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Kingship and Kinship

FROM him to whom much has been given, much shall be required. The moving words with which on the night of December 11 Prince Edward took leave of his people, his subjects no longer, closed a great career of public usefulness, upon which strong hope for the future had been founded. That valediction, however, stands for far more than that. It marks the end of an epoch in which the relationship of the British Crown to the people has been peculiarly intimate and personal. It is true that the events of that momentous period of stress, which opened on December 2, have left the monarchy unshaken ; it is even strengthened ; but it would be idle to claim that it is unchanged. With the proclamation of His Majesty King George VI on December 12, a new era begins.

In the history of kingship, as has been shown by recent research, the well-being and virility of the king is identified with the prosperity and fertility of land and people. It is not without significance, perhaps, that it is precisely among the descendants of those peoples who relied most on the qualities of their king or chief as leader, the conquering Nordic peoples, to use a convenient descriptive nomenclature, that kingship has been most enduring. Yet if the king is the fount of honour, the leader in war, and in peace the source of law and order, as well as the supreme overlord of land and people, it is not in the sense of absolute monarchy in which Louis XIV claimed *l'état, c'est moi*. Britain, fortunate in this as in other matters affecting the liberty of its people, early won affirmation of the principle, which had governed the early kingship—even as now it regulates the powers of the paramount chief in parts of tribal Africa—that the king holds power in virtue of a trusteeship for his people and must rule in concurrence with his and their councillors. It is this principle, with many vicissitudes and obscurations, which runs through the weft of British constitutional development and the growth of self-consciousness in the people. It attained the full measure of imperial democracy in the Statute of Westminster of 1931, and first found opportunity for full expression, bitter though it was, in the tragedy of December 1936.

Events which in other days might well have given rise to revolution have passed without disturbance. That it has been possible for a great and unanimous volume of public opinion to crystallize without delay over the vast distances of the Empire is due in no small measure to the resources which science has placed at the disposal of our rulers in cable and wireless, aided by the newspaper press. It marks a new phase in the growth of democracy. But also it imposes a special responsibility on the new monarch.

It has been pointed out again and again in recent years that the King-Emperor is now the only link which binds together the independent nations which form the British Commonwealth. The new monarch has been acclaimed as "the people's King". This title confers upon him a great trust, but it lays upon him also a heavy burden, as guardian of the honour and integrity of his people. By his personal character and his sense of responsibility he will win the loyal support of his subjects in helping him to bear it. Now that the British Commonwealth of Nations has shown that it is no loose aggregate, but a closely knit unity, if of diverse parts, each of those parts will look to its king as its special representative, for whose services as arbiter, and as the interpreter of the constituent elements one to another, it will be prepared to pay with ever-ready loyalty.

General Science for Secondary Schools

THE science masters of Great Britain have hitched their wagon to a star; but, as men of science, they have selected the star with deliberate judgement and have satisfied themselves that the couplings are trustworthy. The interim report* on the teaching of general science just published by a sub-committee of the Science Masters' Association (after adoption by the general committee) is indeed characterized by the union of admirable ideals with sound good sense, and must be regarded as among the most weighty and most interesting of recent pronouncements on educational policy. There has long been on foot a movement to change the elementary part of the school science curriculum from its traditional, intensive and formal habit to a broader and more human shape; to substitute, in fact, a scheme of 'general' science for the rudiments of one or two branches of academic science hitherto constituting the usual course followed by School Certificate candidates. The terms of reference of the sub-committee were as follow:

"To consider the problems presented to teachers in Secondary Schools by the introduction of courses in General Science as a constituent of general education, and to make specific suggestions about: 1. The aims to be kept in view. 2. The basic principles of the subject, an appreciation of which should be inculcated. 3. The material to be included in such courses. 4. Methods of development and treatment of the material. 5. Time-table requirements at different stages."

The report (1) summarizes the growth of this movement from its inception in 1915–16 to the appointment of the present sub-committee in 1935; (2) considers the aims of science teaching; and (3) suggests and interprets a syllabus of general science, with a special note on the biological section.

It is natural to turn first to the committee's views upon the aims of science teaching, for the curriculum and treatment to be adopted must obviously depend upon the ultimate objective. The report observes that the numerous reasons urged to justify the inclusion of any subject in the school course can be roughly classified under the three headings of (*a*) utilitarian or vocational, (*b*) disciplinarian, and (*c*) cultural; and the committee proceeds at once to make the important point that the preparation of technical experts cannot be considered as one of the functions of a school. We should have liked to see even greater emphasis given to this fundamental principle, which applies not only to the School Certificate stage but also to the two years afterwards spent in specialist studies by many boys and girls at school. We believe—and are confident that the vast majority of schoolmasters agree—that it ought to be no part of the business of a public or secondary school to train pupils for such professional examinations as the First M.B. The proper place for professional or technical training is the university or technical institution; and though parents may find it economical, and the university or institution convenient, to thrust a steadily increasing portion of such training upon the schools, the effect upon secondary education, already sufficiently serious, is likely in the long run to be extremely detrimental. On the other hand, the pre-preparation of experts is one of the schoolmaster's legitimate tasks, and, as the committee wisely remarks, "this can best be achieved by broadening the syllabus; for it is at school that particular talents are discovered and their development fostered. Many a potential specialist, in the life sciences especially, has been lost to the world by the narrowness of the teaching at school". The committee is too timid—or too polite—to add what should nevertheless be said in the plainest and most uncompromising English: that if the teaching at school is narrow, the fault is chiefly due to the stranglehold of the external examination system maintained by examining bodies under university control.

Vocational preparation, then, is relegated by the committee to a subordinate position, and this action is justified not merely on general grounds, but also because a purely vocational curriculum "presupposes a static, unchanging society" and because "the occupations of the people exhibit such amazing diversity that it is impossible to cater specifically for more than a small fraction". Where such a fraction is in practice catered for, the school authorities would do well to ask themselves whether they are not subsidizing some of their pupils at the expense of others.

* The Teaching of General Science. Science Masters' Association Interim Report of the Sub-Committee appointed in 1935. Adopted by the General Committee in 1936. (London: John Murray, 1936.) 2*s*. 6*d*. net.

Upon the second claim advanced in favour of the teaching of science in schools; namely, that it develops "certain powers of clear and vigorous thinking, of coherent and logical deduction, of exact and accurate observation", the committee discreetly adopts an attitude of reserve, accepting —or at least not disputing—the experimental evidence "that the possibilities of transfer of training are much smaller than had formerly been supposed". It is, however, a little disconcerting to find that the committee next draws the quite unwarranted conclusion that school science syllabuses should not include "any matter whatever which is taught *only* for the sake of the training it gives". Dr. Arnold's remarks on such a capitulation would have been pleasurable hearing; but since it would probably be impossible to isolate any topic the value of which is purely disciplinary, the committee perhaps penned this sentence tongue in cheek. The committee is, on the contrary, wholly serious in its insistence upon the cultural aim of science teaching, urging that "the peculiar intellectual glory of the Western peoples has been the creation of a Natural Science which is far in advance of that of earlier times", and that no one "can now be considered truly cultured, no one can be considered as having felt the European spirit at its best, if he has never had his imagination stirred by that great adventure of ideas on which we are engaged: the scientific exploration of natural phenomena". These are noble sentiments finely expressed; they represent the true spirit in which science should be taught.

The committee feels that the cultural and subsidiary aims of science teaching may best be achieved by arranging courses in as liberal a manner as possible, and by designing them to cover a wide range; but it is not blind to the difficulties which general science has to encounter. The details of the practical problem have therefore been attacked with courage, with skill, and, we think, with a considerable degree of success. In constructing an 'ideal' syllabus the committee adopted three criteria: (1) the selected material should call forth activity on the part of the pupils, (2) every item in the syllabus should lead to the understanding of fundamental scientific principles, and (3) the syllabus should provide a field suited to the cultivation of those habits, interests and sentiments which are fundamental to science. For the systematic way in which these criteria were applied, and for the ingenious method employed to frame a scheme in which each criterion was fully respected, reference must be made to the report itself; but the syllabus as a whole is so constructed as to help the pupil toward an intelligent understanding of his immediate environment, his own body being the central figure in it.

A particularly welcome feature of the scheme is that the committee, all the members of which have had wide experience of science teaching, abandons the pursuit of "breaking down the barriers between the special sciences" (a phrase which the members admit to have puzzled them), and frankly observes that the division of science into three main branches is both convenient and logical. The syllabus is accordingly divided into three sections, dealing respectively with physics, biology and chemistry, but the lines of demarcation are not emphasized, and the root of each section lies in the common experience of average pupils. The time which the committee suggests as adequate for the course is 451 periods of 45 minutes plus 29 periods for revision, that is, a total of four periods a week for four school years. This allowance—which is accompanied on the syllabus-charts by suggestions as to the number of periods to be allotted to each individual topic—appears to be ample, and it is probable that sets of more intelligent pupils would be able to get through a good deal more than the printed course. If so, the additional material might suitably consist for the most part of chemistry, to which the committee has assigned only 95 of the 451 periods, as against 197 to physics and 159 to biology.

