude and longitude. The organisation of the calculations.—**Léon Guillet** and **Marcel Ballay**: The corrosion of steels after cementation or formation of nitride.—Charles Nicolle was elected a non-resident member in the place of the late Ch. Depéret.—**O. Borůvka**: Projectively deformable surfaces which admit a group of ∞' projective transformations in themselves.—**Fatou**: A criterion of stability.—**Nicolas Théodoresco**: The application of a formula generalising the Cauchy integral to a hydrodynamical question.—**Jean Courrégelongue**: The existence of two families of vortices behind immerged solids.—**L. Ravier**: A general formula for the calculation of the thrust of the soil.—**Paul Woog**: The extension of lubricants on solid surfaces. Molecular influences. The rôle of photolysis.—**Marcel Chopin**: The flow of gas through an orifice in a thin wall at variable temperatures.—**P Swings**: The resonance series of sulphur vapour.—**L. Goldstein**: The relativist treatment of the problem of several bodies.—**Frédéric Joliot**: The electrochemical properties of polonium.—**Mlle. Dorabialska**: The heat evolved by polonium. The amount of heat evolved, reduced to a quantity of polonium in radioactive equilibrium with 1 gram of radium, was found to be 24 calories per hour. This figure is given with reserve, since it is distinctly below that deduced from the heat measured for radium and its derivatives.—**Maurice Lecat**: The prediction of binary azeotropism.—**Roger Lyon**, **G. Fron**, and **Fournier**: The influence of artificial ageing on the mechanical properties of wood. Data are given showing the effects of mild and drastic treatment with ozone on wood.—**Raymond Hocart** and **Jacques de Lapparent**: The bœhmite of bauxites. The identity of Bœhm's 'bauxite' with bœhmite was proved by the application of Debye and Scherrer's method.—**Constant Ktenas**: New researches on the petrochemical characters of the caldeira of Santorin.—**Maurice Couvreur**: Note on the conformal and non-conformal siliceous epigeny of the testa of Lamellibranchs.—**H. de Böckh** and **P. Viennot**: The geology of Iraq.—**Raymond Furon**: The position of the palæozoic grits to the north of the middle Niger (French Sudan).—**Y. Milon**: The presence of glauconite in the Pliocene sands of Brittany.—**G. Pontier** and **R. Anthony**: The presence of four upper incisors in the *Mastodon* (*Tetrabelodon*) *turicensis*.—**Georges Malençon**: The first stages of germination of the

spores of the genus *Elaphomyces*.—**Paul Guérin**: The proportion of hydrocyanic acid in the genus *Lotus*. Determinations of the amount of hydrocyanic acid in twelve species of *Lotus* have been made. The proportions found depend on the time of year the specimens were collected, and also on the climate.—**Georges Truffaut** and **I. Pastac**: The chemotherapy of plant diseases by organic colouring matters. It has been proved that certain colouring matters, innocuous to the higher animals, can prevent the development of moulds (*Rhizopus nigricans*, *Penicillium glaucum*). The treatment has been successfully applied to diseases of the vine and of wheat.—**Laurent Raybaud**: The action of germinated seeds in feeding. Sterile germinated grain has marked beneficial effects when taken with other food. It has proved especially valuable with rickets in children.—**Jean Piveteau**: A new type of fossil fish from the north of Madagascar.—**Emile P. Terroine** and **Mlle. Thérèse Reichert**: The action of mineral substances on endogenous nitrogen metabolism.—**P. Vayssière**: The migratory Acridians in French Africa during the year 1929.—**L. Lavauden**: The wild cat of Corsica.—**Ch. Pérard**: The caoutchouc conger. In the fish market at Paris congers are occasionally sold the flesh of which differs from that of the normal conger eel, resembling india-rubber, hence its name. Analyses of the flesh of the abnormal eel showed that its consistency was due to a reduction in fat, 0·4 per cent instead of 9 per cent, and this was shown to be due to a concentration of the fat in the ovary.—**Marc de Larambergue**: Cytological study of autofertilisation in *Limnæa auricularia*.—**W. Arciszewski** and **W. Kopaczewski**: The buffer power of serum. Human serum can be treated with either acid or base to a concentration of about $M/2000$ without change in the concentration in hydrogen ions or hydroxyl ions. This buffer action extends to other ions. The serum offers resistance to any change in its surface tension.—**L. Marchlewski**: Researches on phylloerythrin. Phylloerythrin is a product of metabolism of chlorophyll and is identical with the bilipurpurin of Löbisch. Its composition is represented by $C_{33}H_{34}N_4O_3$, and when crystallised from chloroform it gives crystals containing one molecule of chloroform to two molecules of phylloerythrin.—**Maurice Piettre**: The influence of neutral salts on the separation of proteins by the acetone method. The effect of salts (magnesium sulphate) is very important in the separation of proteins by the acetone method. Small quantities of neutral salts prevent, or at least render difficult, the isolation of the proteins of the globulin group.—**Marage**: The causes and consequences of the deafness of Beethoven.—**Ch. Champy** and **M. Heitz-Boyer**: The mechanism of the action of the electrical knife with high frequency. Thermal and mechanical effects of high-frequency currents on the tissues.

