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Craftsmanship in Modern Industry.

IN the building of the Jewish tabernacle some 3500 years ago a very high order of skill was demanded, and implied not only all manner of workmanship in metals, stones, and wood, every kind of cunning work, but also wisdom, understanding, and knowledge. The spirit of Bezaleel has persisted down to this day, and there are still clever workmen, possibly more in Great Britain than in any other country, unspoiled by excessive specialism, highly trained in hand and brain, and of dependable character. But, as Prof. Marshall has observed, skill is a very elastic and relative term, and has varying standards according to the state of general education among a people, their progress in industrialism, and their gifts of mother-wit or native sagacity.

Of late years the view has rapidly gained ground that skill, as generally understood, is required in modern industry in ever-lessening extent; the demand for it declines at an ever-accelerating pace. That the division of labour, extreme specialism, mass production, and scientific management are predominant features of industry to-day is generally taken for granted, though possibly they are not so predominant as is sometimes imagined; and in the degree to which they have been adopted there is probably no doubt that they have involved an increase in the amount of unskilled and possibly monotonous work, both absolutely and relatively. In any event, we are told that the quicker the whole of industry adopts these principles the better, unless it would perish miserably; and when these principles have been adopted, then skill, as we ordinarily understand it, will have become an anachronism. Perhaps it would be better to perish. Certainly the social effects of any substantial decline in the amount or degree of skill demanded from the whole body of industrial workers, including herein clerks, salesmen, draughtsmen, etc., would be deplorable; and there is no need here to elaborate on the philosophy of work and all that it implies in development of character and much else. The paramount need of work of the right kind for every healthy human being is well understood in all its implications.

Faced with such an apparently dark and perilous outlook, somewhat akin to that portrayed by those who speak glibly of the so-called 'machine terror', the economist and student of industry must make it his business to examine thoroughly such alleged tendencies and impressions, and, avoiding vague generalisation unsupported by tangible evidence,

endeavour to get down to a quantitative basis, secure measurable data, and so place the whole discussion on a strictly scientific footing. If economics is the science it claims to be, it should be able to do this. On the assumption, which cannot always be fully acceded, as will shortly be shown, that skill is rapidly dying out, various remedial suggestions have been made; such, for example, as more frequent change of occupation in the factory—a common practice in the Ford works; also, with or without a shortening of the hours of repetitive work, greater opportunity in leisure hours for some form of handicraft or hobby or 'satisfying' recreative work. This latter is certainly in any case a meritorious movement and should be heartily encouraged, as in Italy, where concentrated attention is now being directed to what is called *dopo lavoro*, or after-work occupation.

There are other factors which would militate against the alleged decline in the demand for skill which have not been so much consciously or purposely introduced, but have developed or evolved as industry itself has developed. But to take full advantage of these new growths, it is of course necessary to widen our definition of industrial worker to include not only the men and women in the factory, but also those in the office, for example, the clerks, salesmen, draughtsmen, and other categories. For these must be included if the aggregate amount of skill is in question, and thus at this point we are entitled to emphasise very strongly the fact that these categories have grown enormously of late years, and are constantly growing in proportion as the need for highly trained men in these different spheres becomes more keenly realised. They are characteristic of the modern age: salesmanship and publicity in the olden days were unknown or existed in a very crude form; accountancy, especially costing, the keeping of factory records, and all the multifarious operations involved in the management of a modern factory were formerly almost non-existent, but require to-day large numbers of highly skilled men. Consider also the numbers now employed in the drawing office, the research department, on intelligence and other work, and it will be realised that in the vast complexity and super-organisation of modern industry there are an almost infinite number of openings for highly trained men. The demand for such men, indeed, is often said to exceed the supply.

However, it is not proposed to make too much of these new developments, or to rely on them entirely to refute the common assumption of decaying skill. They at least entitle one to say that skill is not necessarily reduced in the aggregate, but rather changed in direction. From the point of view of the skilled or cunning workman, in cases where he has not migrated into one of the many new openings noted above, there is no doubt that in the design and manufacture of the wonderful and intricate machinery by which alone mass production is possible, the skilled workman is finding an ever-widening field; and who can say that the present form of mass production, with possibly a maximum utilisation of unskilled labour, is the final form or development of modern industry? All things industrial are in flux and transition. No doubt it is difficult enough sometimes to discern very clearly whither we are travelling. At present, industry has brought about a vast number of opportunities for unskilled work requiring little or no training, and much of this work has been taken over by women who otherwise would not go to work at all, although a few more might go into domestic service than is now the case. The position of the male workers who alone, apart at least from the textile trades, can come into comparison between the present and the past in the matter of skill is to this extent almost unchanged.

Remarkable confirmation of this conclusion, so far as it concerns an industry where mass production is predominant, has recently been given by Mr. C. G. Renold, of Messrs. Hans Renold, Ltd., Manchester, in a recent paper in the *Economic Journal*, providing that quantitative basis so much needed in these discussions. The works' records include an analysis of employees classified according to skill at three different periods—1913, 1927, 1928. Skill is used in an industrial sense and includes the black-coated groups. It implies dexterity, knowledge, judgment, and takes something like two or three years to acquire under actual experience of the job. Tables are given showing, *inter alia*, (1) increase in craftsmen category; (2) reduction in semi-skilled machine operators and unskilled labourers owing to use of more elaborate machinery giving greater output with less manning, the increased use of skilled men on such machines, and more women for unskilled work; (3) less 'upper staff' and 'male clerical'; (4) large increase in number of women employed. Other tables give interesting data as to output per worker in relation to prices and wages, showing large increase in efficiency with consequently reduced costs and higher wages.

On the whole, the outlook for the skilled worker, using this term in the wide sense which is legitimate

for industry to-day, is not nearly so hopeless as might at first sight and on superficial grounds be thought. But it is vitally important not to rest too securely on this conclusion. It is sound enough, perhaps, so far as it goes, but the complexities and reverberations of industry go deeper and further. To the social philosopher it has long been patent that skilled labour is not now quite so satisfying or so intellectually stimulating as in the past, not because it has become less in degree or extent, but because the worker himself has changed and demands more from life. Therefore in weighing the satisfaction or mental stimulus to be derived from work, it is necessary to remember that a more highly educated type of artisan, enjoying all the modern educative facilities of travel, wireless, etc., will be much more sensitive to moral and intellectual influences, prevailing currents of thought and mysteriously floating ideas, than he was in the olden days. The skill and dexterity required of him in his work will be much but not all. But still Bezaleel remains among us: the man who puts his whole heart into his work and asks for nothing more.

The March of Mathematics.

Proceedings of the International Mathematical Congress held in Toronto, August 11–16, 1924. Edited by Prof. J. C. Fields, with the collaboration of an Editorial Committee. Vol. 1: *Report of the Congress; Lectures; Communications to Sections I and II.* Pp. 935. Vol. 2: *Communications to Sections III, IV, V, and VI.* Pp. 1006. (Toronto: The University of Toronto Press, 1928.) n.p.

TWO stately volumes commemorate the meeting of the International Mathematical Congress at Toronto on Aug. 11–16, 1924. Although the receding shadow of the War caused some notable absences, yet thirty-three nations, some of them newly born, from all parts of the earth, sent some 450 mathematicians, who made 249 communications varying over the whole field of mathematical endeavour. Six sections were the basis of the classification, four covering the ordinary range of pure and applied mathematics, and the fifth and sixth devoted to statistics, actuarial science, economics, history, philosophy, and didactics. For myself, I presided at one sitting of one of the sections, and felt strongly the truth of the description (by a distinguished scientific worker) of all such congresses, that they resembled, both in extent of subjects and diversity of tongues, the last stage of the Tower of Babel.

Eight formal lectures, however, gave valuable surveys of branches of knowledge by savants, becoming rarer every day, capable of envisaging wide fields of mathematical endeavour. The names of the lecturers, Cartan, Dickson, Le Roux, Pierpont, Pincherle, Severi, Størmer, W. H. Young, are sufficient indications of the value of these addresses. It is, perhaps, invidious to select any one of them, but what could be more stimulating and more provocative than the lecture of Dr. W. H. Young on "Some Characteristic Features of Twentieth Century Pure Mathematical Research"? I will mention only two extracts.

"In proportion as knowledge of mathematical theories has increased, the interest in purely formal work has diminished even in England, which may perhaps be said to have been its last refuge. It has begun to be understood all over the world that a mathematician is only a calculator when he must be. He is by nature a creator, a poet, not an artisan, an architect, not a mere builder."

"The question nowhere arises in Pure Mathematics whether there is anything in Nature corresponding even approximately to a mathematical concept."

Perusal of this lecture is strongly recommended both to those who agree and to those who disagree with it. It was perhaps owing to its difficulty that a similar survey of applied mathematics was not possible. To one standing outside the field of pure mathematics, it seems that Fourier's oft-quoted "l'étude approfondie des lois de la Nature est la source la plus féconde des découvertes mathématiques" requires some extension. For while it is true that many branches of pure mathematics have arisen in this way, it is also true to say that many branches seem to languish and almost die until revived by some new physical theory, for example, the impulse given to Riemannian geometry by the theory of relativity, and is it not likely that recent quantum speculations will stimulate the study of matrices, normal functions, characteristic numbers of differential equations, etc.?

Cartan's lecture on "La théorie des groupes et les recherches récentes de géométrie différentielle" may be cited as an example of this statement. In this lecture the application of the theory of groups to non-holonomous spaces must have derived much of its vitality from the relativistic spaces of Weyl and Eddington, a problem which in the last few months has again been attacked by Einstein.

An instructive lecture by Severi on algebraic geometry gave a historical retrospect of this subject, especially from the characteristic Italian point of view, which can best be described in his own words. "On tient toujours en vue le but principal qui est

d'éclaircir la théorie des fonctions par l'intuition géométrique et de viser les propriétés fonctionnelles au-dessus du symbolisme qui, quoique instrument nécessaire de nos recherches, ne doit jamais constituer leur but final."

Prof. L. E. Dickson gave us an interesting account of a fundamental generalisation of the theory of algebraic numbers. In connexion with the integral quaternions of Hurwitz, it is perhaps not generally known that Sir W. Hamilton in 1856 found the greatest common measure of two quaternions. The fascinating story of Norwegian researches on the aurora borealis was the subject of a discourse by Carl Størmer. The interesting mathematical problem of the trajectory of an electric corpuscle in the field of a small magnet is fundamental in the theory, and many of the phenomena receive their explanation in these trajectories. Simple though this hypothesis seems, the actual calculations are extremely laborious. Prof. Størmer told us that more than 5000 hours have been spent in numerical calculations! Prof. Pincherle gave a lecture on linear functional operations, showing the wide applications of these operations, and Prof. Pierpont displayed an elementary treatment of non-Euclidean geometry, starting from the expression for element of arc.

Prof. Le Roux, of Rennes, gave an account of general theorems arising out of the solution of the equation $c^2\nabla^2 v = \delta^2 v/\delta t^2$, and noted an interesting fact that if a 'source' moves with uniform velocity in a straight line, the value of the potential depends on the *instantaneous* position of the source and not on its *retarded*. Sir J. J. Thomson's original solution of the movement of an electric corpuscle gave a potential having the same property and the electric force radiating from the instantaneous position of the corpuscle. The equivalent solution of Heaviside depended on the 'retarded' position.

When one comes to the communications, a dictum of the late G. H. Bryan comes to mind, that it would be as impossible for an individual to understand everything mathematical published at the present day as it would be to understand every language spoken on the earth. There we have some 1700 pages embracing six sections. The first and second sections—algebra, theory of numbers, analysis, and geometry—occupy nearly half the whole space of the communications. Many of them were concerned with investigations arising out of the definitions of hypercomplex whole numbers, whilst in geometry the influence of the relativity theory could be seen in various directions.

Section 3 deals with the group mechanics, physics, astronomy, geophysics. Speaking generally, the tendency was in the direction of the application of extended analytical machinery to known results. The subject of quantum mechanics of the period was practically absent. The engineering section and Section 5 (Statistics) seemed very much alive; their proceedings contain important contributions to modern problems, such as aerodynamics and ballistics. Apart from specialist researches, some general papers deserve mention, such as those on the influence of mathematics on the development of naval architecture (W. J. Berry), mathematics in industrial research (Messrs. A. P. M. Fleming and R. W. Bailey), the teaching of mathematics for engineering students (Sir James Henderson), the teaching of the elements of the theory of elasticity to engineering students (Prof. E. G. Coker).

In Section 6 mention must be made of two papers by F. Cajori: "Past Struggles between Symbolists and Rhetoricians in Mathematical Publications", and "Uniformity of Mathematical Notations—Retrospect and Prospect", and one by G. A. Miller: "History of Several Fundamental Mathematical Concepts". A paper on the use of mathematics in economic, social and public statistics, by Prof. A. L. Bowley, is another of those surveys which ought to be read by all who specialise in other branches. In these days, the track of the individual mathematician is becoming narrower. He wears metaphorical blinkers in order to concentrate his aim. The benefit of a congress consists partly in the fact that such mathematicians listen to general addresses (which otherwise they would probably never read) and may derive widened outlooks showing new lines of attack. Moreover, in his own particular section, discussion on a specialised paper may introduce ideas quite unknown hitherto. On one occasion the chance mention of the name Ritz in the discussion on a problem in elasticity led to interesting researches regarding this (sectionally) unknown name.

A very interesting photographic engineering supplement to Section 4 will recall to many a very enjoyable and instructive trip to Niagara and the great Queenston-Chippawa power plants. Who can forget the merriment when the trolley-car 'sat down' for want of electricity and was just able to crawl past a 550,000 horse-power generating house?

The editing of this vast work of nearly 2000 pages was done by Prof. J. C. Fields with the assistance of an editorial committee. During the Congress, Prof.

Fields was untiring in his efforts to make everything smooth for visitors. He seemed almost to possess the gift of being in more than one place at the same time, and yet found time to communicate an important paper on " A Foundation for the Theory of Ideals ". When the Congress was over, however, the real hard work commenced. Mathematicians are notoriously difficult to edit. For the most part, their work is badly organised and notations are rarely consistent. Prof. Fields (later on assisted by Prof. Chapelon) had indeed a mighty task in producing the well-arrayed volumes in question. More difficult still, the cost of printing turned out to be double the original estimate; finances had to be found. All this was, however, successfully accomplished, but, it is no secret, a heavy toll was taken of his health, research work, and his personal finances. The result is a monument to the University of Toronto and the Royal Canadian Institute, on the invitation of which the Congress was held, and to the various contributors and collaborators. Praise must also be given to the University of Toronto Press for the excellent manner in which a difficult task has been accomplished.

A. W. CONWAY.

Plant Pathology.

(1) *Principles of Plant Pathology*. By Prof. C. E. Owens. Pp. xii + 629. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 23*s*. 6*d*. net.

(2) *Plant Diseases*. By F. T. Brooks. Pp. vii + 386. (London: Oxford University Press, 1928.) 21*s*. net.

(3) *The Scientific Principles of Plant Protection*. By Hubert Martin. Pp. xii + 316. (London: Edward Arnold and Co., 1928.) 21*s*. net.

(4) *Lectures on Plant Pathology and Physiology in Relation to Man: a Series of Lectures given at the Mayo Foundation and the Universities of Minnesota, Iowa, Wisconsin, the Des Moines Academy of Medicine, Iowa, and Iowa State College, 1926–1927*. Pp. 207. (Philadelphia and London: W. B. Saunders Co., 1928.) 12*s*. net.

SINCE the War, plant pathologists have not only done much valuable research, but also have found time to write numerous books on their subject, and library shelves which ten years ago had ample accommodation for future accessions are now cramped. The four volumes under review are, however, books for which space must be found.

(1) The work by Prof. Owens is a general text-book designed to meet the needs of undergraduate students in American agricultural colleges, but it could also be read with profit and interest by students of botany in academic institutions. It is divided into two parts, of which the first, about a quarter of the book, is devoted to a general account of the development of the science, the nature of disease in plants, and the principles underlying causation and control of disease. Part 2 is a consideration of specific diseases, classified etiologically, which have been selected for detailed study. The author takes a commendably wide view of the science of phytopathology, including diseased states brought about by unfavourable conditions of the plant's environment, and also those due to invasion by slime molds, bacteria, fungi, algæ, parasitic seed plants, nematodes, and viruses. Following the discussion of each disease are directions for its practical study and a series of pertinent ' review questions '.

The references are the weakest feature of the book, for, with few exceptions, American work only is cited. The book is finely illustrated, containing more than 200 good photographs and line drawings, many of which are original. Throughout, the author emphasises the underlying principles of the science, and one cannot help envying somewhat the students who have Prof. Owens for their teacher. There is certainly just as much true educational value to be derived from such a training in plant pathology as from the study of much that passes for ' pure science ' in our teaching institutions. In spite of the American perspective of Prof. Owens's volume, it is a sound text-book and a useful addition to the literature of the subject.

(2) Prof. Owens writes from the point of view of a professor of plant pathology in a State agricultural college. Phytopathology is recognised as an independent science, having its foundations in botany, zoology, chemistry, physics, agriculture, and economics. The author is therefore concerned not merely with specific diseases, but also with the principles underlying causation and control of disease in plants and with the relation of plant disease to human welfare. Mr. Brooks's volume, on the other hand, is written from the point of view of a sometime president of the Mycological Society and a lecturer in botany in a university department, where phytopathology is not recognised as an independent science but as applied mycology, or merely one phase of botanical application.

In consequence, Mr. Brooks devotes very brief consideration to the principles and more general aspects of plant pathology, to diseases caused by

non-parasitic agencies, to preventive and control measures, and to the economic relations of the subject. His book is, in effect, a descriptive catalogue of the fungus diseases of plants with brief chapters on diseases caused by viruses, bacteria, actinomycetes, myxomycetes, and green algæ. To each of the chapters is appended a well-selected list of references.

The cataloguing is extremely well done, and, for its size, the book contains an astonishing amount of information. All the illustrations are original and some of them are good, but taken as a whole they are not of the quality of those in Prof. Owens's volume. The book is a handy compendium of the mycological aspects of diseases of British plants, and will be useful to all students and practitioners of the more comprehensive science of phytopathology.

(3) Mr. Martin's book is a detailed consideration of a field jointly occupied by phytopathologists and economic entomologists, and it is all to the good that a chemist should step in and summarise from his own point of view the data of *Pflanzenschutz*. Like Mr. Brooks, however, his purview includes only diseases caused by parasites, and the large and difficult, because diffuse and obscure, field of non-parasitic diseases, a field which in the last edition of Sorauer's "Pflanzenkrankheiten" has nearly 1000 pages devoted to it, is entirely omitted. The literature of the chemical aspects—less so of the pathological ones—has been keenly scrutinised; there are references to 116 different scientific journals, and the author index comprises seven double-column pages of names.

The book, in fact, is not merely a consideration of the scientific principles of plant protection, but is also an adequate synthesis of a considerable mass of experimental data, much of which is, otherwise, not easily accessible. The only criticism one would make is that the data are not always carefully selected. In his foreword, Sir Daniel Hall justly says: "There is a general theory of plant medicine and plant hygiene, and Mr. Martin's book is the first introduction to it that has appeared in English." The volume is essentially the contribution of a chemist to a field of research in which chemists must in the future enter more actively and personally than they have done in the past.

(4) To the more general reader the Mayo Foundation Lectures for 1926–27 on "Plant Pathology and Physiology in Relation to Man" will be the most interesting of these volumes. The contents, however, give the impression that four plant pathologists, one ecologist, and one physiologist were chosen, quite arbitrarily, and asked to give one lecture each on some subject coming within their own field of research—the particular topic not really mattering so long as it could be made to impinge on human welfare. The book in consequence has no coherent thread running through it; it is entirely sporadic, and makes no attempt to cover the field expressed in its title. The lectures vary from the nine pages of Prof. Cowles to the fifty of Prof. Coons or the fifty-eight of Prof. Stakman, and, whereas the former is a general talk, the two latter are technical essays. Both the latter equally need illustrations, as, indeed, do most of the essays in the book, yet one has sixteen excellent figures and the other none. A little judicious editing would greatly have improved this volume.

The first lecture by Dr. Kunkel on "Filterable Viruses" gives in simple language a good general notion of these obscure agents of plant disease. One is, however, surprised to hear the author bewailing his lack of diamond lenses, for there is a general impression that workers at the Boyce Thompson Institute possess such things as mere routine equipment. In his brief essay on "Ecology and Human Affairs", Prof. Cowles says some cogent things, and one could wish that more academic botanists would realise with him that "agriculture furnishes much of the best material for students of botany". The lecture by Prof. Coons on "Some Aspects of the *Fusarium* Problem" would be more congruous in a scientific journal. On the other hand, *Fusaria* are among the most destructive parasites of crops, and it is perhaps just as well that the general reader should have opportunity of gaining insight into the methods of study of parasites which exact a toll of his income. Prof. Stakman's discussion of "Racial Specialisation in Plant Disease Fungi" is noteworthy. The importance of hybridisation in the origination of new forms is at last being recognised, and there now remains to be recognised only the fact that single spore strains are not, necessarily, genetically pure. Both the latter essays contain extensive bibliographies which add greatly to their value.

Prof. Whetzel's lecture on "The Relation of Plant Pathology to Human Affairs" is a fascinating account of the development of the science. The importance of plant diseases may be realised from the author's statement that in the United States "approximately one bean in every dozen, one apple in every seven, one peach in every eight, one bushel of Irish potatoes in every twelve, and one bushel of wheat in every ten, are destroyed annually by

diseases in these crops". This very conservative estimate is probably true on average of the crops in the British Empire, and these losses are largely preventable. Such recurrent destruction of produce is scarcely conceivable in any industry other than agriculture, and if it did occur in, for example, engineering or shipbuilding, there would be no time wasted in discussing whether or not money could be afforded for research on cause and prevention; it would be provided forthwith.

Apropos of recent discussions in Great Britain on the training of biologists, one would like to quote Prof. Whetzel's forecast:

"We are only entering on the era of the professional plant pathologist. As yet most plant pathologists are employees of the State or federal government. Here and there, however, one is entering into the employ of commercial concerns interested in the control of diseases of plants: Farmers' organisations, nursery growers, smelting companies, manufacturers, and purveyors of fungicides and insecticides, and the like. The day will come when the sign of the plant pathologist will stand forth in the street alongside that of the physician and surgeon. This country can and probably will profitably support eventually more plant pathologists than physicians of medicine and surgery."

The last essay in this little volume is by Prof. Osterhout, on whom a portion of the mantle of that very great prophet, Jacques Loeb, seems to have fallen. The author deals with his illuminating researches on semi-permeable membranes, and manages to put obscure and difficult things into simple understandable language.