This reduction of the chemistry section of the syllabus is, we feel, the weakest part of the scheme, and the committee itself is apparently not here sure of its ground. No doubt the chemists of the Science Masters' Association will see to it that this one blemish in an excellent—and obviously workable—course of general science is removed before the interim report becomes the final report. In the meantime, Mr. J. A. Lauwerys (convener), Mr. C. L. Bryant (chairman) and all the members of the sub-committee must be congratulated upon having brought a most exacting task to a very satisfactory conclusion. They have shown that elementary science in our schools can be vastly improved, and, more than that, they have shown how the improvement may be effected. Since the main criticism of general science in the past has been that it is impracticable, the present report may become a landmark in the history of scientific education.

Metallurgical Text-Books

(1) An Introduction to Physical Metallurgy
By L. R. Van Wert. Pp. xi+272. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 18*s*.

(2) The Principles of Physical Metallurgy
By Prof. Gilbert E. Doan. Pp. ix+332. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 18*s*. net.

(3) Principles of Metallography
By Prof. Robert S. Williams and Prof. Victor O. Homerberg. (International Chemical Series.) Third edition. Pp. ix+313. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 21*s*. net.

(4) An Introduction to the Metallurgy of Iron and Steel
By Prof. H. M. Boylston. Second edition. Pp. xxii+563. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25*s*. net.

ALTHOUGH the science of metallurgy has been a subject of university rank in Great Britain for many years—actually since 1851, when the Royal School of Mines was founded—the development of metallurgical courses in the United States has been much more rapid, and has taken place along somewhat different lines. It has always been the policy in British universities to give major attention to the extraction, smelting and refining of iron and the non-ferrous metals, and recently a more or less justifiable barrage of criticism has been directed at university authorities for their comparative neglect of the physical and engineering aspects of metallurgy.

The major advances in metallurgy since the beginning of the century have been concerned with the treatment and alloying of metals subsequent to smelting, and with their fabrication and adaptation to use in the engineering industries, and clearly a rather different training is required for metallurgical students who will eventually be employed in the metal working and engineering industries than for those who will be concerned with smelting processes. Some steps have certainly been taken to correct this bias in British metallurgical training, but in the United States physical metallurgy has for long been given the attention it deserves. (At the Massachusetts Institute of Technology, for example, a four-year course in physical metallurgy is provided, although at the same time it is doubtful whether this course can adequately fulfil its purpose without at least some process metallurgy as a background.) The four books under review are representative of the text-books provided for American university students taking metallurgical courses.

(1) Dr. Van Wert has for some years past been responsible for lectures in physical metallurgy at Harvard University, where his students have consisted of a somewhat heterogeneous group of post-graduate mechanical engineers and metallurgists. In the course of his work he was brought to realize that there was no introductory text in physical metallurgy which was at once sufficiently specific and fundamental for those who were to continue in the subject, yet interesting and comprehensive enough for those seeking a general knowledge of metallurgy and whose active acquaintance with it would probably end with the course. The present volume was, therefore, prepared to fill the need.

Dealing first with the common properties of the metallic state and of pure metals, the author proceeds without delay to a discussion of equilibrium diagrams along the usual and orthodox lines (without, however, the tiresome intrusion of the sodium nitrate-water diagram). The major portion of the two chapters devoted to this subject are not unnaturally concerned with simple binary equilibria, but some fifteen pages are taken up with an introduction to the study of ternary systems. The succeeding chapter deals with the micro-constituents of alloys, recrystallization and grain growth. In the chapter on the properties of alloys, hardness curves of representative systems are juxtaposed with the respective constitutional diagrams to emphasize the dependence of properties upon composition and constitution—a useful method for bringing this relation home to engineering students.

The final chapter deals with mechanical and thermal treatment; quite a good outline is given of the mechanism of plastic deformation of single crystals and polycrystalline aggregates, and annealing is considered at some length.

The book is excellently printed and well illustrated with photomicrographs and diagrams.

(2) Three years ago Dr. Doan, who holds the position of associate professor of metallurgy in Lehigh University, collaborated with D. M. Liddell in writing "The Principles of Metallurgy", which covered both process and physical metallurgy. The demand for a separate text on physical metallurgy

has led to the appearance of the present volume. The subject has been approached from the point of view of classical physics, commencing with the states of aggregation of matter, and emphasis is laid throughout on the principles of the behaviour of metals rather than upon individual metals or processes. At the same time, the basic processes and problems involved in the working and use of metals are considered.

The book is divided into three parts, the first dealing with the physics of the metallic state and the deformation and annealing of metals. The second part is concerned with problems of constitution and structure in binary and ternary alloys, and is well illustrated with photomicrographs and constitutional diagrams. In Part 3, under the heading of "Metal Technology", the various working processes are discussed. It is naturally not possible to devote more than a few pages to individual processes, but a clear outline is given of metal-working operations and foundry practice. Throughout, principles are most clearly set out and the book should be of considerable value to students, and, for that matter, to metallurgists and engineers in the metal working and using industries.

(3) This volume, which comes from the Massachusetts Institute of Technology, is frankly intended to serve as an introduction to more advanced works, and to fill the needs of those students of general science and engineering who do not specialize in metallurgy but who will use it to a limited extent in their professional work. Greater emphasis is, therefore, laid upon the applications of metallography and the microstructure of commercial alloys than upon physico-metallurgical principles.

The first edition appeared in 1919, and the need for the present third edition testifies to the appreciation which the book has gained among those for whom it was designed. In rewriting and rearranging the text, the opportunity has been taken to include a considerable amount of new material on aluminium alloys, alloy and stainless steels, laboratory and X-ray methods, and corrosion.

An appendix gives a suggested outline for a laboratory course in metallography and a descriptive list of the more important books and periodicals dealing with physical metallurgy. A comprehensive set of tables gives etching reagents for all types of alloys.

(4) The dearth of reliable text-books on iron and steel manufacture is as serious from the point of view of the student and young technical worker as it is amazing when the great size and importance of the industry in Great Britain are considered. Boylston's "Iron and Steel" was welcomed on its first appearance in 1928, and it is not surprising that a second edition has been found necessary. The author has endeavoured not only to reach students but also to interest the men who work in steel mills in obtaining a better understanding of their profession. In the present edition a number of modern developments have been described; several changes in blast furnace practice are mentioned, such as 'slow-blowing' and 'fanning' of the furnace, and the Brackelsberg melting furnace for foundry work is described in some detail. The Byers-Aston process for producing wrought iron on a large scale is described, and due attention is given to modern electric furnaces. No mention is made of recent practice in strip-sheet rolling, but otherwise the mechanical treatment of iron and steel is well covered.

Mycological Researches

Researches on Fungi

By Prof. A. H. Reginald Buller. Vol. 6: The Biology and Taxonomy of Pilobolus, the Production and Liberation of Spores in the Discomycetes, and Pseudorhizae and Gemmifers as Organs of certain Hymenomycetes. Pp. xii+513. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 28*s*. net.

IN this, the sixth volume of his researches, Prof. A. H. R. Buller, who has recently retired from the chair of botany at the University of Winnipeg, gives the full account of three lines of investigation on which he has been engaged for many years: (1) the biology and taxonomy of *Pilobolus*, (2) the production and liberation of spores in the Discomycetes, and (3) pseudorhizæ and gemmifers as organs of certain Hymenomycetes: preliminary papers on the first two have been published.

The account of *Pilobolus* occupies 224 pages, and is the fullest we have of the genus, though it must be added that a good deal of it summarizes and comments on previous work. The species of *Pilobolus* are usually coprophilous and are characterized by the shape, somewhat like an inverted Florence flask, and by the apical black-walled sporangium being forcibly shot off. The genus

has been known and frequently described since the time of John Ray. The main point of the present account is the explanation of the method of sporangial discharge, which was rightly attributed to the subsporangial swelling acting as a squirting apparatus by Link in 1809. Buller in 1926 put forward the hypothesis that the swelling also acts as an ocellus. When the incident rays of light strike the swelling obliquely, this acts as a lens, and the protoplasm which receives the spot of light sends a phototropic stimulus down to the protoplasm at the top of the stipe just beneath the base of the swelling. The top of the stipe, elongating more rapidly on the one side, bends until the spot of light reaches the base of the swelling, which ensures that the free end of the *Pilobolus* 'gun' is directed towards the source of brightest light. The hypothesis is attractive, but it can refer only to half a dozen or so species. The lens action of the swelling has been investigated in various ways, and shadow photographs were taken. A large number of clear construction diagrams are given, but these disregard the deviation which must arise from the presence of the excreted water drops. Experiments on spore discharge gave six feet as the maximum vertical height for *Pilobolus longipes* and a little more than eight and a half feet as the maximum horizontal range.