Official Publications Received.

BRITISH.

The Common Commercial Timbers of India and their Uses. By H. Trotter. Pp. x+153+13 plates. (Calcutta: Government of India Central Publication Branch.) 1.12 rupees; 3*s*.

Canada. Department of Mines: Mines Branch. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories), 1927. (No. 696.) Pp. ii+107+10 plates. (Ottawa: F. A. Acland.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1233 (Ae. 388): The Graphical and Analytical Determination of Stresses in Single Span and Continuous Beams under End Compression and Lateral Load with variations in Shear, Distributed Load and Moment of Inertia. By H. B. Howard. (L.F. 15.) Pp. 30+18 plates. 2*s*. net. (London: H.M. Stationery Office.)

Survey of India. Geodetic Report, Vol. 3: From 1st October 1926 to 30th September 1927. Pp. xii+163+19 plates. 3 rupees; 5*s*. 3*d*. Professional Paper, No. 22: Three Sources of Error in Precise Levelling. By Capt. G. Bomford. Pp. iii+40+5 plates. 1.8 rupees; 2*s*. 6*d*. (Dehra Dun.)

FOREIGN.

Department of the Interior: U.S. Geological Survey. Professional Paper 158-A: The Occurrence and Origin of Analcite and Meerschaum Beds in the Green River Formation of Utah, Colorado and Wyoming. By Wilmot H. Bradley. (Shorter Contributions to General Geology, 1929.) Pp. ii+7+3 plates. (Washington, D.C.: Government Printing Office.)

R. Osservatorio Astrofisico di Catania. Annuario 1930. Pp. iv+50. (Catania.)

Guide to the Institute of Physical and Chemical Research, Tokyo. Pp. 50. (Tokyo.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 214-218: Über Celluloseamin und Celluloseanilin, von Ichiro Sakurado; Benzyläther der Cellulose, von Tadashi Nakashima; Stupeca Fenomeno če la Senakvigo de Kalcio Sulfato, de Sigeru Yamane; On the Difference of Behaviours of Different Parts of Three-Part Spark in Igniting Combustible Gas Mixture, by Torahiko Terada, Kiyohiko Yumoto and Ryûzô Yamamoto; Thermal Conductivity of Snow, by Masao Kuroda. Pp. 113-159. (Tôkyô: Iwanami Shoten.) 65 sen.

CATALOGUES, ETC.

Siemens Loaded Submarine Telephone and Telegraph Cables. (Pamphlet 200A.) Pp. 62. (London: Siemens Brothers and Co., Ltd.)

Calendar for 1930. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.)

The Nickel Bulletin. Vol. 2, No. 6, December. Pp. 177-224. (London: The Mond Nickel Co., Ltd.)

Bibliography: a Catalogue of Books, Pamphlets, Tracts, etc., relating to all that concerns the Production, Collection and History of Books. (Catalogue 521.) Pp. 64. (London: Francis Edwards, Ltd.)