Altogether the book is one to fascinate any young student of botany or plant pathology, and opens to his view glimpses of the wider reaches of his subject. W. B. B.

Philosophy in Biology.

The Sciences and Philosophy. (Gifford Lectures, University of Glasgow, 1927 and 1928.) By Dr. J. S. Haldane. Pp. ix + 344. (London: Hodder and Stoughton, Ltd., n.d.) 15*s*. net.

PROF. HALDANE'S Gifford Lectures offer several points of special interest. In the first place, every reader will be struck with the reference which he makes in the preface to his older brother, Lord Haldane, and the debt of gratitude which he there acknowledges. In the second place, he gives a sufficient and illuminating account of his own researches in respiration and acclimatisation, fitting them in to his philosophic scheme. Thirdly, he has a full and most interesting account of what he understands by 'vitalism', with reasons why he does not call himself a 'vitalist'. Lastly, his lectures are the most perfect example in the Gifford series of a complete and coherent philosophy built round a definite scientific doctrine. What we have to say about the book may be conveniently grouped round these four points.

In 1883, J. S. Haldane was a medical student at Edinburgh, and a volume of "Essays in Philosophical Criticism", edited by his brother and Andrew Seth, afterwards Prof. A. S. Pringle-Pattison, appeared with contributions from both brothers. The book aimed at distinguishing the fundamental conceptions belonging to different branches of knowledge and was strongly Kantian or post-Kantian in tone. The younger brother, though a medical student, admits that his chief intellectual interest at that time was in philosophy. He had already conceived, under this philosophic influence, the bent against a mechanistic explanation of the phenomena of life which has remained with him throughout. These lectures are the mature outcome of this early training. The philosophical questions from which he started have been before his mind all through his scientific career, and he now attempts to present them as a connected whole, fortified by his scientific conclusions.

Prof. Haldane's own scientific experiments, which have filled the forty years and more since those Edinburgh days, are contained partly in ordinary scientific papers, partly in the two books "Mechanism, Life and Personality" of 1913 and "Respiration" of 1922. The results of these researches are skilfully and relevantly introduced into the chapters on the "Fate of Mechanistic Biology" and that on "Vitalistic Biology". Prof. Haldane takes his stand on the conclusion formulated by Claude Bernard that "all the vital mechanisms, varied as they are, have only one object, that of preserving constant the conditions of life in the internal environment". All the cases which he adds himself to those of Bernard are only further illustrations and corroboration of this general conclusion. Stating the matter broadly, we are forced to conclude that all the separate arrangements or pieces of so-called 'mechanism', by which the organism is kept in contact with its environment, whether internal or external, are regulated or adjusted to the right performance of their function, not by their own mechanism but by some general force, or principle, or agency, so that every part not only subserves the interests of the whole, but also is actually operated by the whole.

It will be said, of course, that this is only what is done in an ordinary man-made engine by a regulator introduced for that very purpose and that it only remains for us in each case to find the appropriate regulator in the living machine. Haldane's answer, and that, we presume, of all vitalists, would be that though we are constantly finding fresh pieces of 'mechanism', yet, pursuing this tack, we get no nearer, but rather further from, the connecting link; that life itself is the regulator.

The other great and obvious characteristic of the living being, that of reproducing itself, is clearly another aspect of the same activity. Granting, with this school of thinkers, that the maintenance and co-ordination of its specific character is the quality of life, then the prolongation of life beyond the activity of the individual follows as a part of the more general function. The special mechanisms by which this is accomplished are subordinate to the main object, just as the various mechanisms of respiration, excretion, etc., are subordinate to the general and constant maintenance of the individual being.

The third point, which we mentioned above, is probably that which will attract most criticism to the book from fellow-biologists. Why, it will be said, distinguish yourself from other vitalists when you agree with them in the substantial point, and only differ, partly from the older and crude view which no one now accepts, partly, as in the case of Driesch, from certain particular applications of the doctrine which may be mistaken without invalidating the main argument? On the whole, we think this criticism of the book and of the author's general position is sound, and that he should be ranked at least among the 'neo-vitalists'. But it is only fair to him, and interesting and enlightening in itself, to put his own ground for distinguishing his position from the vitalists as clearly and strongly as possible. It goes, in fact, to the root of his general philosophical position. He is not a vitalist in his own view, because he does not hold that we see in living phenomena some new force added to the physical and chemical process from without, but that we have in life all the physical and chemical processes taken up and looked at from another and higher point of view. The Newtonian or physical synthesis is thus abstract or provisional. We do not discard it when we advance to biology, but view the facts in another more comprehensive and higher aspect, nearer, in fact, to that highest conception of reality of which we are capable, when we take the last great step and reach the plane of consciousness. Prof. Haldane notes also that in the latest modifications of the Newtonian synthesis we seem to be approximating to the life-conception, even in the parts of our experience which we are accustomed to treat as belonging to the inanimate. On this he, while alluding to Prof. Eddington's recent volume of Gifford Lectures, wisely prefers to say as little as possible.

The last step completes the philosophical hierarchy of the scheme and brings the book into the sphere of metaphysics and religion from which, as the author tells us, he started as a young man in Edinburgh. The ideal of philosophic unity and completeness is the most striking feature of the whole work. As he began with it fifty years ago, so he comes back to it with the satisfaction and sense of rest gained from an ideal confirmed by experience. Detailed criticism of this part of the volume is more suited to other pages, but a brief indication of its purport is called for here. Just as in life we find another principle or point of view subsuming the purely mechanical, so in consciousness a still wider one completes the vital. Prof. Haldane represents this to himself as the integration of time-relations by the conscious mind as biology integrates those of space. Again we think that the biologists may find some cause for quarrel here, and again that the author may have a perfectly valid answer from his own premises. In biology we are concerned with how the organism now works; in psychology the whole process depends on memory, which involves the past, and interest, which looks to the future; and if the critic says, "But this must be true of all living things, and not only of our own minds", the author's answer is, "By all means. My philosophy contemplates life and consciousness as different in degree, but co-extensive with existence." Starting from this premise, or, if you will, this general conclusion, he breaks a lance with Smuts on holism, as he broke one with Driesch on vitalism.

The similarity of the general outlook with that of General Smuts's recent book will of course strike every reader, and Prof. Haldane admits the kinship. But he expresses strong dissent from Smuts on the point of the sudden and mysterious incursion of consciousness into the universe. If it is ever there, it has been there for ever. This stamps his philosophy and brings him at the close to his religion. The fact that so many notices, which have already appeared, find enough to say in criticising its contacts with religion, is evidence of the immense scope and profound interest of the book. It is morally inspiring, intellectually stimulating, substantially true. F. S. MARVIN.

The Parasitic Worms.

A Manual of Helminthology: Medical and Veterinary. By Dr. H. A. Baylis. Pp. xi + 303. (London: Baillière, Tindall and Cox, 1929.) 30*s.* net.

IT is rare indeed to find a text-book of general or economic zoology which treats of the parasitic worms without introducing some errors, often gross errors, although in dealing with the other phyla it may be strictly accurate. This, in the past, has been, in part at least, due to the fact that no good modern text-book on helminthology has been available. With the appearance of Dr. Baylis's work on the subject, that excuse is removed. In a matter of 300 pages, the author, briefly and concisely, provides such short descriptions of the genera and species of helminths of man, the domestic mammals and birds, as will, with the aid of the illustrations, enable the reader to obtain at least an approximate determination of most of the parasites which he is likely to meet.

The book falls into two parts, the first dealing with the flat-worms, and the second with the round-worms. Each part commences with a general account of the anatomy, then proceeds to consider, family by family, the parasites of medical and veterinary importance, their occurrence and morphology, and the more important facts of their life-histories so far as they are known. The clinical and pathological aspects of the subject are not considered and the volume is essentially a zoological one. The classification used is a natural one, so far as our present knowledge makes this possible; and in order to correlate the parasites of each host, a classified index to the parasites of the more important animals or animal groups is appended. The nomenclature used is up-to-date; but to avoid confusion with other names which have enjoyed long, though incorrect, use, the more common and well-known synonyms are usually given as well, the correct names being printed in heavy, conspicuous type.

There is no need to emphasise the importance of this subject in both medical and veterinary medicine, and helminthology is now an essential part of the curriculum of every student of these subjects, either as part of his initial training in zoology or as a separate course later on, or as both. There is accordingly a real necessity for an accurate, authoritative text-book such as this. It has its limitations; limitations set by the extent of present-day knowledge of the parasitic worms, by the omission of parasites of wild or partially domesticated animals (such as elephants and rabbits), and by the absence of pathological and clinical helminthology. To have included these, however, would have required a work of encyclopædic proportions, and correspondingly prohibitive price. Within these limitations, Dr. Baylis has done his work well and has produced a text-book of immense value, especially to those interested in zoological helminthology. The manual is well and clearly written, adequately illustrated, and strongly produced, and should meet with a ready response among zoologists, medical men, and veterinary surgeons.

Our Bookshelf.

Ibn Battúta, Travels in Asia and Africa, 1325–1354. Translated and selected by H. A. R. Gibb. (The Broadway Travellers.) Pp. vii + 398 + 8 plates. (London: George Routledge and Sons, Ltd., 1929.) 15*s.* net.

"THE Broadway Travellers" offers to the public in popular form a store of entertaining reading as well as a series of valuable records, many of which are not otherwise readily available. By including in this series the travels of Ibn Battúta, which are now for the first time made accessible to the English reader, the editors have earned the gratitude of all students of travel literature who are not professed orientalists. Ibn Battúta stands in the first rank of medieval travellers. As a Moslem he gives a picture of the eastern world which not only differs in perspective but is at the same time truer and more intimate than that of the European travellers of about his own time. Granted the difference in orientation, the general attitude of mind of this traveller is more readily comprehensible to the modern reader than that of the medieval Christian.

Ibn Battúta, who was born at Tangier in 1304, set out on his travels at the age of twenty-one. His aim was to accomplish the pilgrimage to Mecca, but he was diverted by circumstances and traversed the whole of Syria before reaching the Holy City. A visit to Iraq was followed by three years' theological study in Mecca, during which time he formed the project of visiting India, but before doing so he visited the trading stations of East Africa. Then India was reached by way of Asia Minor and Central Asia. After a stay of some seven years at Delhi he was sent as an envoy to China. When he returned to his native land after 1348 he had covered a distance estimated at 75,000 miles. He died in 1368 or 1369. The mere recital of the countries visited and the distances covered, however, gives a very meagre idea of the value of his record. His intellectual qualifications and standing as a qádi and his consequent interest in theology, combined with his intensely human personality, give his record an interest which is surpassed by no book of travel of his own and not many of a later day.

Fortpflanzung und Befruchtung als Grundlage der Vererbung. Von Max Hartmann. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Band 1.) Pp. ii + 103. (Berlin: Gebrüder Borntraeger, 1929.) 9·60 gold marks.

Verteilung, Bestimmung und Vererbung des Geschlechts bei den Protisten und Thallophyten. Von Max Hartmann. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Band 2.) Pp. ii + 115. (Berlin: Gebrüder Borntraeger, 1929.) 24 gold marks.

BAND 1 gives in compact form, and well illustrated, an account of the main phenomena of reproduction and fertilisation bearing on heredity, in the Protista and other groups of lower plant and animal organisms. Various terms not at present in general use, such as cytogony for cell reproduction, agamogony (gonidia formation), gamogony (gamete formation), gametanogamy and pædogamy are introduced. The chapter on the antithetic alternation of generations gives a useful series of diagrams in which the nuclear phases of *Cutleria*, *Scinaia*, Phycomyces, mosses, and other plants are compared.

In Band 2 the determination, inheritance, and distribution of sex in Protista and Thallophytes are described. Four types of sex determination and distribution are recognised, namely, phenotypic and genotypic determination in the haplophase and the diplophase respectively. This volume contains a very serviceable summary of the modern work on sexuality in Algæ and Fungi, much of which has not been brought together elsewhere. Scattered observations bearing on the subject in *Characium*, *Gonium*, *Gregarina*, *Actinophrys*, *Alaria*, Diatoms, and many other organisms are included. Numerous tables and diagrams in which the sexes are distinguished by colour make easy a comparison of conditions in different organisms.

Inorganic Quantitative Analysis. By Prof. Harold A. Fales. Pp. xii + 493. (London: G. Bell and Sons, Ltd., 1928.) 12*s.* 6*d.* net.

A TEXT-BOOK of inorganic analysis produced at this period which aspires to more than local interest must treat the subject from some new aspect. This object is achieved here by development from the physico-chemical side, somewhat on the lines of Bassett's "Theory of Quantitative Analysis". The scope of the present volume is, however, much wider in order that the whole field of analytical manipulation may be fully covered; for example, chapters are devoted to precision and to the theory and practice of weighing.

The exercises described are largely determinations such as are encountered practically; there are copious explanatory notes and extensive references to original sources. Electrolytic methods are described, but not potentiometric; 'gas analysis' is confined to the absorption of carbon dioxide for gravimetric purposes. The author strongly advocates the use of 'molar' solutions, abandoning the less specific term 'normal' in this connexion, but while admitting that the term 'millilitre' is desirable, continues the use of 'c.c.'. No text-book seems anxious to initiate this change.

We have read this book with considerable interest; it contains a large amount of useful information and is commended not only to the student but also to the chemist. B. A. ELLIS.

The Theory of Determinants, Matrices and Invariants. By Prof. H. W. Turnbull. Pp. xvi + 338. (London and Glasgow: Blackie and Son, Ltd., 1928.) 25*s.* net.

THIS excellent book gives a survey of a field which has come into great prominence during the present century for two quite different reasons. First, the theory of relativity has compelled physicists to extend their notions of space with the consequent necessity for formulating physical invariants appertaining to quaternary and higher forms. Secondly, the new mechanics has found a need for numbers obeying a non-commutative law of multiplication. Here the matrix representation was ready to hand. Prof. Turnbull has not made the mistake of attempting to develop the theory with an eye to its applications. Rather he has given a consistent and adequate account from the point of view of pure mathematics. Seven chapters on determinants and matrices are followed by a development of invariant theory mainly of quaternary and higher forms. Naturally in a subject of such vast extent a choice has to be made, but it will be found that the choice is extremely judicious.

The book is written in a delightfully lucid style and is admirably suited to the needs of those who wish to familiarise themselves with the mathematical concepts underlying the physical applications. To the student whose interests are purely mathematical, no better introduction could be desired. L. M. M.-T.

Jahresbericht über die wissenschaftliche Biologie: zugleich Bibliographisches Jahresregister der Berichte über die wissenschaftliche Biologie. Herausgegeben von Prof. Dr. Tibor Péterfi. Band 1: *Bericht über das Jahr 1926.* Pp. xii + 627. (Berlin: Julius Springer, 1928.) 69 gold marks.

THE editor states that the great majority of the titles in this "Jahresbericht" are taken from 1328 periodicals placed at his disposal by the publisher. The titles, each with proper bibliographical data, are arranged in sixteen sections, among which are methods, physical and chemical basis of vital processes, cytology and histology, morphology, metabolism, hormones, physiology of reproduction and development, heredity, ecology and systematics. The great majority of the titles relate to papers on animals. The index of authors and the alphabetical list of the sections of the work facilitate the rapid finding of the references to any author or subject. Some of the 7600 titles are repeated under different sections, so that the total number of titles printed is 11,500. A statistical analysis of the subjects dealt with is appended, which brings out the preponderance of works on comparative physiology (including the chemical and physical basis).

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Spectrum of Sunlit Aurora Rays as compared with the Spectrum of Lower Aurora in the Earth's Shadow.

ON several occasions, especially during the great aurora of Mar. 22–23, 1920, I have looked at sunlit auroral rays through a pocket spectroscope and always found the green auroral line very faint as compared with other strong lines in the blue and violet (Résultats des mesures photogrammétriques des aurores boréales, etc., p. 48, *Geof. Publik.*, vol. 4, No. 7). Wishing to obtain a more positive proof of this fact, I decided last winter to try to get spectrograms of these rays. I had already at my disposal some small kinema lenses of high light power and two glass prisms, one of which I had used with success to obtain prism objective photographs of aurora during my expedition to Bossekop in 1913. I was fortunate enough to get the most valuable assistance from Mr. Moxnes, engineer, attached to the physical institute of the University of Oslo. Two small spectrographs were built, one with greater dispersion but rather small light power, and the other with smaller dispersion but with very high light power.

The spectrographs were ready for use during the very interesting aurora of Mar. 15–16 last, mentioned in my recent communication to NATURE (June 8, p. 868). While Tveter, Wesöe, and I were occupied in taking photograms for determining the height and situation of the aurora, Moxnes used the spectrographs, pointing them towards all auroræ seen, especially towards all which were photographed.

Two quite successful spectrograms were obtained with the spectrograph of high light power:

(1) The first, exposed for about five hours, of all auroræ in the form of arcs, bands, rays, and curtains, during the first part of the night; the corresponding situations of the auroræ are seen in Fig. 1, to the right; they were relatively *low* and were situated in the *dark* part of the atmosphere (except one feeble ray without influence on the main result). The comparison spectrum was taken by Moxnes.

(2) The second one, exposed for about one hour, exclusively of all the *high sunlit aurora rays* just before dawn. The situation of those rays is seen to the left on the same diagram, Fig. 1, and was also given in my communication in NATURE of June 8. The spectrum with corresponding comparison spectrum was taken by Wesöe and Tveter; the exposure of the comparison spectrum was too long and therefore we have substituted a darker copy (Fig. 2, No. 2).

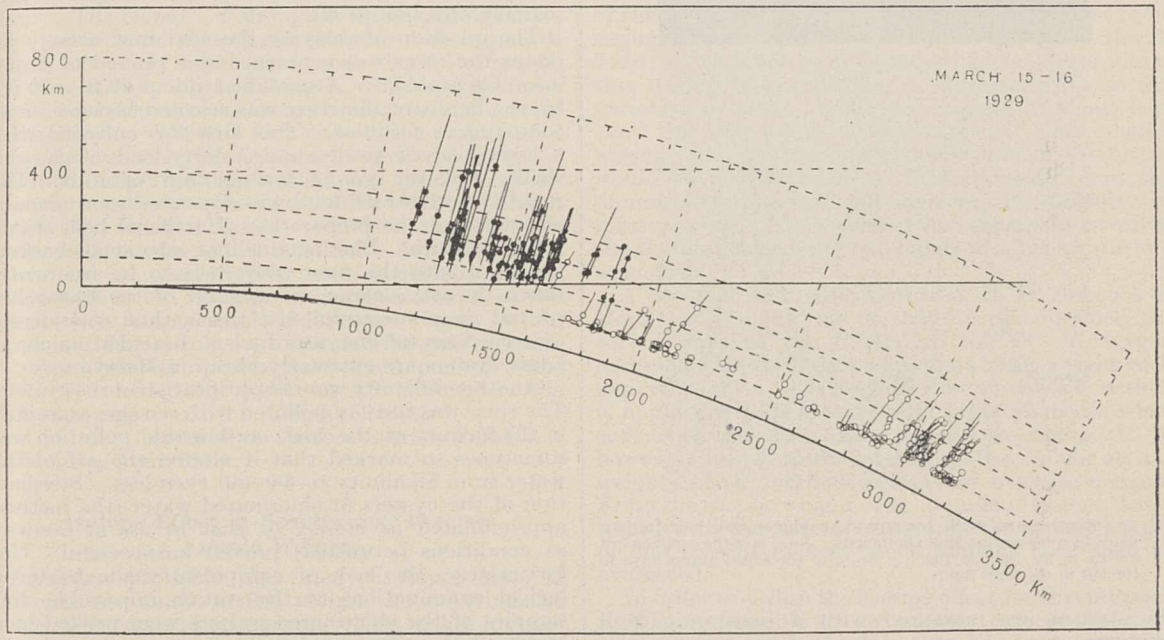

FIG. 1.—Situation of the aurora of Mar. 15–16, 1929, compared with the position of the earth's shadow. The figure represents a vertical section of the earth, and the tangent to the earth's surface is the boundary between the sunlit and dark atmosphere. The sunlit auroral rays are seen to the left, and each point calculated on them is marked by a black dot. The common aurora in the dark atmosphere is seen to the right, each point calculated being represented by a small circle.

On the night of April 16–17 last I received information from the State Telegraphic Department that earth currents were disturbing the telegraphic service. In consequence I warned all my aurora stations, and a long series of about seventy successful photograms from two, three, and four stations were secured. That night only high sunlit aurora rays occurred. Moxnes also took a spectrogram with the same spectrograph of high light power.

At my request Moxnes has here added the result of his measurements and calculations of the spectra. For details I must refer to a subsequent and more complete publication:

"The spectra were photographed on Sonia EW. plates from Herzog, Bremen, with a spectrograph of small dispersion but high light power. The light from a Hilger helium discharge lamp served as comparison spectrum.

"In the first experiment on Mar. 15–16 the slit was 0·15 mm. wide and gave rather broad lines. On April

16–17 the slit was 0·04 mm., and a spectrum with sharp lines was obtained. The spectra show the prominent lines of the aurora with wave-lengths 5577, 4278, 3914 A., and a diffuse band at 4700-4600 A.

"In spectrum No. 2, of the sunlit aurora rays of Mar. 16, the line 5577 is very much fainter than in spectrum No. 1 of the lower non-sunlit aurora of the same night, as compared with the other lines. This difference in relative intensity is very apparent when

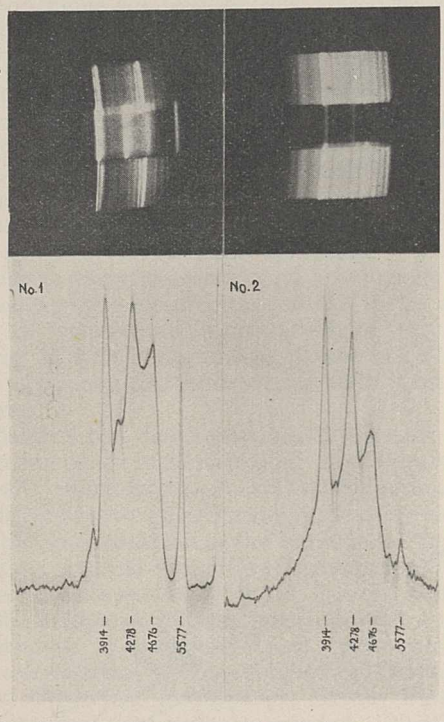

FIG. 2.—Spectrograms with corresponding photometric registrations made by a registering Moll photometer. No. 1 is of the common low aurora to the right in Fig. 1; No. 2 of the sunlit aurora rays to the left in the same figure.

the spectra are measured with a registering Moll photometer.