The veteran mycologist, W. B. Grove, has contributed a taxonomic account of the Pilobolidæ (*Pilobolus* and *Pilaira*). This is a revision of his monograph of 1884, and gives clear and concise diagnoses of the species, but one would scarcely look for a monographic study in such a volume: whether or not, however, there is no justification for giving a taxonomic diagnosis of a new species in English and Latin in the general body of the work, and a repetition of the English one in the systematic account where it is headed "*Pilobolus umbonatus* Buller, in his Researches on Fungi. Vol. VI, pp. 177–78, figs. 81–84, 87–91 (1934)" and ends "Illustration: Fig. 105. Other illustrations in this volume: Figs. 81, 82, 83, 84, 87, 88, 89, 90, and 91". There are similar unnecessary details in many places, including the legends to the drawings.

The observations on spore discharge in Discomycetes deal first with the 'puffing' off of clouds of spores, a phenomenon often recorded by the old mycologists. The asci in many species are positively phototropic, and curve towards the mouth of the apothecium, and puffing produces a blast of air. A chapter is devoted to "The sound made by fungus guns and a simple method for rendering audible the puffing of Discomycetes". This summarizes some of Prof. Buller's previous work on the different genera, and records the hissing that is sometimes heard when one opens a box containing species of *Helvella* or other large species such as *Discina venosa*. The simple method mentioned in the heading is disappointing—"when the fungus is close to an ear, the puffing can be heard even when the room is not quiet and one is talking to one's friends".

The last part of the book contains interesting observations on a number of fungi. First, 'rooting bases' or pseudorhizæ in *Collybia radicata*, *C. fusipes*, *Mycena galericulata*, and *Coprinus macrorhizus* are considered. Usually, as in *C. radicata*, the pseudorhiza is annual and unbranched, but in *C. fusipes* it is branched and perennial. It arises as a small primordium on the surface of a buried root, etc.—becoming differentiated first into primordial pileus and stipe, the latter then differentiating into the primordium of the stipe-shaft and the stipe-base (pseudorhiza); this latter elongates by intercalary growth and pushes the rudimentary stipe-shaft to the surface of the soil.

The last chapter describes *Omphalia flavida*, the cause of the American coffee-leaf disease. The fungus was first known as *Stilbum flavidum* Cke., but a little more than twenty years ago Maublanc and Rangel, placing affected leaves of the Loquat in a moist atmosphere, found that the 'Stilbum' first developed and then the much larger sporophores of an agaric, which they named *Omphalia flavida*. Ashby later proved in culture that the two were really connected. Ashby's work has been confirmed by the author, who gives anatomical descriptions both of the basidiospore form and of the so-called 'Stilbum', which is really a gemmifer with a solid pedicel (not hollow as described by Puttemans), and a terminal, multicellular gemma shaped like a door-handle and detached by the wind. The mycelium is luminous both in culture and in leaf-spots—the latter fact having apparently been recorded in a letter to NATURE so early as 1880 (22, 292). The similar gemmifers of *Sclerotium coffeicola* are referred to.

The volume is produced in the same format as the previous ones, and written in the same style with an abundance of illustrations. From the contents of the present volume, it would seem that Prof. Buller has been rounding off some of the observations he has made in the course of his studies, and it may be that it will be some time before another volume appears. The first volume was published in 1909, and mycologists are under a deep obligation to Prof. Buller for his steady and continuous work which has brought many new and unsuspected facts to light. The highest praise is due to him for never losing sight of the fungus as a living organism.

J. RAMSBOTTOM.

In Search of Beauty

Polly and Freddie
By Sir F. W. Keeble. Pp. iv+275. (London and Toronto: William Heinemann, Ltd., 1936.) 10*s*. 6*d*. net.

SIR FREDERICK KEEBLE was born in 1870. He was educated at Alleyn's School, Dulwich, and Caius College, Cambridge. His botanical researches earned for him the degree of Sc.D. (Cantab.) and the F.R.S. In succession he has been professor of botany in University College, Reading (now the University of Reading), editor of the *Gardeners' Chronicle*, director of the Royal Horticultural Society's Gardens at Wisley, controller of the Horticulture Food Production Department of the Board of Agriculture, an assistant secretary of the Board of Agriculture, Sherardian professor of botany at the University of Oxford, director of Nitram, Limited, and the adviser in agriculture to Imperial Chemical Industries, Limited. His contacts have been those of an accomplished scientific worker held in esteem by his fellows, a writer, a civil servant, an Oxford professor, a director of one of the units of the great industrial merger, Imperial Chemical Industries, the husband of one of the great tragedy actresses of our time and the neighbour of some of the most distinguished contemporary poets, archæologists and scientific workers.

The author's own and the varied interests of his friends and associates could have provided him with abundant material for a chronological survey of men and matters which his facile pen, wit and urbanity could have embellished into a work which would have given the greatest pleasure to his wide circle of acquaintances. But he has deliberately discarded the conventional technique of the biographer and written an autobiography which is a mixture of fantasy, allegory and fact, calculated to appeal to children as well as adults, to scientific workers who can take a delight in brilliant and charming exposition of the subject matter of science as well as to that wider circle of readers who do not resent the intrusion of an explanation of the facts of Nature into a book which has its full measure of human interest.

Throughout the book are staged the boy Freddie and next-door neighbour big-girl Polly, whom the author has endowed with the patience, sympathy, charm and inspiring qualities of a gallery of fair women. To this dream Polly he declares he owes his outlook on his work and his fellows, and to his early memories of Freddie he attributes his desire to quicken the interest of the children of to-day in the beauties of Nature. These he unfolds in delightful studies of growth, fertilization, budding, the green marine worm, the amœba, fascinating commentaries on evolution and mutation, and an illustration of the quality of the man Pasteur by a description of his experiments on anthrax. This appreciation of Pasteur is the finest thing in the book, a copy of which should be in every home.

A. G. C.

Early Chemistry and Geology

A Dictionary of Assyrian Chemistry and Geology
By Dr. R. Campbell Thompson. Pp. xlviii+266. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 21*s*. net.

THE classification of objects was a favourite pursuit of Assyrian scribes, as is shown by the long lists preserved in Ashurbanipal's library at Nineveh. Such texts were generally bilingual, that is, both the ancient Sumerian and the later Babylonian names are given, and sometimes explanations are appended. Stones, earths and metals naturally take their place in these lists, and in the accumulation of miscellaneous texts in cuneiform writing now published there is much scattered information about these materials.

Dr. Campbell Thompson's book is devoted to the collection of this information in an intelligible order, to the examination of the evidence provided by the names and by the uses to which the materials were put, and to the identification of the stones, earths and metals intended. That task must have been very arduous, as anybody who refers to the book will readily see; it demanded not only the work of a lifetime on the Assyrian language and writing, but also a special study of early geology, chemistry and manufacturing processes. There are, for example, important texts describing the making of glass, in the decipherment and interpretation of which Dr. Thompson has himself played the principal part. With the help of experts on glass, he has determined the character of the

constituents named, often for the first time, and has an ingenious explanation of the weights of some of the minor constituents mentioned, which is much in excess of the amounts that could actually be used.

The interest of this work for the early history of science will be obvious to those who realize how little there is left, for example, about what the Greeks knew of stones and earths and their uses. Dr. Thompson is able to bring evidence to show that the practical science of the classical period was, in certain matters, derived from the ancient East, and even that in certain cases names known to the Assyrians continued in use and were known to Pliny. In fact the book puts the study of these ancient texts on a new basis. Stones and pastes used as prescriptions in the medicine of quite early times were not always included for magical reasons; the chemical properties were known and also their physical effects. Some earths and stones were used for making paints. The commercial employment of vitriol and gall-nuts was understood. All who are interested in the development of man's use of matter will find this apparently unreadable book absorbing and indispensable.

Pioneer work of this kind must, of course, be subjected to criticism and correction as the years pass, as Dr. Thompson would himself desire. The identifications are admittedly in many cases only probabilities or possibilities, founded, as is the case of *aqua regis*, on slender evidence. There are many arguments and statements which will appear doubtful. It is surprising to read that Mesopotamian unburnt brick is generally yellow, or to find that the salt excrescence on ground and brickwork can be thought to have borne a name meaning "smoke". Instances of this kind could be multiplied. But however much we may differ from individual statements and conclusions, the value of the book remains unimpaired. It is a storehouse of most interesting information on an abstruse subject.

The Call of the Orient

The Quest for Cathay

By Brig.-General Sir Percy Sykes. Pp. xii +280 +17 plates. (London: A. and C. Black, Ltd., 1936.) 15*s*. net.

SOMEONE once said that "The struggle between Europe and Asia is the binding thread of History; the trade between Europe and Asia is the foundation of commerce: the thought of Asia is the basis of all European religions". With this trenchant observation in our minds, we can read "The Quest for Cathay" with even greater attention than if it were a mere story of exploration, in the annals of which it creates a brilliant and vital chapter.