B.D.H. Vitamin Products. Pp. 23. (London: The British Drug Houses, Ltd.)

Vancoram Review: including a Résumé of Current Literature on Vanadium, its Alloys and Compounds. Vol. 1, No. 1, October 1929. Pp. 35. (New York: Vanadium Corporation of America.)

The Detection and Investigation of Poisons by Spectroscopy. Pp. 18. (London: Adam Hilger, Ltd.)

Diary of Societies.

FRIDAY, JANUARY 10.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—H. G. Watkins: By Canoe and Dog Sledge in Labrador (Christmas Lectures) (2).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir Basil P. Blackett: The Economic Progress of India.

ROYAL ASTRONOMICAL SOCIETY, at 5.—E. A. Kreiken: The Frequency of Double Stars of Different Spectral Types and Absolute Magnitudes.—J. Jackson: The Shortt Clocks of the Royal Observatory, Greenwich, with Special Reference to the Effect of Variation in Arc.—H. Jones: Deviations from Boyle's Law in Stellar Interiors.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—L. C. Burrill: Design and Construction of the Rail-car-carrying Steamship *Seatrain*.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.—Dr. E. K. Rideal: Some Aspects of Surface Chemistry and their Industrial Implications.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Free Trade Hall, Manchester), at 7.—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Prof. T. P. Hilditch: Recent Research on Fats bearing upon the Drying of Oils in Paint and Varnish.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff Technical College), at 7.15.—E. H. Williams: Graphitic Lubricants.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. J. N. Riddle: The Track Circuit in Railway Signalling.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—J. Pringle: The Geology of Ramsey Island (Pem.).—*Papers to be taken as read*:—The Palæobotany of the Kent Coalfield, Dr. R. Crookall and J. Pringle; The Preparation of Thin Sections of Friable and Weathered Materials by Impregnation with Synthetic Resins, R. J. Schaffer and P. Hirst.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Burlington House), at 8.—J. R. Booer: Autogenous Welding in Chemical Works.

PHILOLOGICAL SOCIETY (at University College), at 8.—G. G. Loane: Notes on N.E.D.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Dr. F. W. Edridge-Green: The Influence of the Parafoveal on the Foveal Region of the Retina.—J. D. N. Cardell: Krukenberg's Spindles.—E. Wolff: A Microphthalmic Family.

SATURDAY, JANUARY 11.

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Manchester Athenæum), at 6.30.—J. R. Wollaston: Recent Developments in Steam Generation.

MONDAY, JANUARY 13.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—G. Bond: The Occurrence of Cell Division in the Endodermis.—D. Catcheside; Chromosome Linkage and Syndesis in *Œnothera*.—D. R. R. Burt: A Case of Intersexuality in *Bos indicus*, with a Theory of the Significance of the Genetic Male Intersex.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—A. Davies: The Co-ordination of Transport.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—H. K. Whitehorn: Petrol-Electric Vehicle Characteristics.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—A. Morgan and others: Discussion on Efficiency.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—H. W. Taylor: Voltage Control of Large Alternators.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.—H. A. Leadbeater: Oil *versus* Solid Fuels.

CERAMIC SOCIETY (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.—J. W. Thompson: A New Method of Decoration of Glazed Tiles.—N. D. Wood: Research into the 'Buckling' of Floor Tiles.—R. M. Colles: Heat Losses from Exposed Surfaces.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—A. Wragg: Extrusion, and a Consideration of some of the Physical Properties affecting the Production of Rods, Tubes, and Sections by this Process.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Dr. T. F. Chipp: Forests and Plants of the Anglo-Egyptian Sudan.

INSTITUTE OF BREWING (London Section) (at Charing Cross Hotel).—J. Stewart: Malting Barleys of 1929.

TUESDAY, JANUARY 14.

SOCIETY FOR THE STUDY OF INEBRIETY (at Medical Society of London), at 4.—Dr. W. Brown and others: Discussion on The Rôle of Psychotherapy in the Prevention and Treatment of Alcoholism and other Drug Addictions.