"The same character is shown by the spectrum of the sunlit aurora rays during the night of April 16–17."

It is thus seen from these observations that the green auroral line 5577, which is very strong for the common aurora in the earth's shadow, is very much fainter for the high sunlit aurora rays as compared with the lines of ionised nitrogen 4728 and 3914. This is in accordance with the blue and violet colour of these rays. No lines of helium or hydrogen seem to occur in the spectrum of those high rays.

These results are, however, to be considered only as preliminary. The researches will be continued next autumn.

CARL STØRMER.

Oslo.

Oyster Culture in Malaya.

As nothing is known about oyster culture in British Malaya, this note may be of interest. It is based on work done by myself while I was in charge of the Oyster Experiment Station started by the Federated Malay States Government at Kuala Kurau in Perak State. It is confined to general results, as the experiments only lasted for six months.

The locality selected for the experiment by the Fisheries Department was the mouth of the River Kurau, near Penang. Like most Malayan rivers, the Kurau courses along a soft, muddy bottom, which made it unsuitable for oyster culture under natural conditions. Two small rocky beds were, however, found in the deepest parts of the river (about seven fathoms at low tide), where oysters could be obtained, but only by employing a local diver.

All the usual methods of spat collecting were tried, but were practically unsuccessful. Crates of limed tiles were immersed and taken up and examined after a period of immersion of from three to four weeks. The tiles and the woodwork of these crates were literally smothered with barnacles, which grow very rapidly in Malayan waters, but in spite of this an average of about two spat per tile was collected. Other collecting methods employed included the letting down of ropes of brushwood, and of oyster shells enclosed in a wire-net bag, but these were no more successful than the crates, the former collecting scarcely any spat at all.

The question of relaying the spat now arose. So far as the river was concerned this proved to be an insoluble problem. A small bed (about 20 ft. × 20 ft.) by the banks of the river was selected because of its comparative firmness. This area was cultched with a lorry-load of stones and a lorry-load of mussel-shells, and the young oysters laid upon it. The rapidity with which mud was deposited soon made it obvious that the preparation of artificial beds was a futile measure. Putting the spat into small baskets let down into the river (they had to be frequently taken up and cleaned on account of the barnacles) proved more successful, but the method was merely an experimental one, and had no practical value, as adult oysters are extremely cheap in Malaya.

Another difficulty was the purification of the oysters. The river was heavily polluted with sewage, especially in the vicinity of the bed; at low tide pollution was sometimes so marked that it altered the *p*H of the water from alkalinity to 6·0 and even less. Sterilisation of the oysters in chlorinated water (the method approximated as closely to that in use at Conway as conditions permitted) proved unsuccessful. Unfortunately, the lack of equipment made bacteriological examinations at the station impossible, but samples of the chlorinated oysters were packed in a sterilised tin containing sterilised sea-water, and sent frequently to the Government Bacteriologist at Kuala Lumpur (a twelve hours' journey), with control samples of unsterilised oysters, both in sea-water and in sterile sea-water. It was found that the colonies of *B. coli* and other bacteria produced on the culture plates were generally too numerous to count, both in the chlorinated samples and the controls. As most of the Malayan rivers are similar to Kuala Kurau, this difficulty would have to be overcome by the installation of a proper chlorinating plant. The bacteriological results were extremely interesting, and it is hoped that the Government Bacteriologist will publish a short note on them.

Attempts at artificial oyster culture produced more promising results. For this purpose a solid wooden box was made, with an outflow through eighteen filter candles (the substance known as 'filtros' is more suitable, but I could not obtain it at the time). The outflow was collected in a two-inch false bottom below the candles and let out through a stopcock. The water was further aerated by mechanical agitation. In this box a few oysters were placed, and, just before the station closed down, a good fall of spat was obtained on tiles and on oyster-shells placed in the box. Sixteen large cement tanks fed with water from the river were also used for experiments. In four of

them several hundred oysters were placed with collectors. Their outflow was very slow and was guarded with an elaborate structure of tiles, but in six months not a single spat was obtained. This may have been due to insufficient aeration and the absence of direct sunlight. These tanks were ideal, however, for relaying spat and young oysters, which thrived and grew rapidly in them.

In conclusion, I believe that oyster culture in Malaya on a commercial scale under natural conditions is not possible, though the Fisheries Department may help the native fishermen to supplement their incomes slightly by teaching them the general methods of oyster culture. Given sufficient capital and a good technical worker freed from restraint, the artificial culture of the Malayan oyster (kindly identified by Dr. B. Prashad as *Ostrea gryphoides* Schlotheim) may, however, be regarded as a sound commercial proposition. For in this work, few of the difficulties met with by artificial culturists in Europe and America occur. The climate of Malaya is warm and equable; the oysters breed throughout the year; their growth rate is extremely rapid (some spat about one month old were already $1\frac{1}{4}$ in. in length, while oysters three months old were more than 2 in. in length, and certain old specimens collected had exceeded a length of 1 ft.); the barnacle trouble can be removed by gross filtration of the incoming water; and special food can be easily supplied, as the algæ (which will be described shortly by Dr. K. Biswas) on which the Malayan oyster feeds can be readily cultured. As the Malayan oyster has a good flavour and artificially grown individuals would be superior to those found in the rivers (there is an anæmic industry at Bagan Datoh, Perak, and Muar, Johore), a demand for good oysters, at prices consistent with guaranteed purity, could easily be created by judicious advertising in the Malayan press.

CEDRIC DOVER
(Sometime Ostreoculturist, F.M.S.).

Calcutta, June 18.

Isotope Effect in Spectra and Precise Atomic Weights.

IT seems probable that many isotopes exist in amounts too small to fall within the experimental range of the mass spectrograph. This makes it desirable to seek some means of determining their atomic weights with sufficient accuracy to give reliable values of their packing effects. Two methods, of which the second appears generally applicable, will be discussed here.

In the case of oxygen isotope 17, the energy relationships accompanying the formation of this atom from a collision resulting in a combination of an alpha particle and a nitrogen nucleus with subsequent ejection of a proton, have been considered by a number of observers. Of these we will consider only the results of Kirsch (*Phys. Zeit.*, **26**, 457; 1925), which are given for alpha particles of the ranges 8·6, 7·0, 6·0, and 4·9 cm. respectively.

Kirsch, from a consideration of the initial energy of the alpha particle and the kinetic energies of the newly formed oxygen 17 and the ejected proton, finds that oxygen 17 contains 16×10^{-7}, 16×10^{-7}, 15×10^{-7}, and 15×10^{-7} ergs respectively of the energies originally possessed by the alpha particles listed above. From the relativity relation, energy $= mc^2$, the average of the four values leads to a mass of 0·0010, which is probably reliable to the last stated figure. Then the atomic weight of oxygen 17 is given by N + He + 0·0010 − H.

Birge (Suppl., *Phys. Rev.*, in press) has recently considered the available data on the atomic weights of several elements and has given values of the probable errors. The following values are given: N = 14·0083 ± 0·0008, and H = 1·00777 ± 0·00002. For He the value given in the table is 4·0022, but in a footnote this is corrected to the more reliable value 4·0018 ± 0·0004. Thus $O^{17} = 17{\cdot}0033 \pm 0{\cdot}0009$. This value is based on the assumption that the final state of oxygen 17, as considered by Kirsch, is the normal state of this nucleus. However, the total effect due to the energy is so small that an error in this regard would not be expected to have much influence.

In the case of oxygen 18, it has become evident that the band spectrum isotope effect can be used to give an extremely accurate value of the atomic weight.

The *A*-band of oxygen by which the existence of oxygen isotopes 17 and 18 were established (Giauque and Johnston, NATURE, Mar. 2, p. 318, and June 1, p. 831; 1929; *J. Am. Chem. Soc.*, **51**, 1436; 1929) is quite insensitive to amounts of mass of the order of 0·001 gm., but can be used to establish the amount of the electronic isotope effect. This is expected to be negligible, but should be proved so. However, the *B*-band, which involves an increase of one unit of vibration during the excitation, is quite sensitive to the variation of mass. 0·001 gm. results in about 0·02 $cm.^{-1}$ in the isotopic displacement. The α-band, arising from an increase of two units of vibration, would be nearly twice as effective except that the diminishing intensity will increase the difficulty of measurement. The above method essentially involves the simultaneous use of two bands to solve for the two unknowns.

A personal communication from H. D. Babcock of Mount Wilson informs us that he has obtained excellent data on the *B*-band of the 18 − 16 oxygen molecule which will determine the atomic weight with high accuracy. It is evident that the above method is applicable to the isotopes of other elements when sufficiently accurate data become available. It is, however, limited to the intercomparison of the atomic weights of the various isotopes of a given element. From the atomic weight of an abundant isotope determined with the mass spectograph, the atomic weight of one present in very small amount may then be evaluated.

In order to utilise the isotope effect for this purpose, it will be desirable to use greater care in the theoretical treatment of the data than has previously been necessary in establishing the existence of the isotopic molecules. We have had the co-operation of R. T. Birge in this connexion, and a preliminary survey of the data indicates that it will be possible to obtain the atomic weight of oxygen 18 with a probable error in the neighbourhood of one part in twenty thousand. A joint publication will appear in the near future, based on measurements now in progress.

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Zoological Nomenclature.

THE undersigned has the honour to invite the attention of the zoological profession to the fact that Opinions 105 to 114 have been published by the Smithsonian Institution (*Smithsonian Miscellaneous Collections*, vol. 73, No. 6, pp. 1-26). The summaries read as follows:

Opinion 105. Dybowski's (1926) names of Crustacea suppressed.—Resolved: That all of the new names published in Dybowski's paper, "Synoptisches Verzeichnis mit kurzer Besprechung der Gattungen und Arten dieser Abteilung der Baikalflohkrebse"

(*Bul. internat. Acad. polonaise d. Sci. et. d. Lettres*, No. 1-2*b*, Jan.–Feb., pp. 1-77, 1926), are hereby suppressed, under suspension of the rules, on the ground that the application of the rules in accepting them "will clearly result in greater confusion than uniformity".

Opinion 106. The type of *Oestrus* Linn., 1758, is *O. ovis*.—The type of *Oestrus* Linn., 1758, is *O. ovis* (Art. 30*g*). Latreille's designation of *Oestrus equi* Fabr. as type of *Oestrus* is not valid (Art. 30*g*). The following five names of dipterous genera are hereby placed in the official list of generic names: *Cephenemyia* (type *trompe*), *Gasterophilus* (type *equi* of Clark, synonym of *intestinalis* de Geer), *Hypoderma* (type *bovis*), *Oedemagena* (type *tarandi*), and *Oestrus* (type *ovis*).

Opinion 107. *Echinocyamus pusillus* vs. *Echinocyamus minutus*.—The case of *Echinocyamus pusillus* vs. *Echinocyamus minutus* is subject to two diametrically opposed interpretations. On basis of the principle that a name in current use is not to be supplanted by an earlier but rarely adopted or an unadopted name unless the argument is unambiguous and unless the premises are not subject to difference of opinion, the Commission, because of the somewhat uncertain status of *minutus*, is of the opinion that *pusillus* 1776 should not be suppressed by *minutus* 1774.

Opinion 108. Suspension of rules for *Gazella* 1816.—Under suspension of the rules, *Gazella* Blainville, 1816, type species *Capra dorcas* Linn., 1758*a*, is adopted in preference to *Oryx*, and is hereby placed in the official list of generic names.

Opinion 109. Suspension of rules for *Hippotragus* 1846.—Under suspension of the rules (if need be), *Hippotragus* Sundevall, 1846, type species *Antilope leucophœa* Pallas, 1766, is adopted in preference to *Egocerus* Desmarest, 1822, and *Ozanna* Reichenbach, 1845 (not *Ægoceros* Pallas, 1811), and is hereby placed in the official list of generic names.

Opinion 110. Suspension of rules for *Lagidium* 1833.—Under suspension of the rules *Lagidium* Meyen, 1833, type species *Lagidium peruanum* Meyen, is adopted in preference to *Viscaccia* Oken, 1816, genotype '*Lepus chilensis* Molina', and is hereby placed in the official list of generic names.

Opinion 111. Suspension of rules for *Nycteris* 1795.—Under suspension of the rules *Nycteris* Cuvier and Geoffroy, 1795, type species *Vespertilio hispidus* Schreber, 1774, is adopted in preference to *Petalia* Gray, 1838, genotype *Nycteris javanica* Geoffroy, and is hereby placed in the official list of generic names.

Opinion 112. Suspension declined for *Manatus* 1772 vs. *Trichechus* 1758.—Suspension of the rules is declined for *Manatus* Brünnich, 1772, type species *Trichechus manatus* Linn., 1758*a*, type locality West Indies, vs. *Trichechus* Linn., 1758*a*, monotype *T. manatus*; accordingly the name *Trichechus* is to be used for the manatee instead of for the walrus. *Trichechus* Linn., 1758*a*, type *T. manatus*, is hereby placed in the official list of generic names.

Opinion 113. *Sarcoptes* Latreille, 1802, type *scabiei*, placed in official list.—*Sarcoptes* Latreille dates from 1802 instead of 1804 or 1806 as frequently quoted. It was originally monotypic, containing only *Acarus scabiei*. The 1810 type designation of *Acarus passerinus* is invalid under Article 30*c* and 30*ea*. The acceptance of *Acarus scabiei* as type species of *Acarus* is invalidated by Article 30*g*, according to which *Acarus siro* (syn. *farinæ*) is the type of *Acarus*. *Sarcoptes* Latr., 1802, mt. *scabiei*, is hereby placed in the official list of generic names.

Opinion 114. Under suspension, *Simia*, *Simia satyrus*, and *Pithecus* are suppressed. Under suspension of the rules the names *Simia*, *Simia satyrus*, and *Pithecus* are hereby suppressed on the ground that their retention under the rules will produce greater confusion than uniformity.

C. W. STILES.
(Secretary to the International Commission on Zoological Nomenclature).

Washington, D.C.

Statistics and Biological Research.

IN NATURE of July 20, "Student" propounds to me the problem of what *sort* of modification of my tables for the analysis of variance would be required to adapt that process to non-normal distributions. Since he and others evidently feel that a legitimate extension of my methods might be made along these lines, it may be worth while to point out the reasons for which, quite unusually, I disagree with his view.

The theoretical reasons may be made most clear by ignoring the limits of practical possibility, and supposing that an army of computers had extended the existing tables some two hundred fold, with the view of providing tests of significance for all distributions conforming to the Pearsonian system of frequency curves. The system of tests of significance so produced would then be exposed to criticism from three different angles.

(1) Following the lead of the reviewer in NATURE of June 8, p. 866, of my book, "Statistical Methods for Research Workers", it would be said that the new tables still needed 'correction' in order to include equally possible forms of distribution outside the Pearsonian system.

(2) A student of "Student" would surely point out that the parameters needed to enter the new tables must be calculated from the data available, and that allowance must be made for their sampling errors, by eliminating the Pearsonian parameters and replacing them by formulæ involving statistics only.

(3) A worker along my own lines would suggest that the particular statistics, means, and mean squares entering into these tests are only efficient for normal distributions, and that for Pearsonian curves quite other statistics are required, and not merely revised distributions of the familiar statistics appropriate to normal material.

The two last points could be met by dropping the Pearsonian system for one for which the moments are appropriate, when the way would lie open for the development of an analysis of the third and higher semi-invariants, bearing the same relation to the first attempt as the analysis of variance bears to some of the earlier calculus of correlations. An expert in cubic and biquadratic forms might here open out a new realm of statistical theory, for the application of which adequate data might in time be accumulated.

If the first objection is not ignored, more and more parameters may be introduced, but the patient investigator is still pursued by the analogues of these three criticisms; nor is there any doubt as to the limit of the process. It is not, as at first it might seem, the stultification of all statistical methods, but merely the abandonment of the theory of errors. Beyond all questions of metrical variates there are, largely undeveloped, a system of tests which depend only upon frequency and on order of magnitude. Examples exist in "Student's" writings, and in my own. They are free from all taint of normality, but are too insensitive to be very useful; still, their development would be of more interest than the programme of research first considered.

On the practical side there is little enough room for

anxiety, especially among biologists, who are used to checking the adequacy of their methods by control experiments. The difficulty of obtaining decisive results often flows from heterogeneity of material, often from causes of bias, often, too, from the difficulty of setting up an experiment in such a way as to obtain a valid estimate of error. I have never known difficulty to arise in biological work from imperfect normality of the variation, often though I have examined data for this particular cause of difficulty; nor is there, I believe, any case to the contrary in the literature. This is not to say that the deviation from "Student's" t-distribution found by Shewhart and Winters, for samples from rectangular and triangular distributions, may not have a real application in some technological work, but rather that such deviations have not been found, and are scarcely to be looked for, in biological research as ordinarily conducted.

R. A. FISHER.

Rothamsted Experimental Station,
Harpenden, July 26.

Nuclear Association in the Æcium of *Puccinia graminis*.

IN a letter to NATURE (July 23, 1927, p. 116) Craigie announced the discovery of heterothallism in the rust fungi. In a second letter (Nov. 26, 1927, p. 765) he showed that the æcial stage of *Puccinia graminis*—the parasite which causes the black stem rust disease of cereals—can be produced on the leaves of the common barberry at will simply by applying to the pycnia of a monosporidial pustule of one sex some of the pycniospore-containing nectar excreted from the pycnia of another monosporidial pustule of opposite sex.

A series of experiments on *Puccinia graminis*, recently made by me, has yielded some information as to the manner in which the change from the haploid to the diploid condition in this fungus is brought about.

The sporidia are uninucleate. In a pustule of monosporidial origin, the mycelium and the pycniospores produced by the mycelium are also uninucleate. In such a haploid pustule there appear, near the lower epidermis of the barberry leaf, numerous sterile wefts of mycelium. These wefts, which appear to be crescent-shaped in transverse sections of the leaf and are made up of hyphæ with uninucleate cells, are evidently haploid rudiments of æcial cups waiting to be stimulated into further developmental activity.

When nectar which contains pycniospores of one sex is applied to the pycnia of a monosporidial pustule of opposite sex, the wefts of hyphæ situated along the base of the pustule soon undergo a change from the haploid to the diploid condition. About 48 hours after the pycniospores have been applied, the nuclei at the base of each weft become enlarged. Neighbouring hyphæ then fuse in pairs in a manner similar to that described by Christman for *Phragmidium speciosum*, and two nuclei become associated in each fusion cell. The fusion cells, which initiate the diplophase, elongate and cut off chains of binucleate cells which later divide and thus form intercalary cells and æciospores. Sections through pustules fixed 65 hours after the application of pycniospores have shown young æcial cups with as many as four æciospores in several of the æciospore chains.

The part which the pycniospores play in bringing about æcial development is not yet completely understood. Some of the pycniospores have been observed to germinate, and, in one instance, the germ-tube from the spore had attained a length of 15 μ. In view of the fact that binucleate hyphæ are to be found only at the base of the æcium, it seems probable that, when pycniospores of one sex are applied to a pycnium of opposite sex, the pycniospores are stimulated to germinate and to produce haploid hyphæ which grow down to the hyphal wefts near the lower epidermis and there fuse with cells of opposite sex. The solution of the problem of tracing the hyphæ from the germinating pycniospores to the base of the æcium must await further investigation.

W. F. HANNA.

Dominion Rust Research Laboratory,
Winnipeg, June 24.

The Crystal Structure of Solid Nitrogen.

RECENT researches on the luminescence of solidified gases have shown that systems consisting of mixtures of nitrogen with inert gases give a great variety of oscillatory bands, which are intimately connected with the oscillations which the nitrogen atoms are able to perform in the crystalline state. As pointed out in previous papers, the determination of the crystal structures of these systems will be of fundamental importance for the interpretation of the oscillatory bands characteristic of the solid state.

Researches on the structure of solidified gases have already been taken up by W. H. Keesom and his collaborators at the Cryogenic Laboratory of Leyden (*Comm.*, Leyden, 178). For pure argon they find a face-centred lattice. In the case of nitrogen, which is the most important substance for our purpose, they merely state that they have obtained powder diagrams, which, however, are so complicated that they have not been able to interpret them by means of a definite unit cell and a corresponding crystal system.

As the oscillatory bands mostly originate from nitrogen, it is indeed the nitrogen structure which is of the greatest importance for the interpretation of the luminescence phenomena, and we have therefore also attacked the problem at the Physical Institute of Oslo. We obtained good powder diagrams with a conveniently constructed apparatus, and after having tried a number of crystal classes, we finally succeeded in showing that the spectrum could be interpreted by a unit cell belonging to the cubic system.

The side of the unit cube was found to be 5·65 A. units, and the density measurements of Dewar lead to the result that the unit cell contains 8 nitrogen atoms.

In these investigations I have been most ably assisted by Mr. Alf Maurstad, Mr. S. Stensholt, and Mr. E. Tønsberg.

L. VEGARD.

Physical Institute, University,
Oslo, June 28.

Nature of Disease-Producing Viruses.

TWICE recently I have noticed in the columns of NATURE criticism of the hypothesis that disease-producing viruses are intermediate between molecule and living cell because no non-parasitic forms are known. 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. I agree with the critics that if such bodies exist they may be much more numerous than the viruses, but until some method is devised by which the constituents of the viruses can be recognised, it would seem to be useless to look for them. For the hypothetical intermediate combining molecular structure, metabolism, and reproduction, I have been using the designation *vitamol*.

J. J. DAVIS.

Department of Botany,
University of Wisconsin,
Madison, Wisconsin, U.S.A.,
July 9.

South Africa's Contribution to Prehistoric Archæology.[1]

By HENRY BALFOUR, F.R.S.

THE interest which is manifested in the study of the early chapters in the story of man's culture development is steadily increasing, not only in intensity but also in range, and there are now but few regions which remain totally unsearched for traces of early man and of his material activities. Interest becomes more *intense* as the scattered material is found more and more to belong to one huge complex problem, and it is realised that each scientifically collected item has a place in the cosmic mosaic, and may be the means of illuminating what has hitherto been obscure. The ever-increasing geographical *range* of this interest results largely from the discovery that from most parts of the world there may be collected data having a bearing upon these problems, and that it is profitable to search for traces of early man in almost any area which has ever been habitable.

Unfortunately the exceptional opportunities for study which have been offered by recent primitive peoples have largely been neglected, and the scientific value of close research into their material culture has usually not been recognised until it was already too late to reap the full benefit of the harvest. Civilisation has been more concerned with the extermination or rapid metamorphosis of primitive peoples and their industries than with their scientific investigation; and it is one of the tragedies of prehistory that so much of the invaluable and once accessible material should have been allowed to die away unstudied.