Except for the first pilgrim-explorers such as Hsuan-Tsang—"the greatest of early Asiatic travellers"—the quest centres principally around that period between the mid-thirteenth and mid-fourteenth centuries, an era of the greatest importance in world-history, for it was then that the West first discovered the East. Here is romance indeed, the principal figures being the Friars Carpini and Rubruquis, and the merchant-adventurers—the Polo family. Although Sir Percy Sykes traces the whole story from the earliest penetration of Asia by Alexander the Great down to the arrival of the Portuguese and the Jesuits in the Far East, no less than eight chapters out of eighteen are devoted to the exploits of these travellers, and rightly so, for they do indeed embrace the bulk of the knowledge that Europe gathered about the Orient at that date.

The direct results of the tales these pioneers brought back was that there arose a sudden and impulsive desire in the West for direct contact with the East. Venice and Genoa rose to fame and opulence, but it was not until the fifteenth century that the great quest was set in motion, and many serious attempts were made to reach India and Cathay by way of the North-West Passage, along the Arctic shores of Siberia and by the Caspian route. The great adventures of Dias, Covilhao, Columbus, Cabot, Vasco da Gama, Magellan, Jenkinson and Frobisher were all undertaken with the same object: all had the same prize in view—the untapped wealth of the Orient. Finally, Portugal discovered the sea-route to China, and the author considers the quest ended. But surely, if Jenkinson, ambassador to Bokhara and Persia, was in search of Cathay, those early ambassadors from Muscovy to the Manchu Court should be included in the roll of fame. Russia may have been a bit behindhand, but the story of her push towards the East could have added a chapter or two of surpassing interest, and could have introduced material, unlike that in the rest of the book, not easily come by.

The author adds a personal note to the oft-told tales of these early pioneers, having followed in the footsteps of many of them. The volume is well illustrated, and wisely includes nine copies of early maps.

Economists and the Public:
a Study of Competition and Opinion. By Prof. W. H. Hutt. Pp. 377. (London: Jonathan Cape, Ltd., 1936.) 15*s*. net.

PROF. HUTT has obviously enjoyed the preparation of this book. There are few writers on economics or its applications in social and political problems from Adam Smith, J. S. Mill, Herbert Spencer and Ricardo to J. M. Keynes, J. A. Hobson, W. Lippmann, H. Levy, H. J. Laski, Bertrand Russell and others of our own day at whose teachings he does not direct some shrewd blows. The charge of anonymous criticism which he condemns in Prof. Pigou's "Theory of Unemployment" can scarcely be brought against Prof. Hutt, who rarely fails to specify exactly the writer or teacher responsible for the views he criticizes.

It would be unfair, however, to represent this book as purely provocative or destructive in its criticism. Quite apart from the merits of its able presentation of a case for the competitive system based on much sounder arguments than those of the political platform or press, it is a most stimulating book to all who are concerned with social and economic questions, and particularly with the way in which scientific thought can penetrate society and be integrated into action and policy able to control the destructive forces which threaten it to-day. What Prof. Hutt has to say about the influence of custom on thought, the corruption of opinion, on plausibility and its dangers, on liberty, the basis of authority in opinion, and the independence of university teaching has implications which are very far from being limited to those primarily concerned with economics.

The book is never dull or superficial, and the ideal of economic liberty with equality of opportunity which Prof. Hutt's study of the competitive or *laisser-faire* system leads him to uphold has claims on the attention of all who retain their faith in reason. It can be recommended to all scientific workers who are facing the social consequences of their work, if only for the indications of basic principles to be applied in their thought on such questions and of the pitfalls to be avoided. R. B.

The Book of the Aeroplane
By Capt. J. Laurence Pritchard. Third edition. Pp. x+254+24 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 7*s*. 6*d*. net.

CAPT. PRITCHARD has succeeded in putting into this comparatively small book almost everything that the general reader wants to know about the aeroplane. He is to be congratulated also on the clear and interesting manner in which he explains such things as the distribution of pressure on the wing of an aeroplane, the functions of the various component parts, the controls, the problems involved in obtaining high altitude, high speed and long range, and the ground organization on flying routes. Chapter iii, "How an Aeroplane Flies", is, in particular, a model of clear exposition.

The author of a book of this kind, dealing with a science which is advancing with startling rapidity, suffers from the handicap that his work must always be a little out of date, even on the day of publication. This, the third edition (1935) of a work first published in 1926, takes us down to the date of Miss Jean Batten's flight from Port Darwin to Lympne, April 1935. That is the last entry in the list of famous flights which is a valuable feature of the book. The reviewer was a little disappointed to find no mention of the present very elaborate weather forecasting service for aviation, in the chapters dealing with "The Great Airways of the World" and "Safety in the Air"; but that was the only fault he had to find with this very interesting and useful book.

Collected Papers of Charles Sanders Peirce
Edited by Charles Hartshorne and Paul Weiss. Vol. 6: Scientific Metaphysics. Pp. x+462. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1935.) 21*s*. net.

THIS valuable addition to the collection of Peirce's writings illustrates the extreme variety and creative power of the great American philosopher. Among the notable contributions contained in this volume are the series of articles which first appeared in the *Monist* and were so much appreciated by William James. These articles refer to the doctrines of Peirce on chance (tychism), on continuity (synechism) and on love (agapism). Around these articles, the editors have collected and published a wealth of notes, additions and studies ranging from logistics to telepathy, and showing the diverse interests of their author. This new volume will greatly assist the reader in forming an adequate judgment on Peirce's thought and on the historical background of contemporary logic and methodology. T. G.

Il nucleo atomico
Per Franco Rasetti. (Trattato generale di fisica a Cura del Consiglio Nazionale delle Ricerche.) Pp. ii+232+3 plates. (Bologna: Nicola Zanichelli, 1936.) 50 lire.

IN this book, readers of Italian should find a very convenient, up-to-date and trustworthy summary of the more important aspects of radioactivity and their theoretical explanation in terms of wave mechanics. It is particularly well illustrated, and the subject matter is set forth in a direct and pleasing manner. It should form a handy guide for quick reference; but, on the other hand, it does not contain those long lists of references and footnotes which make the works of English writers in this field so valuable.
L. F. B.

Bird Flight
Written and designed by Gordon C. Aymar. Pp. xii+234. (London: John Lane, The Bodley Head, Ltd., 1936.) 12*s*. 6*d*. net.

THE main feature of this American book is the series of some two hundred 'action' pictures of flying birds by various photographers, including the author. Many of them have appeared before, but they make a remarkable collection, containing much of interest and much of beauty. The text is undistinguished: it gives a brief popular account under the heads of evolution, biology, migration and aerodynamics.

Engineering and Empire Development

IN his capacity as the head of the oldest and most famous engineering institution in the world, the president of the Institution of Civil Engineers occupies a position of undisputed authority, the realization of the character of which has led successive presidents to deliver addresses which, taken collectively, constitute a history of engineering. Some of these addresses have been confined to the particular branch to which the speaker has devoted his life, others contain surveys of many branches, while others again contain valuable autobiographical or biographical sketches. Few of the addresses are not without permanent interest, and some thirty years ago *Engineering* referred to the whole as being to the Institution "a heirloom left it by the many great men who helped so devotedly to build up the position of our Empire".

The addresses of Telford and Walker, who occupied the president's chair from 1820 until 1845, were short and were mainly concerned with the activities of the Institution itself, and the prototypes of the modern presidential address are those of Sir John Rennie in 1846 and 1847, and of Joshua Field, in the two succeeding years. Rennie's first address runs to more than one hundred pages in the *Proceedings*. It dealt with a multiplicity of things including bridges, tunnels, harbours, gas, water, railways, steam carriages, steam navigation and telegraphy and even touched upon mineralogy, geology and meteorology. It reviewed the vast development of engineering from the time Smeaton began work on the Eddystone Lighthouse down to 1846, a period of ninety years. Twenty years later, Sir John Fowler spoke of this address as "a history of engineering and a manual of engineering science". A still longer address was that of Sir William White who, however, confined himself entirely to the progress of naval architecture and marine engineering during the preceding half century, a field in which he himself had played a part second to none. But whether the addresses have been long or short, whether they have dealt with wide surveys or a single subject, they are nearly all excellent reading, and over and over again reference has been made to the many great works designed and carried out by British engineers both at home and abroad, whether in foreign countries or in the British Dominions. There were, therefore, numerous precedents for Sir Alexander Gibb's choice of the title "Engineering and Empire Development", for his address delivered on November 3.

Sir Alexander himself, it is almost unnecessary to say, has had experience in many branches of engineering. Born in 1872, he was a student of University College, London, and then a pupil under Sir John Wolfe Barry and H. M. Brunel. Between 1905 and 1917 he was engaged on the construction of the New Alexandra Dock at Newport, Monmouthshire and the Royal Naval Dockyard at Rosyth, and during the Great War was chief engineer for port construction for the British Armies in France and Belgium. As senior member of Sir Alexander Gibb and Partners, he has recently been responsible, not only for the Kincardine Bridge but also for the great Galloway hydro-electric scheme in south-west Scotland. Unlike many of his predecessors at the Institution of Civil Engineers, his principal work has been done at home, but in choosing the subject of his address, he was inspired partly by the address of Rennie and partly by the opportunity he had had of inspecting the great engineering works in the Dominions and Colonies, which in the last ninety years have wrought a change in conditions overseas similar to those wrought at home in the ninety years covered by Rennie's address.