MINERALOGICAL SOCIETY, at 5.30.—Sir Douglas Mawson: On the Occurrence of Potassium Nitrate near Goyder's Pass, McDonnell Ranges, Central Australia.—Dr. L. T. Nell: On a New Occurrence of Zunyite near Postmasburg, South Africa.—F. N. Ashcroft: Exhibiting Minerals from Broken Hill, Rhodesia, and Other Localities.—W. Campbell Smith: Exhibiting Specimens and Photomicrographs of Volcanic Rocks from Kenya Colony.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—A. A. Ashworth: Efficiency in the Distillation of Light Oils from Crude Oil.

INSTITUTION OF CIVIL ENGINEERS, at 6.—A. E. L. Chorlton: Railway Traction by Oil-Engines.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Eng. Rear-Adml. W. M. Whayman: Water Tube Boilers for Merchant Ships.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Midland Centre) (at Hotel Metropole, Leeds), at 7.—I. Scott Mackenzie and others: Discussion on Colliery Electrification.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.

MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester), at 7.—H. Keat: Insurance of Goods against Marine Risks.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—I. M. Thomson: The Bittern and its Neighbours.

BURNLEY TEXTILE SOCIETY (at Burnley), at 7.15.—J. Leigh: Ropes and Rope Driving.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—J. B. Hoblyn: Aluminium Alloys from the Users' Point of View.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—L. Wright: Chromium Plating.

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—J. M. Offord: Fifty Years with the Quekett Microscopical Club.

WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall, Blackheath), at 8.30.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. M. Critchley: The Psychology of the Senile Psychoses.

PHARMACEUTICAL SOCIETY, at 8.30.—P. A. W. Self: Research (Harrison Memorial Lecture).

INSTITUTE OF BREWING (Scottish Section) (Annual General Meeting) (at Caledonian Hotel, Edinburgh).—A. C. Doull and S. E. Barnett: A Few Notes on some Physical Aspects of Fermentation and their Relationship to Brewing Practice.

WEDNESDAY, JANUARY 15.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.30.—J. P. Lockhart-Mummery: Cinematographic Demonstration of The Operation of Perineal Excision of the Rectum, to be followed by a Clinico-Pathological Meeting.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—Prof. S. M. Dixon: Developments in Transportation by Cableways.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—H. A. Thomas: A Method of Measuring the Overall Performance of Radio Receivers.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—R. D. Burn: Methods of Filtration in Industry.

BACUP TEXTILE SOCIETY (at Natural History Rooms, Bacup), at 7.30.—H. Maude: Plain Calico Weaving.

TEXTILE INSTITUTE (Yorkshire Section) (at White Swan Hotel, Halifax), at 7.30.—H. W. Martin: Humidification in Textile Works.

ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting), at 7.40.—Sir Richard Gregory: Weather Cycles and Weather Recurrences (Presidential Address).—Presentation of Symons Medal to Dr. G. C. Simpson.

ROYAL SOCIETY OF ARTS, at 8.—J. Burton: Quality in Pottery.

ENTOMOLOGICAL SOCIETY OF LONDON (Annual Meeting), at 8.

FOLK-LORE SOCIETY (at University College), at 8.—Dr. W. R. Halliday: Some Notes on the Superstitious Man of Theophrastus.

ROYAL MICROSCOPICAL SOCIETY (Annual General Meeting), at 8.—J. E. Barnard: Resolution and Visibility in Medical Microscopy (Presidential Address).

HASLINGDEN DISTRICT TEXTILE SOCIETY (at Grammar School, Haslingden).—H. L. Trudgill: Slay Construction and the Care of a Fast Reed Slay.

SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at University College, Nottingham).—Dr. S. G. Barker: Measurement of Fading.

SOCIETY OF GLASS TECHNOLOGY (at Sunderland).

THURSDAY, JANUARY 16.