In the history of South African colonisation there may be noted such a failure to seize an opportunity of investigating fully a living primitive culture which might have thrown much light upon culture-details of long-vanished peoples elsewhere. The Bushmen and their kindred afforded an example of persistence of palæolithic conditions into recent times. Their culture was a purely Stone age culture, and they made and used stone implements of types many of which recall forms of implements which prevailed during the earlier section of the Late Palæolithic culture phase of western Europe and North Africa. The functions of the implements of the ancient series have been diagnosed so far as possible, and terms have been assigned to them, indicative of their presumed uses; but this is largely guesswork. Some degree of certainty, however, might have been reached had the living users of identical types of tools been closely studied, while the opportunity lasted, and had the details of manufacture and use of the various tool-types been placed on record.

It is too late for that record ever to be made complete and, from an archæological point of view, enlightening. Dispossessed of their old hunting-grounds, the miserable remnant of the once virile and widely dispersed Bushman race is rapidly passing away under environmental conditions so altered from those formerly enjoyed, that but little light can be thrown by the struggling survivors upon the true characteristics of Bushman culture. The old camp-sites, now deserted, must be investigated archæologically; and, in diagnosing the relics discovered, inference must take the place of direct observation.

Even that most striking feature of all, among Bushman relics, the rock-paintings and engravings, some of which are of very recent date, must be studied archæologically, on similar lines to those pursued in the interpretation of the strikingly similar artistic achievements of Aurignacian and Madeleinean man in France and Spain. How greatly would the interest of this prehistoric art in Europe have been enhanced if only a fuller comprehension of Bushman art had been arrived at by direct observation of its processes and functions. The artists have gone; this chapter in art-history is now closed, and there can be no period of *Renaissance*.

At the same time, while we must admit that the ethnological record is far weaker than it should be, through lack of scientific observation on the part of those pioneers who had opportunities of detailed study, we can note with great satisfaction the steady growth in South Africa of a keen interest in the archæological problems with which the country teems. The progressive development of local attention to the study of the Stone age in South Africa, the increasing desire for the establishment of a time-sequence of culture phases, coupled with the adoption of more precise scientific procedure in research, are features in the intellectual activity of the region the progress of which towards maturity I have myself to some extent been able directly to observe and follow.

My first visit to South Africa in 1899, exactly thirty years ago, revealed to me that, although a definite start had been made and collectors were in the field seeking for relics of the Stone age, this pastime was restricted to comparatively few enthusiasts, and the search was of a somewhat desultory nature, conducted without strict method or well-defined perspective outlook.

My second and third visits, in 1905 and in 1907, showed me that there were already many workers in the field, and that increasing attempts were being made to study the finds stratigraphically and to classify them in accordance with sequence dating. Still, the work of correlation was hampered by imperfect acquaintance with the results arrived at by European archæologists. This limitation led to some deductions which were scarcely justified by the facts.

In 1910 I again found myself in South Africa—by invitation of the South African Association. It was at once manifest that there was an increasing recognition of the importance of the geological associations of the earlier types of stone implements, as a means of establishing their relative antiquity and the ordered sequence of their succession. More serious attempts were being made to investigate

[1] From the presidential address to Section H (Anthropology) of the British Association, delivered at Johannesburg on Aug. 1.

ancient alluvial deposits and to record the particular strata from which implements were derived, and the depth within the strata. The archæological collections in the various museums were beginning to be grouped and arranged so as to tell a definite story—the story of the occupation of South Africa in early times by successive waves of immigrants, each wave introducing more or less distinctive culture elements. In this way the museums were not only attempting to furnish a summary of local archæological phenomena as interpreted up-to-date, but they were also offering suggestions as to the aims and objectives of future field-research, and indicating the nature of the problems awaiting solution.

This year it is my privilege to renew acquaintance with South Africa, the attractions of which, be they scenic, zoological, archæological, or ethnological, ever draw me with magnetic force. It is a very great pleasure to note the strides which have been taken since my last visit, nearly twenty years ago, towards unravelling the local archæological complex, and to note that this pursuit of knowledge is conducted on increasingly methodical and scientific lines.

It is manifest that the vast African area lying to the south of the Zambezi holds almost unparalleled wealth of archæological material. It appears as an inexhaustible mine of ancient relics. This is probably largely due to the successive waves of immigrant peoples having arrived in early times from the north. South Africa, though spacious, is a *cul-de-sac*, a land-terminus beyond which stretches the southern ocean, which arrested any further southward dispersal. We must picture the arrival, one after the other, of primitive peoples in various stages of culture advancement, and it is natural to assume that the order of their arrival in the far south is indicative of their general culture status. The more undeveloped peoples, less capable of defending their rights and of holding their own, yielded to the pressure of the more progressive peoples, before whose advance (due probably to similar causes) they gave way, eventually being forced down into the *cul-de-sac*, where abundance of game animals, no doubt, afforded compensatory attractions, and where they could establish and maintain themselves unmolested, until a new immigration brought a fresh racial stock into the region and renewed the clash of cultures.

During long ages, this sequence of irruptions of peoples inevitably induced a resultant congestion of heterogeneous ethnic elements, the weaker units continually giving way to the stronger, who, it may be reckoned, partly absorbed and partly exterminated the earlier occupants. The existing cultures must, at least, have been influenced and altered through contact with the new. Thus it is not difficult to see how, through a long sequence of immigrations into a region devoid of outlets, vast quantities of the more imperishable culture relics came to be accumulated in South Africa. It is also clear that the inevitable overlapping of cultures, coming into enforced contact in this Ultima Thule, tended to result in not only fusion but also confusion, and to bring about complex, hybrid industries, the parentage of which it is the aim of local archæologists to unravel.

The process of sorting out the data, and of classifying and evaluating the Stone age cultures represented in South Africa, is now proceeding apace, thanks to many keen research workers. Already several new names have been at least tentatively adopted for denoting various differentiated industries, which have been provisionally assigned their places in the chronological series.

This valuable archæological mine has as yet been only partially exploited, but its potential wealth is unquestioned; and, although prehistoric archæology must rank as a 'pure' science, and cannot be regarded as one which materially increases the *financial* welfare of the community, the finds which its pursuit brings to light must be regarded as a valuable asset to the country, worthy to be ranked with gold and diamonds and other commercially productive assets.

The great scientific importance of this valuable heritage imposes certain responsibilities upon the administration. Organisation in research is very desirable, and, although it is undesirable to curb the enthusiasm of untrained collectors, who may help very materially, it is to be hoped that, so far as possible, the field-work may be conducted under the advice and, when possible, the *surveillance* of properly trained and qualified archæologists, who may ensure that scientific methods will be pursued. This will render the finds collected more reliable as evidence, suitable for co-ordination, and capable of serving as material for building up the early human history of the region. The appointment of a carefully selected advisory committee would appear to be a practical measure, and might prevent much unprofitable work.

Surface finds are very frequently of importance to the prehistorian, particularly when accurately localised, but it must be remembered that their interest is *derived* and not intrinsic. Their value to science depends upon the possibility of comparing them with similar types the chronological horizon of which has been ascertained with certainty from their position in undisturbed stratified deposits. Material, form, technique, patination, and abrasion, all have their significance when surface finds are collated with those of determined provenance.

When one is engaged in research work there is undoubtedly a fascination in following up a theory already formulated, and in seeing the newly discovered material fitting into the theory and supporting it. But it must be admitted that there is danger in this attractive procedure, since preconceived ideas tend to restrict and cramp the outlook of the investigator and to bias his mind, causing him to overlook evidence which may be of considerable significance. At the present time it is not so much abstract theories that are wanted as concrete facts—unassailable facts, ascertained by close scrutiny of ancient alluvial deposits upon ancient camping sites, in caves, under rock shelters, and so on. From these in time will be established

the relative antiquity, sequence position, and characteristics of the early industries represented in South Africa; their geographical dispersal, the probable routes of their migrations and their inter-relationships. Also the effects of the successive impacts of newly arrived cultures upon those already established in the region will be rendered clearer when more detailed and precise data have been secured and can be co-ordinated.

Problems still awaiting solution abound in South Africa and call for the onslaught of skilled and unbiased investigators, who are prepared conscientiously to modify and even jettison theories already propounded, if new facts call for this sacrifice.

One of the problems in which I am myself keenly interested is that afforded by the Stone age remains which are so abundant along the Zambezi and its tributaries in the neighbourhood of the Victoria Falls. The first stone implements from that district to be brought to notice were, I believe, collected by Mr. A. J. C. Molyneux; but many others have since been obtained on the spot by Dr. Lamplugh, Mr. Franklin White, Colonel Feilden, and others. In the course of three visits which I have paid to the Victoria Falls—in 1905, 1907, and 1910; collectively amounting to a stay of thirty-seven days—I collected some 1200-1300 implements and artificial flakes or chalcedony and quartzite. The numerous well-defined implements are, with very few exceptions, of pronounced Lower Palæolithic facies, Chellean and Acheulean, and, but for the material of which they are made, they might almost as well have been obtained from the terrace-gravels of the River Thames or of the Somme. That is to say, in form and technique they are absolutely comparable with types which characterise the 'River drift' cultures of western Europe. They might be taken to indicate a late survival of these culture phases which had persisted until relatively recent times on the periphery of their dispersal. Or they may be regarded as an independent genesis of similar cultures, unconnected with the northern series, and evolved in response to similar environmental dictates. But evidence of very considerable antiquity is afforded by the implements themselves, which are often heavily abraded and patinated and frequently very highly glazed.

Still more important is the position in which many of the implements are discovered. I have found some imbedded at various depths in old alluvial deposits along the banks of the Zambezi, and of the Maramba and Masui tributaries; others were associated with or imbedded in thin gravel drifts scattered over the bare basalt plateau below the line of the Falls. This plateau is the ancient bed of the Zambezi over which the river flowed before, by gradual recession of the Falls to their present position, the upper portion of the Batoka Gorge had been eroded.

If we are justified in assuming that the implementiferous gravel drifts distributed over the ancient river bed and now lying 400 ft.-600 ft. above the present level of the river in the gorge, were deposited there by the Zambezi itself, then there is direct evidence not only of antiquity, but indeed of extremely high antiquity. Lamplugh, who carefully surveyed the Batoka Gorge in 1905, A. E. V. Zealley and several other skilled geologists have expressed themselves more or less decidedly in favour of this view, which certainly coincides with my own impressions. Assuming this impression to be correct, it is evident that, since these gravel drifts, with some of their associated artefacts, were deposited upon the ancient river bed, the river has eroded out a channel to a depth of from 400 ft. to 600 ft. through solid basalt. The great depth of this wonderful gorge affords data for estimating the time required for this gigantic work of attrition, while the extent of the canyon above the gravel drifts supplies further measurable time data.

Now, such important evidence of man's antiquity in South Africa deserves very careful scrutiny. It is worth while establishing once for all and conclusively whether the gravels referred to *were* laid down by the Zambezi itself, and not by lateral spruits. In spite of the prevailing geological opinion, one must recollect that Dr. Codrington, and possibly some others, did not accept this view, and, while any possible doubt remains, further investigation is called for by highly competent geologists, who can make an authoritative pronouncement.

The detailed geological diagnosis of the implementiferous terrace gravels throughout the South African region would be of great benefit to archæologists, who are endeavouring to group the early stone implement types into a time scale sequence. Some good work has already been done, but further research is needed before the succession and inter-relationships of the earliest cultures can with confidence be demonstrated.

One of the most interesting questions for local archæologists to answer is the true culture horizon to which the industry of the so-called 'Still Bay' culture should be assigned. It is characterised chiefly by the fine and shapely leaf-shaped blades, many of which are flaked all over with considerable skill. These form a decidedly specialised group. The industry appears to be somewhat local and not to be widely dispersed. It was one of the earliest distinctive industries to be noticed, and came into prominence so early as 1866, when Dr. Langham Dale collected many examples upon the Cape Flats. One wonders, in fact, why Still Bay should be regarded as the 'type site' of this culture, since, by the rules of priority in nomenclature, the designation 'Cape Flats' industry would appear to be more appropriate, in recognition of Dr. Dale's pioneering discovery. But this is by the way. By some, the dominant implements of this industry have been taken, on insufficient evidence it seems to me, to indicate a Solutréan phase in South Africa. J. P. Johnson described the leaf-shaped blades as 'Solutric', and L. Peringuey refers to them as exhibiting a 'Solutrian *facies*', though there is a non-committal touch in his expressed opinion. The chapter which deals with this industry is headed 'The Neolithic'!

It appears to me that the technique of the leaf-shaped Still Bay blades differs considerably from that of the typical Solutréan blades of western Europe, and scarcely justifies any confident suggestion of affinity. It will be extremely interesting when the exact status of the 'Still Bay' or 'Cape Flats' culture is established, and when it is known whether it was evolved locally from a previous indigenous culture; or whether its origin is due to 'mutation', as a result of culture-fusion; or, again, whether it represents an intrusive culture which had been differentiated elsewhere.

Another intriguing problem has as its focusing point the *'kwè*, the stone digging-stick weight of the Bushmen. Although this is one of the best-known implement types in South Africa, and one of the most widely dispersed, it presents one of the greatest puzzles. Judged by the standard of Europe and of most other parts of the archæological world, the perforated stone ball known as *'kwè* seems to be out of place in the hands of a people whose culture largely suggests palæolithic affinities. The art of perforating implements of hard stone was, in Europe, a late development and it does not appear to have become prevalent until the later phases of the Neolithic period. Hence, there is a suggestion of precociousness on the part of the Bushmen, whose general status scarcely warranted their possessing or, at any rate, making perforated stone tools. The question as to how they came by this technique is one which is not readily answered.

A possible solution occurred to me many years ago, when I ascertained that another people, occupying an area in north-eastern Africa, employ a practically identical implement—to wit, a simple digging-stick heavily loaded with a perforated stone weight, through which the stick passes. These people are the Gallas, a Hamitic people domiciled to the south of Abyssinia. Being in a relatively advanced state of culture, *their* employment of perforated stones is not in any way remarkable. But their use of this stone-weighted digging tool does suggest the possibility that, in the course of their southward drift, some of the Bushman hordes may have come into contact with the Gallas, or kindred peoples, and have acquired from them a knowledge of this tool, and of the technique involved, and have carried with them into the south a borrowed idea which was destined to become an anomalous though prominent feature in the so-called 'Wilton' industry. That they should have invented the *'kwè* for themselves is contrary to analogy, and the fact that an identical appliance, used in a similar manner, occurs among a people in the north, at least offers a possible explanation of the seeming paradox.

The existence in South Africa of the *'kwè*, with its marked *neolithic facies*, is rendered the more striking when we remember that implements of distinctively neolithic character are rarities in Africa to the south of the Zambezi. Ground stone celts, for example, are of very uncommon occurrence, and the same applies to the typical late Stone age arrow-heads, locally found examples of which probably scarcely exceed half a dozen in number. Other characteristic neolithic types are conspicuous by their absence in the region. In the local sequence of cultures the typical late Stone age appears to be missing, or at least so faintly represented that it cannot be regarded as ever having exercised a dominating influence. At best, the latest purely Stone age culture definitely represented in South Africa suggests a general Upper Palæolithic and Mesolithic level modified by a very slight infiltration of neolithic intrusion, and no marked invasion of a people possessed of a culture at all comparable with that of typical neolithic man in the north seems to have occurred.

When the great succession of invasions of Bantu peoples was inaugurated, the newcomers were, presumably, already well advanced in their Iron age, and had long since passed out of even the latest phases of the Stone age. Hence, so far as South Africa is concerned, the transition from Stone to Iron was remarkably abrupt. There is a marked hiatus due to the absence of linking cultures between a late Palæolithic phase, somewhat modified by intrusive ideas, and an already evolved phase of metal. The fact that the later arrivals upon the scene—with their superior physique and their knowledge of working iron—were vastly superior to the peoples whom they overran and succeeded in dominating, must have created a sudden and far-reaching change in the general economic development of the region. The unbridged culture hiatus is a wide one, and is one of the striking features in South African history.

The earlier nomad hunters appear to have been gradually forced into their final southern home, and to have remained for a long time in a state of partial stagnation, undergoing comparatively little progressive evolution. To a considerable degree the industries which were successively introduced by them offer analogy to some of the early Stone age industries which have been differentiated and standardised in Europe, and furnish the obvious basis of comparison in prehistoric archæology. In all probability the early cultures of South Africa may, for the most part, be regarded as related to and as offshoots from those the sequence status of which has been determined in the north.

One cannot expect the resemblance between the European and the South African series to be very exact, however, since it is highly improbable that their occurrence in the two widely separated regions synchronised. A migrating culture, even the most unprogressive, cannot long continue unchanged. It is plastic and reacts to new environmental conditions, which create special wants and impose modifications. New elements appear in response to new demands, and some of the old characteristics vanish as their utility ceases. On the periphery of its dispersal an industry is, in fact, liable to show marked differentiation from its original prototype. Certain elements in the complex persist, and continue to supply evidence of affinity with distant cultures: but the points of divergence are no less interesting, since they illustrate the effect of the new environment upon

the habits of the people. South African archæology intriguingly suggests culture affinities, far-ranging both in time and in space, and illustrates at the same time how those affinities have become more or less obscured and attenuated in the course of long migration.

At present the South African problems have to be studied to a great extent as a group of isolated phenomena, because a vast area to the north remains, archæologically, almost unexplored. Northern Rhodesia, Nyasaland, and Tanganyika Territory, when the story of *their* ancient cultures has been fully revealed, should throw a flood of light upon South African archæological peculiarities by furnishing evidence of the migrations routes and of the gradual changes in culture detail resulting from the dispersal southward. Farther north, in Uganda and Kenya Colony, important and suggestive work has already been carried out by Mr. E. J. Wayland and Mr. L. S. B. Leakey, the results of which have an important bearing upon the South African problems. But the full import and significance of the north and south affinities and dissimilarities will be realised when the huge intervening area has revealed its archæological secrets and contributed its data for a valuable chapter in the story of the wanderings and sojournings of migrant peoples in the course of their progress southward.

In the meantime, South Africa may well concentrate upon her local prehistoric problems, and proceed with the exploration of her past and the disentanglement of her sequence of bygone industries.

Such research into the past is surely worthy of every encouragement from the universities, and deserving of government benediction and even financial support. The material appears to be extraordinarily rich, almost inexhaustible in fact, and the deductions drawn from carefully verified data in one district can be checked and re-checked by information culled in others, so that the final summing-up should prove authoritative and highly instructive.

Tung Oil.

TUNG oil is an essential raw material of present-day varnish manufacture, and in fact its unique properties render it indispensable for certain types of varnish. Until comparatively recently, China has satisfied the world's demand for tung oil, and will, it is considered, continue to remain the chief source for some years to come. The oil is derived from two species of *Aleurites*, *Fordii* and *montana*, of which the former is the chief source. It was Wilson, a naturalist in western China, who in 1915, after a study of the species of *Aleurites*, solved the question as to the true origin of tung oil. *A. Fordii* has its habitat chiefly in western and central China, whilst *A. montana* is found more to the south. Tung oil, also termed China wood oil, was known outside China about 1760. It was first introduced into the United States in 1896, into Germany in 1897, and soon afterwards into England. Little notice of it was taken commercially in England until after the outbreak of War, when special water-resisting varnishes were required for aeroplane work. Thereafter, on the recommendation of the Raw Materials Committee of the Imperial Institute, growing experiments (Wilson having stated that he considered the trees could be grown in South Africa, East Africa, Australia, Algeria, and Morocco) were started in India, Ceylon, Malaya, Burma, Kenya, Tanganyika, Hong-Kong, and South Africa. The position of this new industry was first reviewed in a paper prepared by Dr. L. A. Jordan, of the Research Association of British Paint, Colour, and Varnish Manufacturers (Technical Paper, No. 1), published by the Association for private circulation in 1927. The work described proved of such importance and aroused such interest that the paper has been now republished, after a revision, by Dr. Jordan (*Journal of the Oil and Colour Chemists Association*, Vol. 12, No. 107, May 1929).

In China the tung oil trees, with reference principally to *A. Fordii*, occur abundantly and grow luxuriantly mostly in a region between Lat. 26° and 34° N., and in hilly country up to 2500 ft. in altitude, especially in the upper reaches of the Yangtze valley. *A. Fordii* favours the northern and *A. montana* the southern parts of the area, but there is no strongly marked division in the distribution of the species. They are ornamental trees and rapid growers producing fruit, from which the oil is extracted, in and after the third year—though it is safest to calculate on a first crop as from the fifth year. In China the trees generally grow to 20 ft.-25 ft. in height, with a trunk of about 10 in. in diameter. But individuals are said to attain 50 ft.-60 ft. with a canopy 60 ft. in diameter. The trees have a low branching habit and pruning is necessary to prevent a low straggling cover. The fruit is about the size and appearance of a russet apple. The blossoms are very sensitive to early spring frosts, and young trees, until established, are subject to frost. For other details on the manner of growth and cultivation the reader is referred to Dr. Jordan's publication. Of greater interest here is the progress made in the cultivation of this valuable tree.

As has been said, the world was dependent on China for the oil. The United States, the post-War consumption of which went up by leaps and bounds, were the first to realise the position and to take steps to obviate a total reliance on one source of supply and country. In 1914 the U.S.A. imported 61 per cent of the total Chinese export, in 1918, 77 per cent, and in 1925, 80 per cent. The American consumption is now 40,000 tons per annum. The oil is used to a considerable extent for domestic purposes in China, and the increasing world demand will encroach more and more on the stocks required for home use, which will mean that they will only be parted with at an increased price. The methods of collection and extraction of the oil in China are crude and wasteful, yet the crop is regarded as a most profitable one by the Chinese.

It was these considerations which led the Americans, very soon after the War, to take up the question, added to the fact that they were reluctant to depend for their supplies on a foreign country. They began to study the possibilities of establishing a domestic industry ; a period of high prices in 1923 brought the matter to a head, with the result that the American Tung Oil Corporation was formed with Mr. H. A. Gardner, the Director of the American Paint Research Institute, as vice-president and general manager. " British Paint Manufacturers stand to-day ", says Dr. Jordan, " precisely where the Americans stood about 1921 ". The object of the Corporation has been to demonstrate primarily what could be done with tung oil trees as a crop in the hope, which has been fulfilled, of encouraging farmers to cultivate the tree on a large scale upon a commercial basis.