The world before Smeaton's time, Sir Alexander said, had apparently stood still; suddenly there arose a body of great engineers who, in a few years, created a new era. This, he suggested, was a natural evolution from the more abstract discoveries of science due to such as Copernicus, Galileo, Kepler and Newton. H. R. Palmer, actually the first member of the Institution, had said that "the Philosopher searches into nature and discovers her laws and promulgates the principles upon which she acts. The Engineer receives those principles and adapts them to our circumstances". From the outset, engineers thus looked upon themselves as the practical exponents, for the ordinary use of mankind, of the scientific knowledge won by men of science and mathematicians. The basis and justification of the existence of the engineer, and his contribution to civilization, exist in the fact that the application of science to practical use is in fact engineering. The engineer of Rennie's time was of the type visualized by H. R. Palmer, and it is the same type of man who in the ninety years since 1846 has changed the face of the whole world and created the British Empire.

Dealing in turn with canals, roads, bridges, railways, ships, ports, transport, agriculture, irrigation, water-supply, sanitation, etc., Sir Alexander

referred to such achievements as the canals which make it possible for ocean-going steamers to penetrate half-way across the continent of America, the 1,000,000 miles of roads which serve the Empire, the 12,064-ft. long Lower Zambezi Bridge, one of the longest bridges in the world, the railways of Canada, India and Australia, the trans-oceanic trade in foodstuffs and the developments of ports. It is of interest to note that Smeaton's old chart of the Clyde showed a depth of 42 inches at high tide near a point where the *Queen Mary* was launched in 1934. Striking effects have been achieved by irrigation. It was after the famine of 1865–67 that irrigation was started in India on modern lines. Famines do not now occur in India ; shortage and scarcity exist at times, but the possibility of areas of the size and population of Great Britain being left without food owing to the failure of a capricious monsoon has long since been ended.

Whatever has been accomplished, however, "the opportunites of the future," said Sir Alexander, "are vastly greater than any that the past has offered, but frankly, I look with anxiety on the years to come. The machine . . . sometimes seems to be taking control. Inventions and developments succeed one another with bewildering speed, and there seems, unfortunately, to be no limit to the possible results of uncontrolled and misapplied ingenuity. In such circumstances no one can say where Engineering may lead us or what limit there is to the power of the engineer. One thing is certain, and that is that there must be control".

Finally, Sir Alexander appealed for more co-operation between engineers themselves, for the subordination of personal and independent views and feelings to a common policy. "I would like it to be possible for one broad policy to inspire and guide all classes of engineer. I would hope that in time there would arise a body of engineering opinion so weighty, so authoritative, so sure, so sane, that it would prevent waste of energy and misplaced enterprise, and would inevitably command attention in the politics and administration and life of our country and Empire."

Soil Drift in South Australia

THE advances being made by deserts into areas occupied by man, sand drift, and desiccation, are problems which have awakened interest in several parts of the world. At the present time they are under consideration in the Middle West of the United States of America, in West Africa and in South Australia.

Under the auspices of the Council for Scientific and Industrial Research of the Commonwealth of Australia an important monograph (Pamphlet No. 64, Melbourne, 1936) on this subject entitled "Soil Drift in the Arid Pastoral Areas of South Australia" by Mr. F. N. Ratcliffe embodies the researches carried out by the author into this important matter. The history of the investigations are given in a foreword. During the year 1935, the minister in charge of the Council (Senator, the Hon. A. J. McLachlan) asked that consideration should be given to the possibility of undertaking any action to combat drift of soil in the arid and semi-arid parts of Australia. Mr. Ratcliffe, an officer of the Council, was deputed to undertake investigations in typical areas such as the northern portions of South Australia. It is stated that the publication of the report must not be taken to mean that the opinions expressed in it necessarily represent the considered views of the Council.

The problem of soil drift in Australia, says the author, is not, of course, confined to the area dealt with in the report. In order to shorten the period given to the investigations undertaken, the work was confined to the pastoral areas of South Australia. In other regions vegetations differing in type from, and in many ways more complex than, those described in the report would have had to be studied. On the whole, it is considered very unlikely that the problem in, say, western New South Wales would differ essentially from that in South Australia, although the details of the picture might not be quite the same.

The problem of soil drift and the deterioration of the pastoral country is a factor of very considerable importance to Australia's future, as is the case in certain other parts of the world. It is therefore, as the author states, very desirable, if not essential, that its nature and the difficulties which it presents should be properly appreciated by laymen and administrators as well as by scientific workers. Since the laws upon which a country is governed are the work of the administration, the burden of responsibility for a failure to recognize and then deal with a state of affairs often aggravated if not produced by man himself rests with the administrators. Mr. Ratcliffe presents a very clear picture of the

existing conditions and position in the past of southern Australia. It is of interest to note that some of the photographs illustrating the pamphlet have a marked resemblance to parts of West Africa on the south Saharan borderland. It is impossible here to follow the author throughout his investigations, but they may be summarized.

Mr. Ratcliffe holds the theory that the soil drift in Australia is chiefly, if not solely in parts, due to the excessive utilization of the soil by man, chiefly stock; that, in other words, the drift is the result of the disintegration of the soil layers *in situ* into loose particles which thus produce in the end a desert; that these desert conditions are not produced, or even assisted to any material extent, by sand or particles blown from neighbouring desert areas. He admits that this latter is the theory of the local farmers, who speak of the 'encroaching sand' or 'encroaching desert'. The author apparently holds strongly to his theory of the local origin *sur place* of the sand or drift resulting from the gradual deterioration of the soil.

It is difficult to follow this theory. May there not be a certain amount of sand invasion on to good stock grounds from areas outside which are in various stages of degradation down to pure desert conditions—as, in fact, is well demonstrated in the Sahara? Is there any great or sharp distinction between areas containing what Mr. Ratcliffe terms soil drift in Australia and the lands in the immediate vicinity of the Sahara on which the soil is still capable of producing a vegetation of use to man and his animals, but which gradually becomes overlaid with an ever-thickening carpet of blown sand? Is not this a possible factor in Australia? It is difficult to credit the fact that in these deteriorating lands in South Australia the conversion to drift and aridity is practically entirely produced *sur place*, through the admittedly improvident actions of the occupiers of the land by excessive stock grazing and so forth.

The author, after a study of the literature on the problem of erosion elsewhere in the world, considers that "conditions in the Australian arid pastoral areas have no exact parallel elsewhere, and thus the problem of their deterioration must be tackled on its own merits". It is difficult to follow the argument. The resulting aridity leading up to desert conditions in several parts of the world is an outcome of the excessive activity of man and his wasteful utilization of the lands in question, with the inevitable result that the water supplies commence to become intermittent, and then cease, the spring water-level or the water-table sinking in the soil to a depth beyond its possible further utilization for his purposes. The ensuing conditions and their origin in modern times would appear to have a considerable similarity in the three regions of the globe already mentioned.

The remedies suggested by the author, with suitable modifications easily ascertainable in the region in question, appear equally applicable and called for in all. "Permanent pastoral settlement," says the author, "is only possible when the stocking is in equilibrium with the vegetation, and not merely exploiting plant capital"; and he urges the need for readjusting the stocking policy of the arid pastoral country. This is an equally pressing problem in parts of northern Nigeria and in the French Colonies bordering on the southern Sahara.

Geomorphology of the Irish Sea Basin

By Prof. J. Kaye Charlesworth

A MORNING session of Section C (Geology) at the meeting of the British Association at Blackpool was devoted to a discussion of the geomorphology of the Irish Sea Basin. Although the discussion brought out perhaps little that was new, it outlined the main features of the evolutionary development which, treated historically, may have a wider appeal.

The Irish Sea-basin had its beginnings in the remote geological past. The sediments of the geosynclinal sea, which during Lower Palæozoic times obliquely crossed the site of the present basin with shore-lines far beyond the present coasts to the north-west and south-east, were compressed into concertina and less acute folds at the close and elevated into a mountain system. At this remote date, the Irish Sea-basin appeared if only in shadowy outline, and there emerged the rim of mountains of hard rocks that, save in the Mournes then unborn, more or less surround the sea of to-day and exhibit in the trend of their valleys, ridges and geological strike lines, the north-east south-west Caledonian direction. The release of pressure probably initiated the tectonic

subsidence of the Solway Firth and its continuation south of Co. Down that subsequent movements were later to accentuate, and gave rise to cross fractures, such as those which opened the southern part of the North Channel and the depression of the Dundonald valley and Strangford Lough.

The Carboniferous Limestone sea which transgressed the Old Red Sandstone desert that followed these events was in some respects the prototype of the present Irish Sea ; its waters, as attested by shingle beaches, washed against the foot of the mountains of Down, Wicklow and Wales, the Lake District and the Isle of Man. The deltaic conditions that followed and led up to the Coal Measure swamps, with the aid of erosion, largely evened up the basin, so that at the end of the Coal Measure period probably but little of the elevations was left projecting. The succeeding American or Hercynian folding once again emphasized old tendencies and revivified the relief by doming the mountains along the old lines, as in Wales and Wicklow and the Lake District, where some of the Carboniferous Limestone doming must date from this time, and by dropping the rocks down along the periphery and re-opening posthumously the Caledonian fault-lines that ran north-west south-east.