ROYAL SOCIETY, at 4.30.—J. R. Marrack and F. C. Smith: The Composition of Diphtheric Toxin—Anti-Toxin Floccules.—F. G. Spear: The Delayed Lethal Effect of Radium on Tissue Cultures *in vitro*.—J. T. Cunningham: The Vascular Filaments on the Pelvic Limbs of *Lepidosiren*, their Function and Evolutionary Significance.—*To be read in title only*:—Sir Frederick Keeble, M. G. Nelson, and R. Snow: The Integration of Plant Behaviour. I. Separate Geotropic Stimulations of Tip and Stump in Roots.—C. Todd: Cellular Individuality in the Higher Animals, with special reference to the Individuality of the Red Blood Corpuscle.—J. Ewles and J. B. Speakman: Examination of the Fine Structure of Wool by X-Ray Analysis.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. J. E. Littlewood: Mathematical Notes (12); On Functions Subharmonic in a Circle (III.).—R. E. A. C. Paley: On Some Problems connected with Weierstrass's Non-Differentiable Function.—S. Verblunsky: On the Limit of a Function at a Point. On the Denjoy A-integral.—Dr. D. M. Wrinch: On an Integral Involving Legendre Functions and Related Integrals.

INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—J. Fallon: Modern Annealing Furnaces.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group—Informal Meeting), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.30.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.—T. G. N. Haldane: The Heat Pump—An Economical Method of Producing Low-Grade Heat from Electricity.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.—Short Papers.

BATLEY AND DISTRICT TEXTILE SOCIETY (at Batley Technical College), at 7.30.—Celanese, its Manufacture, Properties, and Uses (Lecture).

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—O. G. Hay: The Ross Modification of the Hilger Interferometers for Testing Large Optical Elements.—J. S. Preston: The Reflection Factor of Magnesium Oxide.—*Exhibits and Demonstrations*:—Raphael's Ltd.: Scientype Occluding Glass for Use in the Treatment of Squint; A Visual Test with a New System of Equi-photic Illumination.

CHEMICAL SOCIETY, at 8.—C. E. Coulthard, J. Marshall, and Prof. F. L. Pyman: The Variation of Phenol Coefficients in Homologous Series of Phenols.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Prof. Kuczynski: The Etiology of Yellow Fever with Special Reference to the Etiology of other Insect-Borne Diseases.

BRITISH INSTITUTE OF RADIOLOGY, at 8.30.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Wireless Apparatus for Aircraft.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Institution of the Rubber Industry) (at 39 Elmbank Crescent, Glasgow).—W. A. Williams: Electro-deposition of Rubber.

TODMORDEN TEXTILE SOCIETY (at Todmorden).—R. Holt: Defects in Yarn and how to avoid them.

FRIDAY, JANUARY 17.

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.—Dr. V. Coates: Tissue Reaction in Rheumatic Disorders, with Particular Reference to Subcutaneous Nodules.

BRITISH INSTITUTE OF RADIOLOGY, at 5.—Radiology in Bone and Joint Diseases.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Prof. E. C. C. Baly: The Activated Sludge Process for Sewage Disposal.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—T. Walley: The Pooling of Experience—a Function of the Institution.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—J. D. Johnston: Photographic Conventions.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—G. Andrew-Marshall: London's Water Supply.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).

SATURDAY, JANUARY 18.

NELSON TEXTILE SOCIETY (at Preston Technical School).—C. A. Harrington: Designing of Fancy Fabrics.

PHYSIOLOGICAL SOCIETY (at King's College).

PUBLIC LECTURES.

MONDAY, JANUARY 13.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—W. S. Mansfield: Systems of Cropping to meet Modern Conditions.

TUESDAY, JANUARY 14.

GRESHAM COLLEGE, at 6.—A. R. Hinks: Universe Studies: The Massive Centre of the Galaxy. (Succeeding Lectures on Jan. 15, 16, and 17.)

WEDNESDAY, JANUARY 15.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Great Portland Street Extension of Regent Street Polytechnic), at 5.30.—M. C. Burkitt: Most Primitive Art.

THURSDAY, JANUARY 16.

KING'S COLLEGE, at 5.30.—Lieut.-Gen. H. B. Fawcus: The Royal Army Medical Corps.