Judged from the manner in which this work is developing over a very wide area in the southern United States, and also in Hawaii and the American Pacific Islands, it has become evident that the farmers have responded to the efforts of the Corporation. In 1923 all the information available in America was that a few tung oil trees had been successfully grown here and there in various parts of the southern United States, the oldest of these trees being about 14 or 15 years at that time. The Corporation acquired land adjacent to the Agricultural Experimental Station of the University of Florida, and the first seedlings were planted in 1924. By 1926, 2500 acres had been planted up, representing about 200,000 trees. Distribution of one-year plants raised in nursery centres is made on very favourable terms to bona-fide farmers. In the autumn of 1926 the Corporation had half a million seedlings in the nurseries available for distribution. The Corporation is assisted by the U.S. Department of Commerce, and everything is being done to stimulate the independent planting of the tung oil trees. Seed is now being sold from the nurseries to large landholders, and several hundred pounds of seed were shipped in 1927 to New Zealand, Jamaica, the Virgin Islands, the Philippines, and to England for Colonial purposes. In the Report for 1928 the area under tung oil trees amounted to 4000 acres, whilst another 1000 acres was projected in Florida during 1929.

Experiments have been made as to the best machinery for crushing the seed, 30,000 lb. of seed being experimented upon in 1928. In January 1929, the first large-scale tung oil mill came into operation, capable of expressing about 50 gallons of oil per hour ; this marking the commencement of activities on a commercial scale. As yet but a small percentage of the trees grown are of an age to produce fruit ; it is considered, however, that in a few years a considerable supply should become available. It is estimated that an area of 100,000 acres would be required to supply the present American demand. The quality of the American oil is said to be better than the Chinese and freer from impurities.

Turning now to the activities in this direction in the British Empire, it is apparent that they fall far short of the American. Prior to 1927 they were almost negligible. It has been stated that experiments were started in various Colonies in 1917, though the amount of available seed was small. Kenya had a record planting at 5500 feet in 1922, seed from the trees being sent to the Imperial Institute in 1927. India carried out experiments at the Forest Research Institute at Dehra Dun. In 1924 trees of *A. Fordii* were fruiting at six years old but the seed germinated badly. The work, however, was still in an experimental stage.

The last two years have witnessed a real movement. It was in 1927 that the Research Association of British Paint, Colour, and Varnish Manufacturers took the matter up and Dr. Jordan's first pamphlet appeared, of which 600 copies were printed and widely distributed ; considerable interest and enthusiasm on the subject was thereby stimulated in many parts of the Empire. The Research Association then took the step of purchasing 700 lb. of selected seed of *A. Fordii* of the 1927 American crop and distributed it to privately owned farms and estates, government agricultural stations, and forest officers over the widest possible area. The general manager of the American Tung Oil Corporation rendered invaluable help in this matter, not only with seed but also with advice ; " for the American view ", says Dr. Jordan, " is that beyond a certain point they must ultimately look to British Empire production to augment their own supplies ". The distribution of the seed by the Research Association was effected with the help and advice of Sir William Furse, Director of the Imperial Institute, and Dr. A. W. Hill, Director of the Royal Botanic Gardens, Kew, who heartily co-operated.

The seed was sent to middle and East and South Africa, India (Nilgiris, Malwa plateau, C.I., Bihar and Orissa, Bengal and Assam, the latter province being regarded as the most promising), Malaya, Ceylon, and Burma, where *A. montana* is indigenous. Seven tea estates have taken up the matter in Assam. All of them report approximately 50 per cent germination. One estate reports trees averaging 4 ft. in four months after transplanting : three reported 6 ft. trees as the rate of growth from seed in one season.

Cyprus is experimenting with the seed, and work is being carried out in the West Indies, Palestine, Australia, and New Zealand. Reports as to progress are insisted upon from all recipients of seed ; as Dr. Jordan tersely puts it, " No reports—no seed ". So far the reports received are mostly favourable. It is impossible to follow Dr. Jordan further in his most valuable and interesting paper, which deals fully with culture, extraction, exports, and so forth. To show the extent of the progress achieved the following extract may be quoted : " As far as Africa is concerned, tung oil plants of our 1927 seed are now being watched everywhere from Kenya to the Cape—in Nyasaland, Tanganyika, the Rhodesias, Transvaal, Natal, and Cape Province, and in Nigeria ". The Research Association of British Paint, Colour and Varnish Manufacturers and Dr. Jordan are to be congratulated on initiating a most valuable piece of work which appears likely to introduce a new Empire industry.

News and Views.

SIR DONALD MACALISTER, president of the General Medical Council, who has been Principal and Vice-Chancellor of the University of Glasgow since 1907, has submitted his resignation, which will take effect early in October, after the opening of the War Memorial Chapel. His successor, who is appointed by the Crown, will be available for the early part of the winter session. There is little doubt that when the General Council of the University proceeds to the election of a Chancellor in succession to the late Lord Rosebery, it will take advantage of the opportunity of retaining Sir Donald's services. The office has been generally held by a Scottish peer. Sir Donald's resignation brings to an end a principalship, the success of which is probably unprecedented in the annals of Scottish universities. During the past twenty-one years, the University of Glasgow has made remarkable progress, due mainly to the Principal's genius in administration. He soon introduced great improvements in the business of the University and has unquestionably made it a far more efficient and competent organisation. Before he took office, there had been frequent friction between the University Court and Senate; but his capacity as chairman of the Court and the full confidence of the teaching staff in his judgment, insight, and statesmanship have allowed the Court without opposition steadily to increase its control of the University. This change was inevitable, as the Court has remained a body of fourteen, of which the Rector's membership is nominal, while the Senate has increased in number from 33 in 1907 to 62.

THE number of professors in the University of Glasgow has grown during Sir Donald MacAlister's term of office from 33 to 50, an increase of more than 50 per cent, while the number of lecturers has been raised from 32 to 135. The increase in the teaching staff has been partly due to the confidence inspired in the University among the citizens of Glasgow, who have generously endowed new chairs and lectureships, while Sir Donald has recognised that in modern conditions university departments can no longer be run by one man, but are dependent on a group of teachers. The number of students has increased from about 2500 in 1906–7 to 4761 in the session 1927–28, so that the University of Glasgow is now the largest in Scotland, and in Britain is exceeded only by London and Cambridge. Sir Donald initiated a Students' Welfare Fund which has provided a new Students' Union, increased facilities for recreation, and a large pavilion on the sports ground. The University buildings have been extended, including a well-equipped Department of Zoology, and new lecture and class rooms for arts have been provided by completion of the west quadrangle in the main University building. Sir Donald MacAlister has also arranged for great improvements in the University Library and in the Hunterian Museum, for which he secured an income that has rendered possible its development on lines worthy of the University. The trust in Sir Donald MacAlister felt by the business men of Glasgow was shown at the dinner given him last winter in honour of the twenty-first year of his brilliant principalship.

SIR HENRY A. MIERS continues his campaign on behalf of museums. His Carnegie Report in reality dealt with the whole theme, but he has, since its publication, elaborated the educational possibilities of museums in an address to the Royal Society of Arts. Now he turns to the museum people themselves, and in his presidential address to the Museums Association, delivered on July 2, at the annual conference of the Association at Worthing, he indicates the directions in which they may help themselves, or better still may help each other. The title of the address indicates its theme—"Co-operation: The Task of the Museums Association" (*Museums Journal*, August). Sir Henry doubts whether a unified national museum service organised under one of the great Departments of State could be successful in Great Britain. The county organisation which he suggested as the basis for a thorough-going reformation, referred to in a leading article in NATURE of July 14, 1928, is ideal in many ways, but it is limited in scope, and if a move is to be made towards a wider national co-operation, local efforts must be reinforced by a more general scheme. The driving force of such a scheme ought to centre in the Museums Association, which already contains a nucleus, not too large but representative, of museum workers, and has at hand the machinery for organised effort.

THE weight of the Museums Association's authority must be directed to a determined effort at co-operation aimed particularly at uplifting the less efficient museums, and so raising the whole existing museum service to a higher level. But this requires a certain amount of reorganisation within the Association itself. It must appoint a Council, which would meet as often as need be, to formulate and carry out an active policy. The annual meeting must be taken seriously and must be supplemented by sectional meetings in different centres, by organised visits to local museums, by discussions of particular difficulties as well as of the more general museum themes. More use should be made of the *Museums Journal* in making known individual wants and in pooling experience. Museum publicity should be encouraged and organised, and joint efforts made to arrange special exhibitions with the view of attracting and educating the public. Finally, some attempt should be made at training youth for museum work, first in a simple way by holding a summer school for instruction, at which diplomas of efficiency would be granted, and this might ultimately develop into a school of curatorship, as has happened in the case of the librarians. These suggestions are the bare bones of a progressive policy. They imply much forethought as well as spade work, but they would help on the museum movement and at the same time would add to the efficiency and the authority of the Museums Association itself.

LAST February we directed attention to the initial steps being taken to commemorate in a worthy manner the centenary of Faraday's discovery on Aug. 29, 1831, of electromagnetic induction. From those initial steps came the formation of two committees: the first, consisting of representatives of the Royal Society, the British Association, the Royal Institution, and other bodies, is concerned with the purely scientific aspects of Faraday's work in relation to the proposed celebrations; while the second, consisting of representatives of the principal organisations of those industries which have arisen from Faraday's discoveries, is dealing with the industrial aspects of the celebrations. This second committee has been called together by the Institutio nof Civil Engineers. The dates of the celebrations have now been fixed, and the proceedings will commence in London on Sept. 21, 1931. The British Association centenary meeting will begin in London on Sept. 23. These two centenaries, with important electrical conferences and other events which are to take place at the same time, will conjoin to make 1931 a memorable one in every country where the genius of Faraday has borne fruit.

THE results obtained by the British Association's expedition to excavate the ruins at Great Zimbabwe, of which Miss Caton-Thompson was in charge, were of course reported at the recent meeting of the Association, and a cabled account has appeared in the *Times* of Aug. 3. Excavation was not confined to Great Zimbabwe but was extended to Dhlo-Dhlo and other sites. The results must therefore carry greater weight than if the work had been confined to one site alone. It is evident that the investigations have been carried out on rigidly scientific lines and most careful records made so that the results should be beyond cavil. In a number of cases digging was carried down to bed-rock. Native pottery and weapons and medieval imported objects were found at the lowest levels. On this evidence and that of the walled structures themselves, Miss Caton-Thompson finds herself in entire agreement with the conclusions of Dr. Randall-MacIver.

No object found at Zimbabwe could be dated before about A.D. 600 and the buildings were probably much later. Miss Caton-Thompson thinks the Zimbabwe culture to be "a vigorous native civilization, unsuspected by all but a few students, showing a national organisation of a high kind of originality and amazing industry". Since Dr. Randall-MacIver presented his report on the Zimbabwe ruins to the British Association on the occasion of its former visit to South Africa in 1905, his conclusions have been violently attacked, his methods severely criticised, and his freedom from bias openly questioned. During the last twenty-five years a vast experience has been gained in many fields in the application of archæological methods. Yet in 1929 Miss Caton-Thompson is able to agree with Dr. Randall-MacIver's conclusions in 1905. No more complete and satisfactory vindication of the methods and results of the earlier investigation could be desired. Until some new and utterly divergent evidence appear, the Zimbabwe question may be regarded as settled.

THE rapid increase in the number of overhead lines in Great Britain makes the question of the best method of supporting them a very important one. In a paper on concrete poles by W. T. Taylor, published in the *Electrician* for July 26 and Aug. 9, a very strong case is made out for the use of concrete poles. Everyone who has travelled through western Europe recently must have noticed the large number of high-tension lines which are being built and are supported by concrete poles. In Great Britain the atmospheric conditions lead to the rapid rusting of lattice steel masts. This rapid depreciation has to be added on to the initial cost when discussing the relative merits of steel and wood pole lines. Mr. Taylor proves that this fact in many cases turns the scale in favour of wood poles. In the Shannon scheme the Dublin high-tension line (110 kilovolts) is supported entirely by lattice steel masts, the 38 kv. lines are built on steel poles in the southern and wood poles in the northern areas, and for the 10 kv. lines wooden poles are used exclusively. One great advantage of reinforced concrete poles is that they maintain their initial strength apparently indefinitely. Painting and renewing or resetting poles are entirely eliminated by concrete construction. They are no trouble to landlords or tenants, and hence wayleave costs are reduced to a minimum. Steel poles are about 30 per cent dearer than wood poles, but concrete poles are only about 10 per cent dearer. The great saving, however, in upkeep costs makes the reinforced concrete pole much more desirable from the economic point of view than either steel or wood poles of any type. In appearance however, they are heavy and clumsy and are not so neat and trim as steel or wood poles.

PROF. E. W. MARCHANT read an interesting paper at Johannesburg on Aug. 1 before Section G of the British Association on the limits of economical transmission of electrical power. He pointed out that there is now no special technical difficulty in transmitting electrical energy over several hundreds of miles. It would therefore be useful to compare the cost of generating electricity at a power station near a coal-pit and transmitting it to a town, with that of transporting the coal by rail to a generating station in the town itself. To make the problem definite, he considered the relative merits of a power station at Wigan, where there are many excellent coal-pits, with one in Liverpool, twenty miles away, the coal in the latter case being conveyed by rail. With ordinary everyday efficiencies for the power station, the electrical scheme is the more economical. If, however, an electric unit could be generated for one pound of coal consumed, an efficiency towards which large power stations are now approaching, there would be equality of costs between the two methods. At still higher efficiencies it would be more economical to transport the coal, since, for a given output, transport costs diminish as the efficiency increases, whilst electrical transmission costs remain constant. In his comparisons Prof. Marchant adopts the standard English pressure of 132,000 volts. Electricians have already made experiments on an overhead line designed for a million volts and no

unforeseen difficulties have arisen. The line with its lofty steel lattice towers, however, looks more like a bridge than a transmission line. Prof. Marchant also compares the cost of supplying hydroelectric power from the Victoria Falls to the Rand, a distance of 600 miles, with that of steam generation in the Rand itself. He concludes that if the cost of fuel in South Africa increases, the exploitation of the Victoria Falls will be economically feasible.

IN a short article in the July *Scientific Monthly*, Tze Tuan Chen directs attention to the fact that "some ideas of the origin of species, of variation, of adaptation, and of the structure-function theory were formulated [by Chinese thinkers] several thousand years before Darwinism came into existence and have all been neglected by Western writers in their history of the theory of organic evolution". He cites examples of evolutionary sorts of notions which occur in Chinese folk-lore and myths, such as the still existing superstition that a shark will change into a tiger when it gets on land; but to our minds such magical tales have no bearing upon the scientific thesis that one animal is evolved from another. There is more to be said for the philosophy of Confucius, who in the sixth century B.C., in his "Yi-ching", expressed the idea that things were originated from a single simple source through "gradual unfolding and branching", or in the self-transformation theory of Chuan-tze (fourth century B.C.). In one place that writer stated that "the life of all living things is like the running of a horse, changing and moving at every moment. What do living things do? They will naturally transform themselves." And again, "All living things are species developing to various forms through the process of variation". These are suggestive words, much more indicative of a pregnant speculation than other examples the author quotes.

WE have received from Messrs. Adam Hilger, Ltd., a copy of a bulletin issued by their Sales and Research Department, giving particulars of the work of the firm during the thirty months ending Dec. 31, 1928. It is a notable record in many ways, but it is particularly satisfactory to read that their activities can now be limited to the manufacture of instruments for research. It is noteworthy, too, that more than one-half of the sales in 1928 were to foreign countries, several especially large purchases of spectrometers and interferometers having been made by German laboratories, including the Physikalische Technische Reichsanstalt at Charlottenburg. Some of the new instruments mentioned in the bulletin have already been referred to in NATURE. A very useful feature is the inclusion of a list of some two hundred and fifty references to Hilger instruments in scientific journals; it is often difficult to decide the exact form of instrument best suited for a research, and a list of this type is an invaluable addition to Messrs. Hilger's well-known general catalogue.

AN interesting development in the activities of the Faraday Society is the exchange of certain reciprocal privileges with the American Electrochemical Society and with the Deutsche Bunsen-Gesellschaft. Under the new arrangement, members of the Faraday Society can become full members of the other societies on payment of reduced subscriptions, and vice versa. Membership includes the receipt of all publications issued by the societies to their ordinary members. There can be no question that this arrangement will not only improve the position of the societies participating, but will also be a substantial step towards international co-operation in science.

LORD LEE of Fareham has accepted the chairmanship of the Radium Commission which has been set up to undertake the custody and distribution in Great Britain of radium purchased by the National Radium Trust.

IN a letter to the editor, Mr. Maynard Shipley states that the 'shaky composition' attributed to him (NATURE, May 11, p. 735) was due to the printer, and that his statement regarding the prevalence of a belief in witchcraft in 'vast districts' of Scotland was derived from two natives of that country. It is clear that, at any rate, one of these witnesses was referring to the days of his childhood in Scotland, but rural Scotland has changed much in the intervening years.

IN NATURE of Aug. 3, p. 208, it is stated that the epicentre of the earthquake recorded at Kew Observatory on July 23 was close to the north coast of Ireland; this should be Iceland. Dr. F. J. W. Whipple informs us that the shock in question was felt at Reykjavik. According to a bulletin issued by the International Seismological Bureau at Strasbourg, the probable position of the epicentre was 64° N., 23° W. This is very close to the south-west coast of Iceland.

BY an Order of the Committee of Privy Council, the Viscount D'Abernon and Major A. G. Church, M.P., have been appointed members of the Medical Research Council on the retirement of the Earl of Balfour and of Sir Charles Trevelyan, Bart., M.P. Lord D'Abernon will succeed Lord Balfour as chairman of the Council. By another Order, made after consultation with the Medical Research Council and with the president of the Royal Society, Prof. J. J. R. MacLeod, Regius professor of physiology in the University of Aberdeen, and Mr. Wilfred Trotter, honorary surgeon to H.M. the King and surgeon to University College Hospital, London, have been appointed members of the Council in succession to Prof. E. P. Cathcart and Sir Charles Sherrington, who retire in rotation on Sept. 30.

IN connexion with Prof. Boys's letter in NATURE of June 29, p. 981, on electrified omnibuses, Mr. Charles Macnamara, Arnprior, Ontario, Canada, informs us that in Canada motor tank-trucks for distributing motor spirit to service stations are commonly 'earthed' by a short piece of iron chain which drags on the road beneath the truck. This avoids the risk of a spark, which might, in the circumstances, be dangerous. Mr. Winn W. Davidson, of Gilroy, California, in a letter to the Editor, also refers to this practice, adding that "in the hot interior valley of the San

Joaquin, where during the summer the mean monthly temperatures often range from 100° to 114° F., with an average humidity of 33 per cent, it is customary for the service station attendant to touch the metal-work of automobiles with the metal nozzle of the hose leading from the gasoline pump, before he proceeds to fill their gasoline tanks. If this is not done, there is danger that a spark in the narrow opening of the gasoline tank might ignite an explosive mixture of gasoline vapour and air."

THE eighth Conference Bibliographique Internationale will be held, by kind permission of the governors and Prof. H. L. Callendar, in the Imperial College of Science, South Kensington, on Sept. 16 and 17. The first day will be occupied with council meetings. The general assembly and conference, to which visitors are invited, will commence at 10 A.M. on the second day, when Prof. A. F. C. Pollard will give the presidential address. The agenda includes further proposals for the reorganisation of the Institut International de Bibliographie of Brussels, reports of the commissions on Cataloguing Rules and on Documentary Technique, and a discussion on the possible unification of the aims and objects of international bibliographical organisations. In view of the fundamental importance of information services to science and technology, it is hoped that all who have at heart the organisation of information will endeavour to be present and assist in the discussion. The subscription to the Conference is ten shillings. Further information may be obtained from the organising secretary, Mr. H. T. Pledge, The Science Library, London, S.W.7.

THE Ministry of Health has issued a "Report on Rural Water Supplies" (London: H.M. Stationery Office, price 9*d*. net). It deals with both 'piped' and 'non-piped' supplies, concerning which many practical and financial details are supplied. It is considered that where a piped supply is unobtainable, there is no reason why rain water should not be utilised, at least in country districts, particularly for small dwellings.

WE have received the Annual Report for 1928 of the Department of Pathology and Bacteriology of the University of Leeds, by Drs. Stewart and McLeod, the professors of pathology and of bacteriology respectively. A brief summary is given of the work of the Department and a list of papers published by members of the staff. In an abstract report on cancer research by Prof. Passey, reference is made to work by Dr. Berenblum which shows that mustard gas is capable of inhibiting the production of experimental cancer in mice by an active cancer-producing tar, even if first applied eleven weeks after the commencement of the tar treatment.

THE April-June issue of the *World's Health* (vol. 10, No. 2) commemorates the tenth anniversary of the foundation of the League of Red Cross Societies. Among the articles, one by Dr. Pierre Béhague describes the organisation of first aid on French roads. First-aid posts are created wherever the road is dangerous outside towns and villages, twenty posts on an average being provided for every hundred kilometres of road, and there are at present nearly a thousand of these posts. First-aid material is kept at the posts, and a staff, including doctor, is attached to each one.

THE review of the work of the Rockefeller Foundation during 1928 has been issued by the president, Mr. George E. Vincent. No less a sum than 21,690,738 dollars was disbursed. Among the objects to which sums were contributed may be mentioned (*a*) lands, buildings, or endowments for eighteen medical schools in fourteen countries; (*b*) support of the Peking Union Medical College; (*c*) aid to Brazil in combating a new outbreak of yellow fever and continued studies of that disease in West Africa; (*d*) aid to the governments of twenty-one countries in fighting hookworm disease; and (*e*) grants to health services, for fellowships, and to the Health Organisation of the League of Nations, and several other activities bearing on hygiene and health. An interesting review of the work of the Foundation during the past sixteen years is also included.

GEOGRAPHERS and librarians should be interested in the latest catalogue of Mr. W. A. Robinson, 4 Nelson Street, Newcastle-upon-Tyne, which deals with upwards of 300 second-hand works on early American voyages and other travels.

WE have received a "Catalogue of Cine Cameras and Projectors" from Messrs. Sands, Hunter and Co., Ltd., of 37 Bedford Street, Strand, W.C.2. It will be convenient to those who are interested in such apparatus and their accessories to have so many of the various patterns that are on the market included in a single list.

THE McGraw-Hill Publishing Co., Ltd., 6 Bouverie Street, E.C.4, has just issued new editions of its special sectional lists Nos. 2 and 13 relating respectively to books on radio engineering, telegraphy and telephony, and astronomy, mathematics, meteorology, and physics. Copies can be had free upon application.