The marine regressions and transgressions which, with their erosion and deposition, constitute the Mesozoic history of the basin doubtless re-fashioned this and partially effaced its earlier features. The close of the era indeed saw a plain emerge from the Cretaceous sea that was almost devoid of relief, though it was probably warped upwards over the sites of the ancient uplands and downwards over the Irish Sea and the Solway and Cheshire basins. The end of the Cretaceous is a datum-line of the utmost importance, for the present drainage, except in the region of the Tertiary igneous rocks of north-east Ireland, had its inception on the land-surface that then came into existence.

The Tertiary witnessed a further stage in the development of the basin as we know it. It saw the intrusion of the granites of the Mourne and Carlingford Mountains, which belatedly take their place in the enclosing rim. The foundering of the North Channel probably along its whole length and the opening of the Carlingford depression are of this date. Most important of all, however, the basin was the theatre of intermittent uplift. Periods of rest and planation are recorded in a number of peneplains which are beautifully developed throughout the basin. These periods were separated by others of downcutting and rejuvenation of rivers and of broad warping along the old lines when Wales and the Lake District, for example, were greatly domed and the Irish Sea floor between them and the Isle of Man was equally depressed. The planations still preserved to us include levels at about 1,800 ft., 600 ft., 400 ft. and 200 ft. above sea-level and, less certainly, at other heights. They seem to be later than the Tertiary igneous cycle of north-west Britain, for they cut across the igneous rocks in north-east Ireland and elsewhere intersect the dykes which extend from them. The last of the plains, of early Pliocene age, rises into the Central Plain of Ireland and extends through Co. Down and the coastal plains of Wicklow and Anglesey and underlies much of Cheshire and the Machars of Galloway. It was succeeded by still further uplift which enabled the rivers to cut gorges, now for the most part 'buried' or submerged. Towards the close of the Pliocene a reverse movement 'drowned' the lowest valleys and admitted the sea to a coastline which is still traceable in numerous places.

The Ice Age, the last chapter of this morphological history, did much to modify the topography which it inherited. Its glaciers sculptured the uplands, converted their V-shaped gorges into U-shaped valleys, hollowed out their floors into lakes, widened their heads into cwms and gave to the basin its only fiord, Carlingford Lough. The ice deposited its load as boulder-clay, drumlins, moraines and sands and gravels that mantle the plains and mask the Lias and Chalk which form much of the solid sea-bottom. It transformed the late Pliocene gorges into 'buried valleys', both within and without the present coast, concealed the preglacial shore-line along most of its length, and converted parts of the sea-floor into dry land, as in the Cheshire Plain, Vale of Clwyd, northern plain of the Isle of Man and the isthmus beneath Stranraer.

After the dissolution of the ice-sheets, the incoming temperate flora provided the forests which clothed so much of the surface when the sea was 100 ft. or more lower than now. A rise of the sea, due to general eustatic changes and to local movements of the crust, inundated these 'submerged forests' and isolated Ireland and the Isle of Man from Great Britain.

This age-long and never-ending evolution still continues. Running water is slowly paring down the land and dumping its detritus into the sea. The sea itself is wasting away the shores and silting up the bays and estuaries, and on-shore winds are piling up the dunes. The unstable ground is slowly tilting southwards, as is shown by the submergence of an occasional prehistoric site along the coast of Co. Cork and by the recent fine levellings of the Ordnance Survey in England.

Racial Theory and Genetic Ideas*

By Prof. H. J. Fleure, F.R.S.

THE newer concept of species makes it possible to consider both the origins of mankind and a classification of mankind in a new light freed from the limitation of requiring the sterility of crosses as a test of specific difference. The fact that human migrations from early times have had a scale, a range and a rapidity unknown among animals is another biological point of the first importance. We may give up both the view that mankind originated from a single pair or from a small group and the view that the different groups of mankind originated separately from prehuman ancestors. Rather should we picture groups of beings on the threshold of a full human status, with probably differences within the group as well as between groups, scattered over a wide area as more or less mobile collecting and hunting societies forming a sort of human network over a wide area of the Old World, stretching at least through North Africa and south-west Asia. The persons in different parts of the network would probably differ, but almost any part might contain individuals similar in many characters to individuals in other parts. With development of desertic conditions in North Africa and Arabia bringing increasing settlement near rivers, some degree of isolation and a high degree of long-continued local intermarriage developed, and no doubt different variations, at least some of them adaptive, occurred in different regions, so that:

(*a*) A number of small remnants of diverse early types remained, sometimes perhaps degenerate, as pigmies of the African and south-east Asiatic forests, as blackfellows in Australia and so on.

(*b*) African, Papuo-Melanesian, eastern Asiatic and north-western groups in the Old World became distinct, while drifts to America from eastern Asia added another chapter to the story. These may almost be called sub-species.

Characters, even those used in discussing so-called race types, are nearly always both genotypic and phenotypic. Stature is closely linked with environmental factors; nose-form may have some such link, perhaps an indirect one. A penetration of characters from the north into the Congo Forest shows that stature diminishes, more rapidly than nasal index increases, along the zone of penetration. It is most probable that hot, wet conditions and poor food have prevented higher stature from persisting, but it has apparently been more difficult to alter nose-form, so we get an aureole of fairly narrow-nosed people of short stature around the wedge of narrow-nosed taller people projecting into the forest.

Shaxby has shown that skin pigmentation changes gradually from the Sudan to near the Arctic Circle, where Scandinavia yields the Nordic type, as it is called. Similar points might be made in respect of other characters. Thus the pattern of the main mass of mankind in the Old World may be said to be one of transitions in some respects between certain 'standards' in Africa, Europe, Eastern Asia, Papuo-Melanesia.

A scheme based on transitions more or less under environmental influences is, however, not much more satisfactory than a purely geographical classification; for we cannot but be impressed by the fact that almost every population consists of disparate elements that reappear or persist side by side in a population generation after generation. We cannot treat an ordinary population as a unit to be described by giving means and standard deviations for each character. Those figures often are mere abstractions. We need to try to see how bundles of characters are grouped together, what bundles occur and seem to be transmitted as entities, and how the proportionate numbers with different bundles vary from district to district. For they do differ, and we can understand this better if we remember that each of us had, in theory, 32,768 ancestors about the time of the discovery of America, and 1,073,000,000 about the time of the Norman Conquest. As marriage was largely localized, and few rural areas with persistent intermarriage had a population of 32,000 in the fifteenth century, we realize how much branches of genealogical trees must intertwine, and so how possible it is for an element, a group of characters, that got into a locality long ago, through a good number of individuals, to go on century after century in spite of some intermixture with individuals from outside, provided it has not to work against a Mendelian dominant. Needless to say, the bundle of characters need not be, and is not, exhibited by every member of the local group, nor is any claim made that all members of the group are of strictly localized descent. We are dealing only with proportions of a population.

* Contribution to a joint discussion of Section D (Zoology) and Section H (Anthropology) on "Genetics and the Race Concept" at the Blackpool meeting of the British Association, on September 11.

Another necessary *caveat* is that the interpretation of differences between localities has to be done with great reserve unless we know from skeletons a fair amount about the back history of the district's population. Fortunately, as regards Egypt, we have the knowledge, from the work of Elliot Smith, Morant and others, that there has been a persistence of a bundle of physical characters from pre-dynastic days until ours. In Great Britain, in some areas once inhabited (*c.* 1900 B.C.) by the beaker-making people, the characters which distinguish their skulls are still found in certain cases among the modern population. In some areas of special isolation quite a number of people may carry and transmit a bundle of characters that seems associated with the very earliest population known from skeletal remains in Britain.

The recurrence of these bundles is more than can be accounted for by any estimate of the probability of recombinations occurring in the course of intermixture; persistence seems the more likely hypothesis and the linkage of characters in a bundle is fairly obviously a feature.

We are, then, dealing with bundles of characters inherited more or less as such; diverse bundles often existing side by side. Even an interbreeding population, therefore, need by no means form a unit, and averages may mislead seriously. A pure race with essentially uniform bundles of characters in all its members probably does not exist; indeed, it is better not to use the term race at all in view of its painful misapplication in political discussions as well as of its inherent biological difficulties attached to the use of this word.

Obituary

Sir Edwin Deller

THE death of Sir Edwin Deller has robbed the University of London not only of a great administrative head, but also of a man beloved by all who knew him well. He died on November 30, from injuries received in an accident at the new buildings of the University in Bloomsbury.

Born at Paignton in 1883, the son of a carpenter, Edwin Deller left school at the age of twelve years to begin work as an office boy. Even in early boyhood he dreamed of a career in London, and as a youth he sought and found work there. After a period of other employment he entered the offices of the Kent Education Committee as a clerk, having chosen that position in preference to a better-paid post in a commercial house. He studied law in evening classes at King's College, University College and the London School of Economics, and graduated LL.B. with honours in 1911.

It was in 1912, at the age of twenty-nine years, that Deller first entered the service of the University of London, as secretary to the academic registrar. There he remained until his death, apart from war service in the Inns of Court O.T.C. and a short period in 1920 as assistant secretary to the Royal Society. He was invited to return to the University as academic registrar, and he held that office from the beginning of 1921 until his appointment as principal of the University in the autumn of 1929. In 1916 he gained the degree of LL.D. with a thesis on "The Liberty of the Subject".

Both as academic registrar and as principal, Deller served the University in times of exceptional importance. The period of his registrarship was one of great growth in the schools of the University, while his principalship covered the critical years, from 1929 onwards, in which new statutes came into operation and a new constitutional body, the Court, exercised centralized control over finance. Furthermore, his years as principal saw the arduous beginning of the vast building scheme in Bloomsbury. In both posts he was brilliantly successful; and it is difficult to believe that any other than he could have achieved an equal measure of success.

Endowed with vigorous health and blessed by a supremely happy home life with his wife and son, Deller brought to every task and to every occasion a wealth of energy, ability and human quality which made him an ideal administrator. He possessed in an extraordinary degree the power of radiating good humour and diffusing goodwill; of reconciling differences by discovering the measure of common purpose existing in apparently conflicting aims; and of going straight to the heart of a subject, often finding a clear solution where others had seen only an obscure problem. He delighted in working with scholars and men of science. Himself a man of wide culture, he shared their ideals and understood their ways. But he was equally at home with men of affairs, and indeed with all sorts and conditions of men. He gained to a most remarkable degree the affection, not only of members of his own staff, but also of countless colleagues in the university world at large.

Deller owed and acknowledged special allegiance and gratitude to three men with whom he was very closely associated in his work: to Sir E. Cooper Perry, principal officer of the University from 1920 until 1926, who was an outstanding influence in his life; to Lord Macmillan, chairman of the University Court; and to Mr. Harold Claughton, now clerk of the Court, and formerly secretary to the Senate. The delight of constant association with Deller in the work of the University was something which had to be experienced to be believed. One who experienced

it for nearly three years recalls the daily talk with him (and one other colleague) about the work of yesterday and to-day, his irresistible sense of fun and extraordinary gift of sympathy, and his wise counsel and unfailing loyalty. It was easy to understand that in the Inns of Court O.T.C., where he had been a sergeant instructor, in the words of a comrade: "Recruits worshipped him, fellow N.C.O.'s loved him, officers valued and respected him".

In 1926 Deller visited the United States as the guest of the Laura Spelman Rockefeller Memorial. On his return he published under the title "Universities in the United States" some critical impressions which gained high praise in competent circles in America. He was deeply interested in American universities in relation to the community they serve; and the hospitality and friendship which he extended to visiting American scholars and administrators became proverbial. In 1927 he took a large part in the task of founding the British Institute in Paris; and up to the time of his death he served on the executive committee in London and on the educational committee, paying periodical visits to Paris and taking a keen interest in the progress of the Institute. He believed whole-heartedly in understanding and co-operation between France and Great Britain in general and between the universities of Paris and London in particular.

Many distinctions were conferred upon Sir Edwin Deller. One which he prized highly was his election as an honorary bencher of the Inner Temple in 1933. He was a fellow both of University College and of King's College. In 1932 he was made a Chevalier of the Legion of Honour "in recognition of his services in the cause of university relations between France and England". He was knighted in the New Year's Honours of 1935. T. F. S.

Prof. E. H. Kettle, F.R.S.

THE death of Prof. Kettle on December 1 is a serious loss to English pathology, coming as it has when he was at the height of his powers at the age of fifty-four years and when he had just got his department at the new British Postgraduate Medical School, London, well established and working productively. He was a London man, trained at St. Mary's Hospital, where he was afterwards on the teaching staff, going on to Cardiff in 1924, to St. Bartholomew's in 1927 and to his last post in 1934: he was elected into the Royal Society this year.

With Kettle goes one more of the disappearing race of general pathologists which the current specialization no longer produces, and he was an expert in bacteriology as well as morbid anatomy and ready to tackle any problem experimentally. Besides the ordinary contributions to knowledge which come from most laboratory workers, he will be remembered for suggestive work on the variation of the local inflammatory response to different bacteria and especially for his investigation, started originally with Dr. W. E. Gye, on the poisonous action of silica on the tissues and its relation to tuberculosis. This led him into the difficult field of industrial silicosis, which has in recent times turned out to be much more widespread and important than was at first supposed, and he showed clearly that it was the chemical character of the dusts rather than their mechanical irritation that determined the localization of tubercle bacilli which entered the body. Incidentally, he devised a very useful method of testing the potential danger of any industrial dust by animal experiment lasting a few weeks.

Hampered throughout life by a maimed leg and for the last ten years with recurrent and serious illness, Kettle never lost his buoyancy and his ready cheerfulness to teach his students and to guide young workers in the way they should go. He earned the respect of everyone and the affection of those who knew him well enough.

Rev. J. Gordon Hayes

THE Rev. James Gordon Hayes, Vicar of Storridge, near Malvern, died on November 21 in his sixtieth year. He devoted much attention to a critical study of the records of polar exploration and was the author of four outstanding books on the subject. In "Antarctica", published in 1928, he dealt with the natural features of the Antarctic continent and the journeys of explorers during the first quarter of the twentieth century. It was the result of a great amount of reading and gave an important comparison of the methods and results of modern explorers. This was followed in 1932 by a more distinctively historical work "The Conquest of the South Pole", designed as a continuation of Dr. H. R. Mill's "Siege of the South Pole" and showing deeper appreciation of the personal qualities of explorers than was apparent in the earlier work. The other two books, relating to north polar exploration, were "Robert Edwin Peary", an endeavour to show the improbability of that explorer having reached the pole, and "The Conquest of the North Pole", a well-balanced summary of Arctic exploration in the twentieth century.

Mr. Gordon Hayes, who had been a civil engineer before he entered the Church and had taken honours in history at Cambridge, was engaged on a work on Napoleon as a statesman at the time when the progress of his fatal illness put a stop to his labours. He was a tireless worker, an enthusiastic seeker after truth in all quarters, and a warm friend of all interested in polar exploration, by whom his cheery companionship will be much missed. H. R. M.

We regret to announce the following deaths:

Dr. J. K. Fotheringham, F.B.A., reader in ancient astronomy and chronology in the University of Oxford, on December 12, aged sixty-two years.

Sir Herbert Jackson, K.C.B., F.R.S., formerly director of the British Scientific Instrument Research Association, on December 10, aged seventy-three years.

Dr. A. A. Robb, F.R.S., author of works on aspects of relativity, on December 14, aged sixty-three years.

News and Views

John Maurice, Count of Brühl (1736–1809)

THE bicentenary of the birth of John Maurice, Count of Brühl, recalls an interesting figure in the history of science in Great Britain in the eighteenth century. Born at Wiederau in Saxony on December 20, 1736, he studied at Leipzig, and at the age of nineteen years entered the Saxon diplomatic service and was sent to Paris. In 1759 he was transferred to Warsaw, and five years later, when but twenty-eight years of age, was appointed ambassador extraordinary to the Court of St. James. From the time of taking up his appointment in 1764, save for one journey abroad in 1785, he continued to live in England for the remainder of his life, and died at his house in Old Burlington Street, W.1, on June 9, 1809. He was devoted to astronomy, and effectively promoted its interests. Through his influence, von Zach, who was a tutor in his family in 1783, became an astronomer and assisted Brühl in determining the latitude and longitude of Brussels, Frankfort, Dresden and Paris. He patronized the chronometer makers Mudge and Emery, wrote on time-keepers, was intimate with Herschel and delighted in transmitting abroad the discoveries made by him and others through the medium of Bode's "Jahrbuch". At his villa at Harefield about 1787, he built a small observatory, and a few years later equipped it with one of the first astronomical circles constructed by Ramsden.

Mr. A. B. MacDowall

A FREQUENT correspondent to NATURE about a generation ago was Mr. Alexander Baird MacDowall, who completed his ninety-third year on December 18. Mr. MacDowall was particularly interested in terrestrial and solar meteorology and the relationships between them, and most of his communications to these columns and to the Royal Meteorological Society dealt with this subject. The methods used by him, and some of the results, are typically illustrated in a small book published in 1895 with the title "Weather and Disease: a Curve History of their Variations". In this volume Mr. MacDowall showed, by means of graphs, the variations which certain elements of the weather and the mortality from certain diseases had undergone in the course of years. The mode of representation adopted by him was that commonly used at the time to illustrate the relation between two variables, the curves being subjected to a process of smoothing so as to record the averages of five or ten consecutive values.