WE have received from the publishers, Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street and 24 Gower Place, W.C.1, the new edition of the Catalogue of Lewis's Medical and Scientific Circulating Library, revised to the end of 1927. The catalogue is in two parts: Part 1, authors and titles, and Part 2, classified index of subjects. Part 1, which runs to more than 400 pages, contains the full titles of the works listed, under authors' names. The classified index of subjects in Part 2 should be very useful apart from the library. In it under a subject the names of authors of works are given, with date of publication, so that the later works may be picked out if desired, and by reference to Part 1 the full title of the book can be found. Subjects are, moreover, subdivided; for example, 'Botany' has eight subdivisions—alpine, economic, geographical, etc. The library contains a considerable selection of works in medicine and general science, and the subscription terms appear to be very reasonable and free from restrictions.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An assistant veterinary inspector under the Surrey County Council—to carry out duties under the several Acts and Orders relating to : Milk and Dairies ; Diseases of Animals ; and such other veterinary duties as the Council may require—The Clerk of the County Council, County Hall, Kingston-upon-Thames (Aug. 19). An assistant lecturer in the Chemistry Department of the Derby Technical College—The Secretary, Education Committee, Becket Street, Derby (Aug. 28). A chief inspector of weights and measures under the County Council of the West Riding of Yorkshire—The Clerk of the County Council, County Hall, Wakefield (Aug. 31). A male lecturer in education at University College, Southampton—The Registrar, University College, Southampton (Sept. 2). Probationary assistant engineers in the Engineering Department of the Post Office—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (Sept. 12). Lecturers in mechanical engineering and in civil engineering, at the Government Technical Institute, Insein, Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Sept. 14). An assistant lecturer in metallurgy and assaying at the Manchester Municipal College of Technology—The Registrar, Municipal College of Technology, Manchester (Sept. 16). A professor of physiology at the Presidency College, Calcutta—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Oct. 31). A lecturer in physics at the Memorial University College, St. John's, Newfoundland—S. J. Harrington, Woodfield, Malvern Wells. A full-time lecturer in mechanical engineering at the St. Helens Municipal Technical School—The Secretary for Education, Education Office, St. Helens. A marketing research assistant at the National Institute of Poultry Husbandry—The Director, National Institute of Poultry Husbandry, Newport, Salop.

Our Astronomical Column.

Telescopic Bielid Meteors.—Prof. Charles P. Olivier, who is the director of meteoric observations in the United States, notes in *Astr. Nach.* 5641, that Mr. Franklin W. Smith, while guiding for a photograph in Andromeda on Nov. 11, 1928, saw 11 telescopic meteors pass through the field (which was 1° in diameter) in the period of 102 minutes. He noted the position angles of the meteors, from which Prof. Olivier deduced that 10 out of the 11 were members of the Bielid stream, otherwise known as the Andromedids. The radiant was found to be R.A. 10°, Decl. + 40°, with an error not exceeding 3°. There were several conspicuous Bielid showers in the last century, and the present observation is of value as helping to trace the present position of the stream. Prof. Olivier expresses the hope that any observers who may see telescopic meteors will make a record of the time of observation, and the position and direction of the tracks.

Curve of Solar Activity from 1877 to 1928.—Signor Luigi Taffara, of Catania Astrophysical Observatory, has published a discussion of the solar activity during the above period in *Mem. Soc. Astron. Ital.*, vol. 4. Spots and prominences are separately discussed, and a curve drawn from a combination of all forms of activity. The dates of maximum are given as 1884·78, 1893·50, 1905·62, 1917·31, 1928·50. Those of minimum as 1878·89, 1889·76, 1902·11, 1913·38, 1923·50. The highest maximum is that of 1893, and the curve indicates some tendency for successive maxima to be alternately high and low ; this would harmonise with the conclusion that the complete cycle comprises two eleven-year periods, which was deduced from the alteration of the law of polarity of spots in successive eleven-year cycles. The author gives 4·313 years as the mean interval from minimum to maximum, and 6·728 years for that from maximum to minimum.

Prof. Aitken's Double Stars.—*Lick Observatory Bulletin*, No. 413, contains remeasures by Prof. Aitken of 296 of the double stars discovered by him early in the century. Several of the stars give evidence of motion ; in a few cases, this is sufficient to enable approximate orbits to be calculated, and in many more cases it is sufficient to deduce dynamical parallaxes. These deductions have not been made as yet, but the list offers material for those who have leisure for the research. More than one-third of the stars are of spectral type *F*5 to *G*2 and the remainder are divided nearly equally into the groups *B*8 to *A*3, *A*5 to *E*2, *G*5 to *K*2. Aitken 111 is an interesting triple star. The close pair consists of two equal stars, magnitudes 9·1, mean distance 0·18″, period 10·5 years. The third star, the connexion of which is proved by common proper motion, is distant 2·2″ ; its magnitude is 12·5. Aitken 1928 has also a short period, about 19 years. An orbit, computed in 1918, is given for the naked-eye star 83 Aquarii ; period 23·82 years, *a* 0·245″. The list closes with measures of 14 new double stars discovered in the last two years.

Stark Effect in Stellar Spectra.—It has been considered for some time past that the great widths of hydrogen lines in stellar spectra are due at least in part to the Stark effect. A discussion of line widths in early-type stars by Dr. O. Struve (*Astrophysical Journal*, **69**, 173) shows that the broadening in these types is probably due to a combination of Stark effect, axial rotation, and abundance. The general appearance of the lines agrees with the requirements of the theory, and the asymmetrical broadening of the lines which would be expected from the fluctuating Stark effect is also in good agreement with observation. The Balmer lines, if broadened by the Stark effect, should increase in width from $H\beta$ to $H\epsilon$, and although measures by Elvey show such an increase, the amount observed is smaller than the expected value (a discrepancy which is also found in laboratory experiments). Dr. Struve finds a definite theoretical relation between line width and absolute magnitude in which stars with narrow lines are more luminous than those with broad lines. This agrees well with the well-known luminosity effect discovered by Adams and Joy, which is used at Mount Wilson and at the Norman Lockyer Observatory in the determination of spectroscopic parallaxes of early-type stars.

Research Items.

Prehistoric Man in East Africa.—In *Man* for July Mr. E. J. Wayland discusses the dating of prehistoric man in East Africa in connexion with the geological evidence from pluvial periods in that area in the quaternary age. He suggests that archæologists, in drawing conclusions from this evidence, have not observed all due caution which the conditions demand. It is now possible to tabulate the major events in the Pleistocene history of this country. There are three moderately well-fixed points: First, Oligocene earth movements which superinduced the present topography on an older; second, a mid-Pleistocene dry period; and then a moist period preceding the present. By means of correlation of the evidence at different points, it appears that, at the time of the laying down of the gravels of what is called the 175 ft. terrace, that is, early (perhaps including *late*) Pleistocene times, there was a climatic change, possibly a local expression of a world event, at a time when the Günz-Mindel pluvial should have occurred. For these reasons the First Pluvial is tentatively accepted. There is abundant evidence of a similar change after the mid-Pleistocene dry spell, which is regarded as the second Pluvial. It was followed first by a brief period of aridity and then by the sub-recent moist period, scarcely to be called a pluvial. It is argued that this last period corresponds to the Bühl with Magosian (epi-palæolithic) industry; the second Pluvial to Riss-Würm with Sangoan (Mousterian with local facies) industry, and the First Pluvial to Günz-Mindel with Kafuan (pre-Chellean) industry. It is noted that no unquestionable Chellean, Acheulean, and Neolithic remains have yet been found in Uganda. On this dating the Third Pluvial of the Kenya Archæological Expedition becomes the equivalent of Epi-Pluvial and Nakuru man no older than the Fayum Neolithic.

Unitary Behaviour of the Nervous System.—In his presidential address to Section 3 of the Royal Society of Canada, delivered at the meeting in May last, Prof. Frank Allen, professor of physics in the University of Manitoba, made an interesting contribution to the study of neural phenomena. Investigations extending over a period of twelve years and involving ingenious methods for correlating the degree of sensation with the insensity of stimulation, have culminated in a broad generalisation which, in effect, permits the application of an equation of Fechner's form, not only to the subjective phenomena of sensation, but also to all types of physiological responses and to so-called psychological processes. In order to embrace responses (S) given by very strong and very weak, as well as the usually accepted medium intensities (I) of stimulation, Allen shows that his graphs conform to the generalisation

$$S = \pm k \log I + c,$$

where k and c are constants possessing physiological significance and the + or − signs are to be interpreted according as to whether the effect of a stimulus is to enhance or to inhibit the response of a succeeding stimulus. The application of this equation to certain phenomena of colour vision, taste, etc., and even learning processes, tends to remove many of the difficulties associated with these.

American Shore Birds.—In a second part of his account of the North American 'waders', Arthur Cleveland Bent describes the habits—courting, nesting, and breeding—of forty-five species, some of which are even more distinctively European than American (*U.S. Nat. Mus. Bull.*, 146). The accounts are thorough, as may be judged from the size of the volume, 340 pages, and they bear evidence of careful record-sifting. Amongst much of interest to the ornithologist and naturalist in these pages, we cite only the recent discoveries, after many years, of the nest and eggs of the surf bird (*Aphriza virgata*) 1000 feet above the timber-line in Alaska, of the wandering tattler (*Heteroscelus incanus*), also in Alaska, and the account of the practical extermination of the Eskimo curlew (*Numenius borealis*), which is attributed to the slaughter of migrating birds in Canada and the United States.

Deep-water Sponges.—M. Burton (*Jour. Quekett Microscopical Club*, vol. 16, 1928) has given an interesting comparative account of the characteristics of shallow-water and deep-sea sponges, with notes on their external form and reproduction. While light is perhaps not essential to growth, there is a suspicion that in some species it contributes materially to the well-being of the sponge, and that it may constitute an important factor in determining the depths to which the species can penetrate. Discussing the skeleton, the author is led to conclude that it is impossible for sponges to exist without skeletal support for the tissues except in the very shallowest waters, and that in default of its proper skeleton the sponge will use almost any means (for example, by packing its tissues with sand grains, etc.) to make good the deficiency. It is known that the formation of spongin can usually only take place in moderate temperatures and the restriction of the Euceratosa—with few exceptions—to the seas between 45° N. Lat. and 45° S. Lat. supports this view, as also does their abundance in the warm shallow waters of the Mediterranean and the Gulf of Mexico. Deep-sea sponges are characterised by the symmetry and regularity of their external form, lack of colour, adoption of special methods of reproduction and the development of structures—long stalks of spicules, or basal tufts of spicules which, becoming matted with mud, act as floats or rafts—which lift the animals above the unstable substratum of oozes. The author discusses each of these characteristics. He states that in the deep-sea Tetraxonida, particularly those living below 600 fm., ova and sperms and the early stages of cleavage are unknown, but many hundreds of embryos have been found. The fact that these are all in an advanced stage of development and the absence of ova leads the author to doubt the sexual origin of the embryos.

Hydatids in South Australia.—In a further paper on this subject (*Bull.* No. 40; Council for Sci. and Ind. Res., Australia, 1929), Dr. I. Clunies Ross finds considerable variation in the size and shape of the hooks in the species *Echinococcus granulosus*. The eggs are viable under moist conditions in summer for three weeks, but they will not withstand desiccation. Hatching of the egg appears to occur normally in the small intestine. Hydatid cysts remain viable after removal from the host for four days at 20°-23° C., and for thirteen days at temperatures between 4° and 8° C. Adult *Echinococcus* require about seven weeks for complete development. The most important control measure to prevent infection of the dog is the boiling of all offal of cattle, sheep, and pig before feeding to dogs. Infestation of man with the cysts, which appears to be increasing in South Australia, is preventable by the observance of elementary rules of hygiene, such as washing after handling any country dogs. Dogs

should be treated periodically to free them from the adult worm (arecoline hydrobromide is highly efficacious for this purpose). The author emphasises the importance of an educational campaign for the instruction of stockowners and others as to the nature of hydatid disease and how it may be avoided.

Structure of Cellulose.—Because of its industrial and botanical importance, the structure of cellulose continues to arouse considerable interest. A recent number of the *Journal of the Textile Institute* (**20**, No. 6; 1929) contains two papers dealing with the interpretation of the structure from data derived from water absorption. A. Urquhart (pp. T 125-132) considers particularly the cause of the hysteresis during water absorption and desorption, while F. T. Pierce (pp. T 133-150) develops a mathematical treatment of a two-phase theory of the absorption of water vapour. In both cases, hydration and dehydration are treated as in part due to chemical forces at the surfaces of the cellulose units and in part due to the spaces between the micellæ.

Kimberlite Pipes and Sub-crustal Rocks.—The *South African Journal of Science* for December last contains a valuable article by Dr. P. A. Wagner on "The Evidence of the Kimberlite Pipes on the Constitution of the Outer Part of the Earth". Reasons are given for believing that the kimberlite magma originated at a depth of the order of 60 km. In addition to granite and gneiss, the xenoliths brought up by the magma include gabbro, amphibolites, pyroxene-granulite, eclogites of both types, and a great variety of peridotites. There is complete absence of any xenoliths that could be referred to the hypothetical basaltic substratum postulated by Daly, Joly, and Jeffreys. The sial crust is here apparently underlain by a shell of gabbroid amphibolites and granulites passing down into gabbroid eclogite. This in turn, if the reasoning is correct, is underlain by a great peridotite zone in which there are bands and lenses of pyroxenite and eclogite, both of types allied to peridotite. The chemical composition and radioactivity of the kimberlite eclogites do not support the hypothesis of the equivalence of eclogites and plateau-basalt. The amphibolite-granulite shell is tentatively regarded as a vast potential reservoir of basaltic magma. If Dr. Wagner's researches could be correlated with 'near' earthquake observations in South Africa, a definite advance in our knowledge of sub-crustal rocks would be achieved.

Eutectics and Igneous Rocks.—In a paper appearing in the *Comptes rendus de la Société géologique de Finlande*, No. 2, 1929, Prof. W. Wahl gives a valuable account of the theory of eutectics and its application to problems of the crystallisation of igneous rocks. It is shown that the influence of 'eutectic surfaces' on the behaviour of rock magmas during crystallisation provides a valuable clue to an understanding of the way in which individual members of the great rock families come to vary from one occurrence to another, and to contain minerals of varying composition within the limits of a few isomorphous series. The mixed crystals separating on different sides of a singular point on a eutectic surface are of different composition, and as crystallisation proceeds, they come to be enriched in opposite ways. Thus in magmas that differ in composition but slightly, crystallisation-differentiation may proceed in quite different ways. Change of pressure may affect the position of maximum and minimum points on the liquidus curve of a mixed crystal series, and therefore crystallisation-differentiation occurring at different pressures may result in the production of different residual magmas from the same parent magma. The paper shows how complicated the interplay of controlling circumstances may be, and is worthy of careful study by all petrologists.

Magnetic Survey of Italian Somaliland.—Volume 2 of Memoirs of the Central Office for Meteorology and Geophysics, Rome, contains an account by Prof. Luigi Palazzo of the magnetic survey of Jubaland and Italian Somaliland carried out in 1926. The principal instruments used were a Dover-Schneider magnetometer and a Dover dip circle. The positions of the points of observation were determined from government maps available, or in cases of doubt by direct measurements of latitude and longitude. The results are shown by lines of equal deviation, equal dip, and equal horizontal force over an area from Lat. 2° S. to 5° N. and from Long. 41°-46° E. The lines of equal deviation run approximately from north-west to south-east perpendicular to the Benadir coast, the deviation being 2° 10′ W. in the south at Port Sherwood and 0° 30′ W. near where the Shebeli River crosses the Abyssinian frontier. The lines of equal dip run from west-by-north to east-by-south, the dip being 11° south in the north and 25° south in the south. The lines of equal horizontal force run in nearly the same direction, the force being 0·34 in the north and 0·31 in the south. Corrections to the deviations of the compass recorded in the Italian and in the British Admiralty Charts exceeding in a few cases 1° are necessary.

Recombination of Electrons and Ions.—Prof. R. Seeliger has published a useful summary of the scattered papers dealing with the recombination of positive ions with free electrons, in the issue of the *Physikalische Zeitschrift* for June 1 (pp. 329 - 357). This particular atomic process is of importance in many connexions. It gives rise to a type of continuous spectrum stretching from the limits of a spectral series to shorter wave-lengths, and extension of recent laboratory work in which such spectra have been studied in conjunction with electrical measurements by Dr. Langmuir's methods should be of great value in elucidating the conditions under which similar spectra can be produced in stars. Some of the still incompletely understood phenomena of the Geissler discharge are also beginning to yield to the same treatment. On the theoretical side, recombination comes in as one of the unit processes occurring in the maintenance of equilibrium in thermally ionised media, and so again becomes important in connexion with the theory of stellar atmospheres, whilst very recently it has, like many other rather obscure phenomena, been receiving the attention of the quantum mechanics. Prof. Seeliger dismisses this last aspect of recombination in a few lines, but proposes to return to it again later. The value of critically written articles of this type at the present time cannot be too strongly emphasised.

Acoustics of Public Halls.—An article in the *Journal of the Franklin Institute* for July by Emile Berliner, whose death has recently been reported, gives an account of a method he invented for improving the acoustical properties of auditoria and public halls. About one quarter of the total area of the auditorium walls underneath the ceiling is covered with wire cloth diaphragms over which is spread a special porous cement mixture. When dried and hardened, this forms a smooth cement wall surface. Cement diaphragms thus formed are found to be as vibratory as the sounding boards of pianos. They diffuse as well as reflect the sounds which fall on them coming from singers, speakers, and mechani-

cal sources. This has a marked tendency to prevent both reverberations and echoes. Practical experience has shown that this method has been successful in improving very appreciably the acoustic conditions. When theatres are treated in this way it is sometimes found possible to reduce considerably the size of the orchestra. Hitherto absorption has been mainly relied on to eliminate reverberations. The Berliner method is stated to give better results. These diaphragms cannot be used on floors. Furniture and audiences have to be depended on to prevent the disturbing sounds which would otherwise proceed from empty and reflecting floor spaces. An audience filling about a quarter of the floor space is usually effective in preventing the disturbances which would otherwise arise from the floor.

Ultra-Violet Microscopy.—The June issue of the *Journal of the Royal Microscopical Society* contains the presidential address delivered in January last by Mr. J. E. Barnard, on some aspects of ultra-violet microscopy. Mr. Barnard discusses the materials—quartz and fluorite—available for making lenses, slides, and cover-glasses for ultra-violet microscopy, and points out the results of the defects present in some samples of these substances which render them useless for this special purpose. He then passes to consider the illuminants suitable for ultra-violet work and states that the cadmium spark-image in wave-length 275 $\mu\mu$ is still the most suitable. He uses a pin-hole camera for observation of the spark-image so as to enable an image of almost constant length and form to be secured by adjustment of the spark-gap at short intervals. Turning to dark-ground illumination, he points out that a silvered surface, such as is used for visual light, is quite unsuitable for ultra-violet work, and that magnalium is the best metal hitherto found for this purpose, as in certain wave-lengths it reflects as much as 81 per cent of the incident light, but this is contingent on the production of a polished surface of high quality. Messrs. R. and J. Beck, Ltd., have produced an ultra-violet dark-ground illuminator, the reflecting surfaces of which are of magnalium, and the top lens, which is in immersion contact with the under side of the slide, is of fused quartz. Mr. Barnard expresses the opinion that the results achieved with this apparatus and a quartz objective mark a striking advance. In conclusion, he refers to the wealth of fine detail shown in the photographic negatives obtained and expresses the hope that the method may contribute to the advance in our knowledge of the filterable viruses.

Preparation of Phosphorus Trioxide.—Since the preparation of phosphorus trioxide in a state of purity by Thorpe and Tutton in 1890, several experimenters have had occasion to obtain this compound. In no case, however, have any details of this difficult preparation been published which would provide a possibility of obtaining any control over the yield of the trioxide. These have recently been given in full by Wolf and Schmager in the *Berichte* of the German Chemical Society and in the June issue of this journal Wolf, Kalaehne, and Schmager describe experiments on the other methods of preparation of phosphorus trioxide which have been reported, such as the action of phosphorus trichloride on phosphorous acid. It was shown that none of these methods gave any trioxide, and the authors state that the method used by Thorpe and Tutton, namely, the regulated combustion of white phosphorus in air, is so far the only one which leads to the formation of phosphorus trioxide.

Dichloramine.—Although the first and last chlorination products of ammonia, namely, monochloramine, NH_2Cl, and nitrogen trichloride, NCl_3, are known in the pure state, very little information is available as to the existence of dichloramine, $NHCl_2$. In the July number of the *Journal of the American Chemical Society*, R. M. Chapin describes some experiments in which a solution of ammonium acetate of definite acidity controlled by a buffer solution was treated with chlorine water similarly treated with a buffer solution. The resulting solution was extracted with ether or carbon tetrachloride and was also analysed for the nitrogen-chlorine ratio. The results showed that dichloramine is produced by the chlorination of ammonium ions at acidities in the range pH 4·4 to pH 8·5, being the sole product at pH 4·5 to pH 5·0. It is also produced by corresponding acidification of monochloramine solutions. So far, the substance is known only in solution.

Buildings to Withstand Hurricanes.—In an article in *Engineering* of Aug. 2, on "Recent Tornadoes and Hurricanes", Mr. R. Fleming summarises the reports on the damage done by the St. Louis tornado of Sept. 29, 1927, and the Porto Rico hurricane of Sept. 13, 1928, and refers to the lessons to be learnt in regard to the construction of buildings to withstand these severe storms. A committee of engineers and architects which reported on the St. Louis tornado, said that greatest damage was due to the effect of a partial vacuum at the centre of the tornado. While it might not be possible for any economical form of construction to withstand the maximum force of the wind, the indisputable teaching of the disaster was the importance of integral bonding between all parts of buildings, from the individual bricks of a wall to the completed structure. The velocity of the Porto Rico storm is estimated to have reached 180-200 miles per hour. At one place, Cayey, the effects were as destructive as elsewhere, but the 600 ft. wireless towers stood. Nuts were loosened, anchors yielded, bracing members bowed and snapped back to a taut position like cords, but no rivets were reported as being sheared or any members broken.

Fluid Flow in Pipes and Channels.—The flow of fluids in pipes and channels, which is of importance in such practical matters as the study of steam turbines, the design of boilers, condensers, and evaporators, the ventilation of buildings and mines, the handling of liquid fuels, questions of water supply, irrigation and sewage disposal, has been the subject of much experimental inquiry of recent years, by Reynolds, Stanton and Pannell, Schiller, Hopf, Fromm and others. In *Engineering* for July 19 and 26, and Aug. 2, Messrs. S. J. Davies and C. M. White give a review of the advances made in this branch of hydraulics. Beginning with notices of the work of Poiseuille in 1846, and of Darcy in 1857, they make especial reference to that of Reynolds, who first introduced streams of coloured liquids into the main stream of water passing through glass tubes and showed that at some critical velocity the motion changes from laminar or streamline to turbulent flow. He also applied dimensional reasoning to practical hydraulics, and thus laid the foundation of more recent research. In the experiments of the investigators mentioned, different liquids were used, the pipes and channels were made of various materials and of various cross sections, and to Fromm, working in conjunction with Hopf at Aix-la-Chapelle, we owe a comprehensive laboratory study of the influence of roughness. Recent advances owe much to the use of the principle of dimensional similarity, but that principle, though an almost universal tool of the scientific worker, has not yet received sufficient recognition by the practising engineer.

Toxicity Tests for Novarsenobenzene.

ALTHOUGH the arsenobenzenes of therapeutic value are, theoretically, chemical individuals, different batches of the same compound may vary both in toxicity and therapeutic efficiency, so that biological tests on each batch are essential before clinical use. Two separate tests are required, since toxicity and therapeutic efficiency are not proportional: in fact, they may vary inversely, and a toxic sample may have only a negligible therapeutic effect. The tests are usually carried out on mice. In the therapeutic test the animals are first infected with a trypanosome and the curative effect of a small dose of the drug under test observed; in the test for toxicity, larger doses are given and the mortality determined, the dosage being such that some proportion, but not all, of the animals injected die within some specified period after the administration. The toxicity tests in use for novarsenobenzene and neosalvarsan have been exhaustively examined by Durham, Gaddum, and Marchal:[1] their conclusions are of interest both from the point of view of toxicity tests in general, and also from the fact that they have led to the formulation of a simple and trustworthy test for this compound.

The test required is not one for the determination of the potency of the sample in terms of the standard, but one ensuring that its toxicity does not exceed that of the standard by more than a specified amount, and the investigation was directed to settling the limit of permissible toxicity and prescribing a simple test which would exclude the majority of samples exceeding this limit whilst passing the majority of those lying within it. The standard preparations were obtained from Prof. Kolle, of Frankfurt, who distributed them on behalf of the Health Organisation of the League of Nations.

The first aim was to obtain a curve relating death-rate to dose injected: this 'characteristic' curve has the S-shape common to toxicity curves in general. To eliminate possible variations in sensitiveness of different batches of mice injected on different days, the range of doses was given to animals of each batch each day, the experiment being continued for several days until a sufficient number of animals had been injected with each dose. Throughout the investigation, however, no evidence of a day or seasonal variation in sensitiveness was obtained. The curve is steeper, that is, small variations in dosage cause greater variations in mortality, when animals of a uniform stock are used, and especially when they are of much the same weight: greater accuracy is obtained with fewer animals of uniform sensitiveness than with a much larger number of a mixed stock. The curve was steepest with doses between 0·4 mgm. and 0·5 mgm. per gm. body weight, the mortality being observed over a period of three days after the injection. Investigation of the relationship between weight and sensitiveness showed that mice of 13-15 gm. weight are about 25 per cent more resistant than those of 18-20 gm. or 24-26 gm. Females of 18 gm. in weight or more are 8-10 per cent more susceptible than males, but there is little difference between the sexes in the case of the smaller animals: the males, however, are more uniform in their reaction. It appears from the results obtained that sex can be neglected, but that, if possible, animals of similar body weight should be used: if the limits of variation in weight are within 2 gm., the dose can be expressed in mgm. per mouse.

[1] Medical Research Council. Special Report Series, No. 128: Reports on Biological Standards. 2: Toxicity Tests for Novarsenobenzene (Neosalvarsan). By Florence M. Durham, J. H. Gaddum, and J. E. Marchal. Pp. 40. (London: H.M. Stationery Office, 1929.) 9*d*. net.

Having obtained the characteristic curve with the use of a large number of mice, it is possible to calculate the probability that not more than a certain number of a small number injected, for example, 5, 10, or 30, will die for different values of the true mortality, and hence the probability that the true toxicity of a given sample will be disclosed when only a small number of animals is used. In the specific case under investigation the upper limit of permissible toxicity has been fixed at 20 per cent above standard, so that the question to be settled is the probability of a sample within this limit passing and of one exceeding this limit being rejected, when the test is carried out with the use of only a small number of animals.

The tests at present in use have been examined with the aid of these calculations: the British is not sharply discriminative and allows an undue proportion of toxic samples to pass; the German gives a sharper discrimination but still passes many toxic samples; the Japanese and American are even less discriminative than the British, and fail to exclude many samples exceeding the limit of 20 per cent greater toxicity than standard.

As a result of the investigation an improvement in the test is proposed, to give greater discrimination and to exclude more of the toxic samples. The drug is dissolved in water, freshly redistilled with a condenser of hard glass, at 2 per cent strength, and the fresh solution injected into the tail vein of the animal. The mice used are fasted overnight, weighed, and then given food, the injection being made an hour or so later. The test is carried out in three stages. In the first, 10 animals, weighing 18-20 gm., are taken and into each is injected 7·6 mgm. of the novarsenobenzene: if not more than 2 die, that is, 20 per cent mortality, the sample is passed forthwith: among those passing would be samples with a toxicity less than that of the standard and about 61 per cent of those with a toxicity equal to that of the standard. The others are injected in the same dose into a further 10 mice, and the total mortality on the 20 animals so far used observed: if this is not more than 40 per cent, the sample passes: a further 38 per cent of the samples of standard toxicity should pass at this stage. Further, if more than 15 of the animals have been killed, the sample can be rejected without further test, as exceeding the limit of permissible toxicity. The remaining samples are injected into a further 10 animals: those which have killed not more than 15 of the total of 30 injected are passed, whilst those causing a higher death-rate are rejected. Hence the final demand of the test is for the survival of at least 50 per cent of 30 mice on a dose of 0·4 mgm. per gm. The test passes all samples of toxicity up to that of the standard, and fails 0·4 per cent of those of toxicity 10 per cent above that of standard, 59 per cent of those of toxicity 20 per cent above, and 99·6 per cent of those of toxicity 30 per cent above. If this test is considered to be too severe, 0·38 mgm. per gm. or a total dose of 7·2 mgm. can be used, when 94 per cent of samples of toxicity 20 per cent above that of standard would pass, but only 11 per cent of those of toxicity 30 per cent above.

The actual dosage used may require adjustment according to the sensitiveness of the stock of mice employed: the standard enables this sensitiveness to be tested from time to time and also allows of comparable results being obtained in different laboratories with different conditions of diet, temperature, etc. Samples of the drug properly dried and kept at low temperatures remain stable over several years, and show no increase in toxicity after this time.

An International Committee on the History of Sciences.

THERE was recently held in Paris the first meeting of the Comité International d'Histoire des Sciences, which owes its existence to the International Congress of Historians. At the meeting of that body last year at Oslo, the first steps were taken towards the formation of the new Comité. Most benevolent and practical interest in the Comité International has been evinced by the permanent office of the parent body, and especially by its distinguished secretary, M. l'Héritier. It is consonant with our experience of other intellectual movements that the stimulus towards studies on the history of science has come not from governments nor even from universities, but from voluntary associations of individual workers. As the heroic figure of the movement for the study of the history of science, we may cite Dr. George Sarton, a Belgian who is now domiciled in the United States. His self-sacrificing industry was interrupted but not deflected by the European upheaval. He has now the satisfaction of watching the growth of the History of Science Society, which has honoured itself by contributing some part of the cost of Sarton's remarkable journal *Isis*. The History of Science Society has its centre in Washington. It numbers many Europeans among its members, and welcomes all who take interest in the history of science.

The newly-formed Comité International d'Histoire des Sciences has its seat in Paris. The Comité itself will consist exclusively of persons actively engaged in investigating problems within the field of the history of science and technology. It will comprise 30 *membres effectifs* and 50 *membres correspondants*. They will meet annually in Paris, while every three years they will hold larger international congresses. The Comité is of course in active co-operation with the larger History of Science Society, to which all of its members belong, and there is no sort of rivalry between the two bodies.

The first president of the Comité International d'Histoire des Sciences is the very distinguished Italian mathematician and writer on the history of mathematics, Prof. Gino Loria of Genoa. The honorary secretary is Prof. Aldo Mieli, distinguished both for his own writings on the history of science and for the journal *Archeion* edited and published by him. The success of the recent Paris meeting of the Comité was mainly due to the admirable organisation of Prof. Mieli.

The French Government has allotted to the Comité a beautiful home in the Hôtel Nevers, a seventeenth century house which formerly belonged to Mme. de Lambert and afterwards held the first nucleus of the Bibliothèque Nationale. Here Prof. Mieli is organising a Centre International d'Histoire des Sciences, in which he will be assisted by Mme. Hélène Metzger, author of important contributions to the history of chemistry and physics. Madame Metzger will act as archivist and librarian.

In the Hôtel Nevers the members of the Comité recently assembled, the constitution of the Comité was agreed upon, and a number of most interesting papers were read. Among them were contributions both by the president and by Prof. Ruska of Berlin on the importance of Arabic manuscripts for the study of the history of mathematics; by Prof. Thorndike of Columbia University, president of the History of Science Society, on a treatise on surgery ascribed both to John Braccia and to Peter of Tossignano; by Prof. Mieli on Spallanzani and his relationship to Redi and to Pasteur; by Prof. Dingler of Munich on Nicholas of Oresmes; by Prof. Darmstaedter of Munich on his remarkable experiments to elucidate the formation of copper and silver alloys described in ancient treatises of alchemy; by Prof. Sigerist of Leipzig on the organisation of medical historical research; and by Dr. Feldhaus of Berlin on his Institute for the History of Technology. Prof. Vetter of Prague described the holograph manuscript of the "De Revolutionibus Orbium Celestium" of Copernicus, now at Prague. He discussed the interesting divergences between the manuscript and the first printed edition, and it was agreed that the manuscript should if possible be published in facsimile as an important historical document.

One session, attended by many distinguished visitors, was devoted to a commemoration of the work of the late Paul Tannery, who not only himself made important contributions to the history of science, but also, so early as 1903, at the International Congress of Historians in Rome, foreshadowed the creation of a permanent international body for the study of the history of science.

Paris opened its hospitable doors to the Comité. A dinner was given by the parent Comité International des Sciences Historiques, and a reception by the Institut International de Coopération Intellectuelle. The latter was the occasion of an eloquent address by the assistant director of the Institut, Prof. Alfred Zimmern, who expressed the hope that, through the history of science and cognate synthetic movements, it might be possible for the mind of the savant to exercise its legitimate influence in the international comity of nations.

Dr. Charles Singer was elected president of the Comité International d'Histoire des Sciences for the next two years, and it was decided to hold an international congress in London in 1931.

Meteorology in British East Africa.

THE first *Memoir* of what is to be known as the British East African Meteorological Service, from the pen of its director, Mr. A. Walter, formerly director of the Royal Alfred Observatory, Mauritius, has recently been received. This memoir describes the circumstances leading up to the inauguration of a joint meteorological service for British East African territories. The money for the undertaking is to be contributed by the Governments of Egypt, the Sudan and Zanzibar, and those of the East African colonies Uganda, Kenya, Tanganyika, and Northern Rhodesia; the Egyptian Government is intimately concerned with the acquisition of meteorological information from the East African uplands, the rainfall of which controls the Nile flow, and not inappropriately makes the largest financial contribution. For many years records of rainfall and temperature have been collected by the agricultural departments of Kenya, Uganda, and Zanzibar, and Tanganyika possessed a fully organised meteorological service when under German rule.

The new service begins with funds amounting to nearly £7000 a year and is able to undertake a comparatively ambitious programme involving the organisation of five 'first order' stations, where the work will include electrical and magnetic observations, measurements of solar radiation, and the exploration of upper wind currents by means of pilot balloons. In addition, there will be about forty 'second order' telegraphic reporting stations, at which observations

of atmospheric pressure, wind direction and velocity, rainfall and cloud, will be made twice a day. The stations will be important in connexion with weather forecasting for the air services, and it is hoped that they will assist the forest advisers of Government in the problem of the progressive desiccation of Africa.

The fact that the funds necessary for the launching of such a large meteorological service in a few years were forthcoming, taken in conjunction with the slow growth of European services in the latter half of last century, shows the extraordinary increase of recognition of the value of applied science that has taken place within the last ten or fifteen years.

University and Educational Intelligence.

CAMBRIDGE.—At Emmanuel College the studentship offered to a student of another university intending to begin research in Cambridge in October 1929 has been awarded to Mr. J. K. L. MacDonald, of McGill University, Montreal, for research in physics. The following awards have been made from the Research Fund to members of the College: Studentships of £150 each for two years to N. W. Pirie (biochemistry) and S. Clay (botany); grants to J. G. A. Griffiths (physical chemistry) and E. W. Pickford (psychology).

Mr. E. T. C. Spooner has been elected to a research fellowship at Clare College. Mr. Spooner was placed in the first class of the Natural Sciences Tripos, Part II. (pathology) in 1925 and was elected to a Commonwealth Fellowship tenable at Harvard in May 1929.

DURING the next few months about a hundred officers will be required by the Royal Air Force for flying duties under the short service commission scheme. Applications are accordingly invited from well-educated candidates of good physique who are between the ages of eighteen and twenty-five years. During their period of service, short service officers have opportunites for preparing themselves for civil life; a competitive examination is also held annually, and from this a limited number of short service officers are appointed to specialist courses in engineering, wireless telegraphy, armament, etc., with the view of obtaining permanent commissions in the Royal Air Force. Particulars can be obtained from the Secretary, Air Ministry, Kingsway, London, W.C.2.

FROM the Universities of Cambridge and Leeds we have received pamphlets containing abstracts of theses approved for research degrees during 1927–28. The Cambridge dissertations are classified as follows: chemistry 12; physics 10; biochemistry 7; botany 3; geology 3; zoology 2; mathematics 2; agriculture 2; engineering 1; metallurgy 1; experimental psychology 1; pathology 1; physiology 1; English, history, languages, and law, 9. Of the fifty-six authors (of whom six were women), thirty-one had come to Cambridge from other universities, namely, from other universities in Great Britain 12, from North America 7, Australia 4, South Africa 3, India 2, Ireland 1, South America 1, Russia 1. The Leeds pamphlet, which includes also lists of other researches and publications by members of the staff and graduate students, gives abstracts of theses as follows: in chemistry 8 (including 6 in colour chemistry), botany 5, mathematics 2, gas-engineering 1. Though somewhat belated, the publication of these abstracts, running in most cases to five or six hundred words, should prove useful to other research workers.

THE International Federation of University Women has issued a bulletin of 104 pages containing a report of its council meeting held in Madrid last September, including reports of 28 national associations and a list of international club-houses and hotels. Founded ten years ago, it has steadily extended its membership and it now embraces almost every country in Europe, the United States of America, Canada, Mexico, South Africa, Australia, New Zealand, and India. Furthermore, ground is being broken in South America. Chile and Ecuador were represented at the meeting by Mlle. Mistral, technical adviser for Spanish America at the International Institute for Intellectual Co-operation, and the adhesion of associations of university women in most of the South American republics in the near future is confidently anticipated. The function of the Federation in relation to the university women of all these countries is, declared its president, Dr. Ellen Gleditsch, of Oslo, in a public address at Madrid, "to act as a catalyst in the chemistry of international relations". One of its chief enterprises is the establishment of international fellowships to enable scientifically trained women to study in countries other than their own. As yet the endowment fund does not permit the award of more than one fellowship annually, but there are others available within the organisation, such as the two recently offered by a member of the Australian federation, one offered by the American Association, and the residential scholarships offered by the Paris Club and by Crosby Hall in London. A campaign for raising a capital sum of a million dollars for this purpose is in progress. The Federation is financed mainly by contributions from the United States.

FROM the Kent Education Committee we have received a copy of "Education in Kent, 1923–1928", by E. Salter Davies, the County Director of Education. This volume, comprising a report covering 180 pages and numerous tabular statements, plans of buildings, and photographs, constitutes a record (to use the author's words) of "five strenuous and difficult years of self-examination, stocktaking, and reconstruction", and contains much valuable evidence of modern tendencies in English education. Very conspicuous are the evidences of the far-reaching effects on organisation, staffing, curricula, training of teachers, and buildings of the modern emphasis on individual differences. In a chapter on the reorganisation of elementary schools the report details the steps taken and planned, in accordance with the principles set out in the Board of Education's pamphlet, "The New Prospect in Education" of 1928 (sequel to the Hadow Report of 1926) towards the provision for *all* adolescents (ages 11-15) of "realistic and eminently practical forms of education which will develop the capability of the pupils to the full according to their several abilities and will equip them for their work in life". To ensure efficient classification and differentiation between pupils of different types of capacity and of different aptitudes, the committee has for some years provided facilities for obtaining training in the testing of individual capacities. In selected areas it has prescribed the use of a pupil's record card on which are recorded year by year the results of applying certain psychological tests. There has been, the report says, a very decided increase of late in the study of elementary science, particularly on the practical side. The supply of science apparatus is centralised through the Committee's Stores Department, which last year spent £4672 on it out of a total budget of £103,491. For elementary botany a microscope set is made to the committee's specification by a firm of engravers in the county.

Calendar of Patent Records.

August 18, 1835.—Numerous modifications of the steamboat paddle-wheel designed to reduce splashing and loss of power on entering and leaving the water were invented in the early days of steam navigation. One of the best known is the cycloidal wheel, in which each float, instead of being a single piece, is composed of several pieces of narrow width set one in advance of the other along the line of a cycloidal curve. Originally suggested by Joshua Field in 1833, this wheel was first patented by Elijah Galloway on Aug. 18, 1835. The wheels were used on the City of Dublin steam packets and were extensively adopted. Galloway was also the inventor six years earlier of a wheel in which the blades were automatically feathered. This wheel was successfully applied by William Morgan, by whose name it is usually known.

August 19, 1791.—On Aug. 19, 1791, there was granted in France a patent to Le Bas of Paris for "Moyens et procédés pour conserver et rendre à Paris, ainsi que dans tout le royaume, du poisson de mer et de rivière très frais et même vivant",—the first for the transportation of fresh food for long distances. The fish were to be conveyed in double-walled wagons, the space between the walls being filled with ice and salt, and replenished at allotted places on the way.

August 21, 1841.—The first incandescent electric lamp patent was granted to Frederick De Moleyns of London on Aug. 21, 1841. The lamp consisted of an exhausted glass globe in the upper part of which was a tube open at the bottom and containing powdered charcoal and a platinum wire which ran through the tube and was coiled at the lower end. A second wire, coiled at its upper end and nearly touching the first, came up through the lower portion of the globe. The powdered charcoal filled the two coils and bridged the gap between them, and was heated to incandescence on the passage of a current, any charcoal that was burnt up being replaced from the supply in the tube.

August 22, 1781.—Though an agricultural drill for sowing seed, the invention of Locatelli, an Austrian living in Spain, was described in the *Philosophical Transactions* for 1665, and the advantages of the use of such an implement were loudly proclaimed by Jethro Tull in his "Horse-hoeing Husbandry" published in 1731, it was not until Aug. 22, 1781, that the first patent for a machine drill was granted—to Thomas Proud of Bagley in Yorkshire, who attached the drill to the side of a common plough beam.

August 22, 1850.—The first method of mechanical refrigeration to come into general use was by means of compressed air, and the pioneer of this system was the American, Dr. James Gorrie, whose English patent was granted, in the name of the agent, W. E. Newton, on Aug. 22, 1850. Plant, built by James Watt and Co., was erected in London, but was not commercially successful and it was some years before the apparatus was perfected. Sir William Siemens made a valuable report on the Gorrie plant and suggested improvements for which he applied for a patent, though this was not proceeded with.

August 23, 1780.—James Pickard's patent for the application of the crank to the steam engine, which caused James Watt to invent his sun-and-planet movement as an alternative method of producing the rotary motion, was granted on Aug. 23, 1780.

August 23, 1815.—Seidlitz powders date from the patent granted to Thomas Field Savory, of New Bond Street, on Aug. 23, 1815, for his "discovered and combined neutral salt powder which possesses all the properties of the medicinal spring at Seidlitz in Germany". The patent was declared to be invalid in the courts, but the name caught the public fancy.

Societies and Academies.

DUBLIN.

Royal Dublin Society, June 25.—Irish Radium Committee Report for the year 1928. A brief history is given of the foundation of the Irish Radium Institute in 1914 and of the invention by Dr. Joly of the needle method of treatment. Reports are included from medical users on the treatment of 291 patients during the year 1928; in many cases the results were very successful.—**H. A. Cummins, Violet E. C. Kennelly, and M. Grimes**: A study of fungi found in milk. Among samples of milk examined in the Department of Dairy Bacteriology, University College, Cork, during the first five months of this year, twenty-one species of fungi were found, many of which had not previously been reported in milk.—**P. A. Murphy and R. McKay**: Some insect vectors of virus diseases in plants. A list found by various workers to be capable of conveying leaf-roll, both aerially and through the soil. In experimental work with aphides extending from 1922 until 1928, the number of successful leaf-roll infections secured with *Myzus persicæ* were 19 out of 25; with *Myzus pseudosolani*, 2 out of 40; with *Macrosiphum solanifolii*, 1 out of 151; and with unidentified aphides, 5 out of 34. Insects other than aphides play no appreciable part in causing infection in the field. *M. persicæ* is capable of conveying infection from sprouting tubers, young plants, or full-grown plants to sprouting tubers, young plants, and full-grown plants. The younger the inoculated plant, and apparently also the younger the plant providing infection, the quicker the symptoms develop on the former. This is correlated with greater ease of infection in the earlier stages of growth. Plants infected early in the season generally give rise to a totally diseased crop in the following year. The tubers of those inoculated late in the season may escape infection altogether, or some of them may become diseased and some remain healthy.—**L. P. W. Renouf**: A hydrographical and biological study of Lough Hyne, Co. Cork.—**J. Reilly**: (1) An investigation of the polysaccharides. (1) Inulan. (2) The cryoscopic constants of acetamide.—**J. H. J. Poole**: A suggested new type of sensitive, suspended needle galvanometer. By the use of a high-permeability core, the sensitivity of an astatic galvanometer may be much increased if difficulties connected with the demagnetisation of the core can be overcome.

PARIS.

Academy of Sciences, July 8.—**Charles Richet**: Some statistics concerning the foreign associates and corresponding members of the Academy of Sciences. Details of age at election, age at death, period of membership and nationality.—**Gabriel Bertrand and Mme. C. Voronca-Spirt**: Titanium in cryptogams. Ferns, algæ, and fungi were analysed, care being taken to avoid contamination with earth or dust. Titanium was generally present in the proportion of some milligrams per kilogram of material. Negative or doubtful results were obtained in a few cases, including yeast and *Aspergillus niger*.—**L. Léger and O. Duboscq**: The evolution of *Paramœbidium*, a new genus of Eccrinideæ, a parasite of aquatic larvæ of insects.—**B. Hostinsky**: The probabilities of phenomena connected in Markoff's series.—**N. Lusin**: The problem of implicit functions.—**Radu Badesco**: An integral equation.—**Guido Ascoli**: The approximation of functions.—**J. Haag**: The extension of Phillips's conditions concerning the balance wheel.—**J. Ph. Lagrula**: The rapid location of the photographic position of a minor planet or non-catalogued

star by the method of Schlesinger.—**A. Grebel**: The variation of the temperature of spontaneous combustion of petrols to which different substances have been added. The measurements were made in Krupp's modification of Moore's apparatus, the anti-knock compound being added in proportions varying from 0 per cent to 100 per cent. The curves showing the ignition temperature as a function of the amount of antidetonant added are discontinuous, generally two or more straight lines. 'Motyl' (solution containing 25 per cent iron carbonyl) was much more efficient than 'ethyl' (50 per cent lead ethyl).—**Emmanuel Dubois**: The Volta effect in steam and in hydrogen.—**Witold Kessel**: The complexity of the terms of the resonance spectrum of tellurium vapour.—**Picon**: The action of high temperatures on some metallic sulphides. The type of carbon resistance furnace employed gave temperatures up to 2000° C. The sulphides of molybdenum, tungsten, and uranium, as well as aluminium and magnesium sulphides, are volatile and dissociable in a vacuum, at 1200° to 1300° C. Pure crystallised sulphides of these metals cannot be obtained by distillation.—**A. Andant**: Some relations between the chemical constitution, absorption, and fluorescence of the alkaloids.—**J. Duclaux** and **R. Titeica**: Micellary equilibria and membrane equilibria. Experiments are cited proving that for a given hydrosol, the composition of the liquid after ultrafiltration is independent of the pressure of filtration. It is not changed when the concentration in solid particles is increased and is independent of the nature of the membrane used as the ultra-filter (cellulose, nitrocellulose, acetocellulose).—**Ernest Morlet**: Copper-aluminium alloys containing manganese, tin, and cobalt.—**Weizmann** and **L. Haskelberg**: Researches on the preparation of glycerol esters of the fatty amino-acids.—**Georges Mignonac** and **René Vanier de Saint-Aunay**: The polymerisation of ethylene by the silent discharge. The synthesis of butene and hexene. The gas was rapidly circulated through the apparatus and the products cooled to − 60° C. The hydrocarbons were identified by means of their ozonides and included butene, $CH_3-CH_2-CH=CH_2$ and hexene, $CH_3(CH_2)_3CH=CH_2$.—**G. Allard**: The crystalline structure of thorium boride.—**H. Parent**: Observations on the age and sense of the Corsican orogenic movements.—**Gruvel**: Some oceanographic peculiarities observed on the coasts of Syria.—**Maurice Melcion**: A form of (electrical) discharge at atmospheric pressure.—**Paul Guérin**: Papilionaceous Lotus containing a cyanogenetic glucoside.—**Ch. Brioux** and **Edg. Jouis**: The active lime of basic slag and of disintegrated phosphates.—**J. Millot**: The cephalothoracic gland of a spider, *Scytodes thoracica*.

LENINGRAD.

Academy of Sciences.—(*Comptes rendus*, No. 6).—**V. Mitkevich**: (1) The transformations of magnetic flux. In an ideally uniform toroidal coil wound around an absolutely symmetrical ring core, there must be formed, as a result of the transformations of the separate magnetic links connected to the individual turns of the coil into the common magnetic flux, first, closed magnetic lines inside the core, and, secondly, independent magnetic rings, completely disconnected from this magnetic flux.—(2) The anomalous magnetic flux. In ordinary conditions the anomalous component of the magnetic flux is comparatively so small that it can be neglected. But in some cases, and especially in the case of sufficiently high frequencies, the anomalous flux and its action can become appreciable.—**N. Annenkova**: Polychæta from the relic lake Palæostom (Western Caucasus) and the rivers connected with it. Only two species were found, namely, *Nereis succinea* (Leuckart), known hitherto from the Atlantic Ocean, Mediterranean Sea, the Suez Canal, and the Black Sea; and *Mercierella enigmatica* Fauvel, known from the Mediterranean Sea and the English Channel.—**K. Domin**: A new variety of *Kœleria gracilis*. A description of *Kœleria gracilis* Pers. var. *Bushiana* nov., from the Caucasus.—**I. E. Znamenskii**: Changes occurring in the cytological structure and some physiological processes in the cells of *Mnium cuspidatum* under the influence of dehydration. The chloroplasts in a cell of *Mnium* subjected to a loss of water either by freezing, drying, or treatment with plasmolytic substances always form similar groups. The retinal structure is the same in the cells of the plant taken from under the snow, and in artificially dehydrated cells. The chloroplasts begin to lose their normal shape at 88 per cent of relative moisture.—**N. N. Netchayeva**: Action of X-rays on animal organisms. Experiments with X-rays on *Daphnia* showed that with the increase in the duration of irradiation by X-rays the rate of mortality decreases, reaching finally a minimum value; with still further irradiation the rate increases again.—**B. N. Mogilnitskii**: The action of Röntgen rays on the nervous tissue. Although the most delicate methods used in the experiments failed to discover any alterations in the brain cells after irradiation, it still appears that the normal physiological condition of the brain is affected.

Comptes rendus, No. 7.—**V. N. Ipatiev** and **A. D. Petrov**: Hydrolysis and cracking of naphthenic acids at high temperatures and under high pressure. Under atmospheric pressure, olefines result; under a high pressure, carbohydrates of the paraffin and naphthene series.—**V. N. Ipatiev, A. D. Petrov**, and **I. Z. Ivanov**: An experiment on the cracking of a primary tar from a Donetz coal under pressure in a hydrogen atmosphere. By varying the conditions of cracking under pressure, it is possible to obtain substances with a greater or smaller content of aromatic carbohydrates.—**V. N. Ipatiev, N. A. Orlov**, and **M. A. Belopolskii**: The cracking of a petroleum tar under high pressure in a hydrogen atmosphere.—**V. N. Ipatiev, N. A. Orlov**, and **N. D. Lichatchev**: The cracking of some organic compounds under high pressure in a hydrogen atmosphere. A primary tar heated for a short time in the presence of hydrogen produces about 30 per cent of light benzenes, no coke being formed.—**V. N. Ipatiev, G. A. Razuvaev**, and **I. F. Bogdanov**: The replacement of metals in the organo-metallic compounds by hydrogen under high pressure. The reaction goes on according to the equation: $Pb(C_6H_5)_4+2H_2=4C_6H_6+Pb$. At a pressure of 60 atmospheres and temperature 250° C., the quantity of replaced lead reaches 100 per cent.—**S. Kostytchev** and **C. Egorova**: The supposed rôle of the glyceric aldehyde and glyceric acid in alcoholic fermentation. Neither the glyceric aldehyde nor the glyceric acid is an intermediate product of alcoholic fermentation.—**S. P. Kostytchev** and **O. G. Shulgina**: The microbes producing alcohol in the maceration juice of yeasts. The theory of extracellular fermentation is not proved, but not improbable.—**V. B. Sotchava**: A new species of *Bromus*, *B. vogulicus*, sp. n. The new species is described from the Alpine region of the Northern Ural mountains.—**S. L. Sobolev**: Notes on the papers by N. N. Saltykov, "Researches in the Theory of Equations".

SYDNEY.

Linnean Society of New South Wales, Mar. 27.—**W. R. Browne** (Presidential address): An outline of the history of igneous action in New South Wales until the close of the Palæozoic era. Evidence of vulcanicity is recorded in the strata of all the Palæo-

zoic systems represented. No certain traces of continental vulcanism prior to that of Kuttung times have been discovered. The Kuttung epoch of freshwater (Carboniferous) sedimentation closed with subsidence and marine transgression, but the preceding Burindi epoch of marine deposition was ended by a folding movement localised in New England and gradually dying out to the south and west. A similar localised movement commenced at the close of the Upper Marine (Permo-Carboniferous) epoch. Igneous intrusion occurred in connexion with all the orogenic movements, the rocks being calcic, usually of granitic character, but ranging to basic and ultra-basic. The Devonian intrusive epoch resulted in the most widespread and important series of intrusions, comprising injections of both plutonic and hypabyssal habit; and it is worthy of note that the late Permo-Carboniferous intrusions, confined to New England, bear quite a close resemblance to those of the Kanimbla (Devonian) epoch, both petrologically and in the nature of the associated ore-deposits. The ultra-basic rocks of the Great Serpentine Belt were injected in closing Burindi times. The latest Palæozoic eruptive episode was possibly the injection of the alkaline-monzonite series of Mount Dromedary, on the south coast, in a place and at a time of vertical crustal movement.—**M. Bezzi**: Australian Pyrgotidæ (with an appendix by **J. R. Malloch**). The family is not a large one in number of species, but is present in all the zoological regions. Eighty-eight described species are listed.—**J. R. Kinghorn**: Description of a species of lizard from the highlands of New South Wales and Victoria, which was for many years considered to be the Tasmanian form, *Lygosoma pretiosum*, but is found to be more closely related to *L. entrecasteauxi* and is regarded as a distinct species.—**H. Claire Weekes**: On placentation in reptiles (1). Placentation among snakes is described for the first time. As most of the venomous snakes in Australia at least are viviparous, it is probable that placentation among them is not uncommon. At the stage described, the snakes *Denisonia superba* and *D. suta* have no omphaloplacenta, as the allantois has completely encircled the yolk-sac. Omphaloplacentation and allantoplacentation are also described for a new species of *Lygosoma*. This type is interesting, because it suggests a stage in the development of the placenta intermediate between that in the lizards *L. quoyi* and *L. entrecasteauxi*.—**Ida A. Brown**: Preliminary note on monzonitic and nepheline-bearing rocks of Mount Dromedary, N.S.W. At Mount Dromedary there is a monzonitic plutonic complex in which acid, intermediate, basic and ultra-basic phases are represented by banatite, monzonite, olivine-monzonite, kentallenite, and pyroxenite. A further result of differentiation has produced a number of rare types. This is the first record in Australia of a complete series of plutonic monzonitic rocks.

May 29.—**H. J. Carter**: Revision of the Australian Phoracanthini (fam. Cerambycidæ), with notes and descriptions of new species of this group and of allied genera. **C. P. Alexander**: Notes on the Australian species of *Molophilus* (Tipulidæ, Diptera). A key is given for the separation of the Australian species into groups, and the twelve species described by Skuse in 1889 are ranged in their groups and their affinities discussed.—**A. S. Hitchcock**: Papuan grasses collected by L. J. Brass. Twenty-one species are recorded, in addition to one species of *Isachne* which is described as new.—**A. B. Walkom**: Note on a fossil wood from Central Australia. A coniferous wood from the Cretaceous glacial beds at Muloowurtina, Central Australia. The wood shows well-marked narrow annual rings, indicative of regular seasonal change in climatic conditions, but not necessarily of glacial conditions.

VIENNA.

Academy of Sciences, April 18.—**F. M. Exner**: Gravitation waves in the atmosphere. In essence, diurnal pressure and temperature changes appear to be nearly identical with the phenomena of gravitation waves.—**F. Heritsch** and **H. R. v. Gaertner**: Devonian petrifactions from Paphlagonia.—**K. Lohberger**: Some new fish forms from Lake Victoria.—**O. Scheerpeltz**: Staphylinidæ from Palestine and Syria. Zoological expedition by R. Ebner, 1928.—**A. Himmelbauer**: Apatite-twins from Elba. Crystals are described with a rotation in the plane of symmetry.—**E. Furreg** and **F. Querner**: Peculiar fluorescence phenomena in the shells of gastropods (families Trochidæ and Turbinidæ). Filtered ultra-violet light was used of wave-lengths between 400 and 300 $\mu\mu$. The method appears useful for detecting the presence of definite pigments even when overlaid by others.—**V. F. Hess**: New investigations on the ionisation balance of the atmosphere over Heligoland. Observations were made on the north point of the island and 50 metres above sea-level. Numerical results varied with direction of the wind, with visibility, and with spray.—**H. Cammerloher**: The larva of *Anthocephalus elongatus*.—**T. Pintner**: Studies of Tetrarhynchi with observations on other tapeworms (4). Some of Diesing's originals and related forms.—**F. Werner**: Scientific results of a zoological expedition to Algeria and Morocco (2). New Orthoptera.—**R. Ehrlich**: The periodic series of colour sensations, with an appendix by **R. Schumann**: Mathematical investigations of a series appearing in the theory of colour sensations.—**S. Meyer**: The question of the formation of neutrons. A mathematical discussion of the combination of protons and electrons and possible explanation of γ-rays.—**A. Basch**: Error-tensors, error-affinors, and general error transport laws.

April 25.—**H. Balss**: Expedition of the *Vola* to the Red Sea, northern and southern half, 1895–96 and 1897–98. Zoological results. Decapods of the Red Sea (4). Oxyrhyncha and final comments.—**F. Sigmund**: The action of ultra-violet rays on aldehydes. Studies on hexahydro-phenyl-acetic aldehyde, hexa-hydro-β-phenyl-propionic aldehyde and n-dodecyl-aldehyde.—**F. Lieben** and **E. Molnar**: The oxidative decomposition of some physiologically important bodies by the process of Hehner.—**G. Jantsch** and **K. Meckenstock**: Chromium (iii)-p-toluol-sulphonates.—**K. Przibram**: Piezochromy (change of colour under pressure) in natural minerals.—**E. A. W. Schmidt** and **G. Stetter**: The use of the valve-electrometer for the investigation of proton-rays.

May 2.—**M. Holly**: Some new fish forms from Brazil.—**O. Gugenberger**: Geological studies from the Upper Etsch (Alto Adige) with special reference to glacial problems.—**A. Wagner**: Influence of the thermometer exposure on temperature registration in Vienna Hohe Warte.—**E. Clar**: A contribution to the knowledge of the lead-zinc ore deposits of Schönstein near Cilli in Jugoslavia.—**W. Leithe**: The rotation, refraction, and volume of organic bases in solution.—**K. Zindler**: Parallel plane sections of a convex body.

May 10.—**H. V. Graber**: Report on geological petrographic researches in the Upper Austrian primitive rocks (2).—**F. E. Suess**: Tectonics of the Scotch Caledonians. The results of a visit to the Moine district and of the British Association excursion to Ballachulish. The geological structure of Scotland is compared with Alpine, Variscan, Scandinavian, and Moravian structure.—**Y. Abe**: Sexual differences of cell size in albino rats. Female cells about 95 per cent of the size of cells in the male.—**P. Walden**: Landolt Oudeman's law in non-aqueous solutions.—**L. Moser**:

Extension of method of gravimetric analysis.—M. Kohn and A. Aron: Debromination of brominated cresols with zinc dust and acetic acid.—L. Kober: Report on geological investigations in Attica.—A. Musil: Thermodynamic relations between lye and soda saponification of esters.—A. Dadieu and K. W. F. Kohlrausch: Studies on the Raman effect (2). The Raman spectrum of organic substances (benzol derivatives).—K. Przibram: Recrystallisation and coloration of rock-salt.—L. Walchshofer: Volatilisation of radium B and radium C as dependent on the nature of their substratum.—F. Urbach: Absorption bands of solid bodies.—F. Urbach: Stokes's law.—R. Mayer: Morphology of the middle Burgenland.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 4, April 15).—**Richard C. Tolman**: On the possible elements for the universe. Einstein's and de Sitter's line elements, with that given by the special theory of relativity, are the only ones compatible with the usual assumptions as to the physical nature of the universe and with general relativity.—**Lora Lane Loeb and Leonard B. Loeb**: The existence of radioactive recoil ions of high mobility. The ionisation chamber consisted of an ebonite ring separating two brass plates through holes in which the discs serving as radioactive source and detector respectively could be inserted. Rutherford's alternating current method and a short period source were used. No evidence was obtained of high velocity ions.—**William T. Richards**: An intensity gauge for 'supersonic' radiation in liquids. A glass gauge, on ear-trumpet principle, of exponential form and thick-walled, gives the best results, the concentrated sound energy being measured as a hydrostatic pressure. If it could be calibrated, it could be used as an absolute gauge.—**V. Guillemin, Jr., and C. Zener**: Hydrogen-ion wave function.—**S. A. Ratner**: Latent carriers of electricity in the gaseous discharge. A gauze ionisation chamber was placed inside a pile of parallel circular annuli; the 'pile' formed one electrode and an external metal rod the other. In spite of a potential difference between each pair of annuli, large currents were measured by the ionisation chamber, due presumably to metastable atoms which diffuse into it.—**Hermann Weyl**: Gravitation and the electron. Mathematical development of a field scheme.—**Roscoe G. Dickinson and Robert T. Dillon**: Raman spectra of solutions of some ionised substances. Frequency changes appear to be independent of the nature of the positive ion.—**A. J. King**: The crystal structure of strontium. Powder diffraction data indicate a face-centred cubic structure, the unit cube edge being 6·075 A. and the distance between strontium atoms 4·295 A.—**Chas. W. Metz**: Selective segregation of chromosomes in males of a third species of *Sciara*.—**Thomas Harper Goodspeed and Priscilla Avery**: The occurrence of chromosome variants in *Nicotiana alata* Lk. et Otto.—**Edward W. Berry**: An eocene tropical forest in the Peruvian desert. Silicified fruits and seeds from a thin outcrop near Punta Pariñas indicate that in Tertiary times the region supported a forest cover of tropical vegetation; the rainfall of the region was much greater than at present and well distributed through the year.—**B. P. Gerasimovič**: On the stability of gaseous stellar structures. An analysis of Jeans's stability criterion. If changes of ionisation of a star in a perturbed state are taken into account, not only dwarfs and giants but also supergiants are stable in the gaseous state. Certain stars of very large mass may be 'liquid'.—**N. Wiener and M. S. Vallarta**: On the spherically symmetrical statical field in Einstein's unified theory of electricity and gravitation.—**D. G. Bourgin**: Unimolecular reactions. Application of new quantum theory considerations.—**J. Dieudonné**: A generalisation of Rolle's theorem with application to entire functions.—**S. Lefschetz**: Duality relations in topology.—**G. A. Miller**: Groups which admit three-fourths automorphisms.—**A. Adrian Albert**: The rank function of any simple algebra.—**M. S. Knebelman**: Conformal geometry of generalised metric spaces.

Official Publications Received.

BRITISH.

Proceedings of the Royal Society of Victoria. Vol. 41 (New Series), Part 2, 11th April. Pp. 65-242+plates 12-24. (Melbourne.)

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 6, June. Abstracts Nos. 1026-1279. Pp. v+207-247. (London: H.M. Stationery Office.) 9*d.* net.

Ceylon Journal of Science. Section B: Zoology and Geology. Spolia Zeylanica. Edited by Dr. Joseph Pearson. Vol. 15, Part 3: A Monograph on Cestodes of the Order Trypanorhyncha from Ceylon and India, Part 1. By Dr. T. Southwell. Pp. 169-312. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.) 3 rupees.

University of Mysore. Report on the Statistical Analysis of the Medical Examinations (1924-25 to 1926-27) of Students of the Mysore University. By Prof. K. B. Madhava. Pp. 80. (Mysore: Government Branch Press.)

Transactions of the Optical Society. Vol. 30, No. 4. Pp. iv+141-184. (London.) 10*s.*

Empire Marketing Board, May 1928 to May 1929. (E.M.B. 19.) Pp. 54. (London: H.M. Stationery Office.) 1*s.* net.

Leeds University: Department of Pathology and Bacteriology. Annual Report, 1928, by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research, by Prof. R. D. Passey. Pp. 16. (Leeds.)

Medical Research Council. Ninth Annual Report of the Industrial Health Research Board (formerly the Industrial Fatigue Research Board) to 31st December 1928. Pp. 33. (London: H.M. Stationery Office.) 9*d.* net.

FOREIGN.

Proceedings of the United States National Museum. Vol. 76, Art. 1: New Fossil Land and Fresh-water Mollusks from the Reynosa Formation of Texas. By William B. Marshall. (No. 2798.) Pp. 6+1 plate. (Washington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 86: Piroplasmosis in Egyptian Fowls (Egyptianella Pullorum). By Prof. M. Carpano. Translated by Zaki Morcos. Pp. 7+3 plates. (Cairo: Government Press.) 5 P.T.

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 12: Work of the Bureau of Education for the Natives of Alaska. By William Hamilton. Pp. 6. (Washington, D.C.: Government Printing Office.) 5 cents.

Meddelelser fra Kommissionen for Havundersøgelser. Serie Fiskeri, Bind 8, No. 7: On the Age and Growth of the Coalfish (*Gadus virens* L.), the Norway Pout (*Gadus esmarki* Nilsson) and the Poutassou (*Gadus poutassou* Risso) in Icelandic Waters. By Bjarni Sæmundsson. Pp. 37. (København: C. A. Reitzels Forlag.)

Secrétariat du Comité Météorologique International. No. 1: Rapport de la septième Réunion de la Commission Internationale des Renseignements synoptiques du temps à Londres, mai-juin 1928. Traduction en français du Rapport du président de la Commission avec des textes allemands des résolutions. Pp. 79. (Utrecht: Kemink en Zoon.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 25, Part 3: On the Known and Unrecorded Species of the Japanese Pyraustinae (Lepid.). By Jinshichi Shibuya. Pp. 151-242. (Tokyo: Maruzen Co., Ltd.)

CATALOGUES.

Autumn Books, 1929. Pp. 16. (London: George G. Harrap and Co., Ltd.)

The Nickel Bulletin: a Summary of Current Information on Nickel. Vol. 2, No. 2, August. Pp. 64. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

SATURDAY, AUGUST 17.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—Annual Meeting.

CONGRESS.

AUGUST 29 TO SEPTEMBER 1.

SWISS SOCIETY OF NATURAL SCIENCES (at Davos). In seventeen Sections. Lectures:—Dr. W. Mörikofer: Problems of Meteorological Radiation Research.—G. Bener: Mountain Road Construction and Science.—Prof. R. Staehelin: The Physiology of High Altitudes.—Prof. E. Guyénot: The Hypothesis of Morphological Territories in Biology.—Prof. R. Doerr: The Submicroscopic Forms of Life.