IN a paper to the Royal Meteorological Society on April 21, 1897, Mr. MacDowall used this method of smoothed curves to make a comparison of weather statistics with the sunspot cycle, and was led to conclude that "In the climate of Western Europe there is apparently a tendency to greater heat in the summer half and to greater cold in the winter half near the phases of minimum sunspots than near the phases of maximum." Though the curve correspondences used by Mr. MacDowall and others to reveal periodicities have since been superseded by the periodogram and the statistical method of correlation, they were suggestive and represented a helpful stage in the understanding of meteorological relationships. Mr. MacDowall was a student at the Old College in High Street, Glasgow, under Prof. Thomson (afterwards Lord Kelvin), who influenced his whole subsequent career. After leaving Glasgow, he went to Berlin for a time and then voyaged to Australia and back in a sailing ship. He next settled in London and embarked upon a career of general journalism, working at the British Museum and the Patent Office. At that time he met Thomas Carlyle and became acquainted with D. E. Hughes, inventor of the microphone. In later years he has lived more or less in retirement and at present resides at Rothesay, Isle of Bute, where, in spite of his advanced age, he still retains active interest in scientific subjects.

Cultural Origins in Central America

NOTWITHSTANDING numerous attempts continued over a long period of years to trace the prehistoric civilization of Central America to its origins, the ancestral forms, especially of the culture of the Maya, remain obscure. It is now reported that a substantial advance towards a solution of this problem has been made by a joint archæological expedition to Yucatan of the Peabody Museum and the Smithsonian Institution of Washington, which has excavated a stratified site on the Ulua River, known locally as the "Beaches of the Dead". This site, the second only of the recorded stratified sites in this part of the world, lies on the fringe of the Mayan area. It has been known since 1929, when Mrs. Dorothy M. Popence was lowered by ropes into the channel which has been cut by the river through the deposits to collect skeletal material which had been washed out with potsherds and other debris from the culture-bearing strata. Dr. W. D. Strong, who is in charge of the expedition, now reports to the Smithsonian Institution the discovery at a depth of twenty feet of house-floors, refuse heaps and pottery fragments incised or painted in monochrome with designs which, though less elaborate, suggest an early Mayan type. Overlying this culture is a deposit of sterile clay, six and a half feet thick, and above this again is a deposit of burials and potsherds typically Mayan in character. The intervening cultural and chronological gap is partially filled by a culture from a site on the tributary Comayagua River, where an apparently transitional stage affords pottery of Mayan type that seems to shade into the "Beaches of the

Dead" style. On the evidence of its precedence in time and its similar but simpler character, it is suggested that the "Beaches of the Dead" type may be ancestral to the Maya style. Posthumous distortion has destroyed the evidential value of the skeletal material, beyond an indication of a general physical resemblance to the type of the Maya people.

Mosquito Control and Local Authorities

REFERENCE has been made in these columns on a number of occasions to the valuable work on mosquitoes and their control carried on by Mr. J. F. Marshall at the British Mosquito Control Institute, Hayling Island, Hampshire. The Institute was built and equipped by Mr. Marshall in 1925, and has become an important advisory and educational centre, which has been maintained almost entirely by him. Before he began his work, Hayling Island was infested with the salt-marsh mosquito and other species, but by dealing systematically with the breeding-places these pests have almost disappeared from the island. Experience has shown, however, that inspection and other control measures cannot be allowed to lapse if they are to be of practical value. This is evidently realized by the Havant and Waterloo District Council, which, in a Bill being presented to Parliament, includes a clause giving powers to the Council to "subscribe or contribute such sums as they may think fit to the British Mosquito Control Institute so long as that Institute shall remain established at Hayling Island and the Council shall consider its work contributory to the freeing of the district from mosquitoes".

HITHERTO, consent of the owners of property has had to be obtained to examine an area suspected to contain breeding places of mosquitoes or to deal with it suitably. The Bill mentioned above empowers the local council to take whatever action it may consider necessary for health's sake to inspect such areas or carry out measures of mosquito control. The clause relating to these powers reads as follows : "The Council may take all reasonable measures to make and keep the district free from mosquitos and with this object they may in particular (apart from any other measures)—(*a*) enter by their officers upon any premises which they have reasonable grounds for suspecting to be a breeding place for mosquitos and apply thereon any tests or examination for the purpose of discovering whether and to what extent mosquitos or their larvæ are there ; (*b*) require the owner of any premises upon which there is stagnant water or marshy ground which is a haunt or breeding place for mosquitos or contains the larvæ of mosquitos to drain the site of such water or such marshy ground to the reasonable satisfaction of the Council and to apply thereto such other treatment (if any) as the Council may reasonably prescribe." The inclusion of this clause in the Bill shows that the Council not only realizes the existence of mosquito pests but also the practicability of dealing with them by measures which have been successfully adopted during the past eleven years or so by Mr. Marshall as director of the British Mosquito Control Institute.

Exhibition of Electric Illumination

THE Science Museum is holding a Special Exhibition of Electric Illumination, which will remain open until April 25, 1937. Push-button demonstrations illustrate the principles involved in illuminating engineering practice, such as various types of reflection and transmission of light, reflection factors, effects of contrast, etc. Two full-sized rooms are devoted to decorative lighting and standard lighting system definitions. The great advances made in tungsten filament lamps are illustrated by exhibits showing the control now exercised during manufacture. The electric discharge lamp is dealt with in detail. Apart from examples of discharge lamps and their application to street lighting, industrial lighting and floodlighting, there are exhibits illustrating the cyclical form of the discharge and stroboscopic applications. All types from low-pressure tubes to water-cooled quartz tubes operating at 8,000° C. are shown. The phenomenon of luminescence, discovered by Crookes in 1879 and now applied to discharge lamps, is shown in considerable detail. By way of contrast, a concise historical exhibit illustrates the state of illumination technique through the ages. The exhibition has been arranged by Mr. W. T. O'Dea, of the Science Museum, with the assistance of the E.L.M.A. Lighting Service Bureau and an advisory committee under the chairmanship of Mr. C. Rodgers.

THE opening ceremony was performed on December 15 by Lord Rutherford, with Sir Henry Lyons, the chairman of the Science Museum Advisory Council and a past director of the Museum, in the chair. Lord Rutherford remarked that the subject is one which has interested him all his life. During the past ten years, there have been remarkable advances in illumination which, emanating as they have from pure science research undertaken in industrial laboratories, illustrate admirably the close relationship between science and industry. 80 candle-hours ten years ago cost the same as 300 candle-hours to-day, and this improvement happily comes at a time when it is really wanted in the cause of road safety. Some 25,000 hot cathode discharge lamps now illuminate 1,000 miles of road in Great Britain alone. With regard to modern developments in the application of the phenomenon of luminescence, Lord Rutherford said he hopes to live to see the time when we shall obtain light without filaments or electrodes simply by the conversion of invisible radiation. Mr. H. T. Young, president of the Institution of Electrical Engineers, in proposing a vote of thanks, mentioned the valuable educational work which can be done by such an exhibition ; it is expected that the exhibition will attract a quarter of a million visitors.

Modern Views on Infection and Disinfection

THIS was the subject of a Chadwick lecture delivered by Sir Weldon Dalrymple Champneys at Manson House, London, on December 9. Microbial diseases, he said, can be defined as a disturbance of health in man or other living things due to

the presence of parasitic organisms, as a disturbance of the equilibrium between host and parasite unfavourable to the host. The reactions of any host to the presence of pathogenic organisms are numerous and complex, but are not mutually exclusive. Thus, the parasite may be rapidly killed by defensive mechanisms of the host's body, without giving rise to any symptoms of disease, or it may cause a local reaction known as inflammation. Fever is also a common result of infection, and tends to be a protective mechanism. Sir Weldon dwelt on the fact that a 'carrier state' may be established either following illness with apparent recovery without complete destruction of the invading parasite, or in consequence of a 'silent' infection without actual disease.

THE manner in which infecting parasites gain access to the body was then dealt with, the two commonest portals of entry being the skin and the nose and mouth. Infection may enter through the nose or mouth by the inhalation of infected droplets in the breath of patients or carriers, as with measles, influenza and others, or by swallowing infected food or drink, as in cholera and typhoid fever. The importance of the carrier state as a cause of cases or epidemics of infectious diseases was emphasized, and reference was made to the fact that different diseases may be caused by the same organism. For example, scarlet fever, tonsillitis, puerperal fever and probably acute rheumatism are all caused by various hæmolytic streptococci. In conclusion, Sir Weldon discussed measures of disinfection and prevention, and in regard to 'current' and 'terminal' disinfection, pointed out that treatment of infective material in the sick room during the patient's presence there ('current disinfection') is all that is necessary with most diseases. 'Terminal disinfection' after recovery or removal of the patient, upon which until recent years most reliance has been placed, is needless, and may be confined to the free use of soap and water with thorough ventilation.

Discoveries in Antarctica

A DISPATCH from the British Graham Land Expedition under the leadership of Mr. J. Rymill published in *The Times* of December 12 announces an important change in the map of Graham Land. In December 1928 Sir Hubert Wilkins in his flight over Graham Land reported the existence of two straits, Casey Channel and Stefansson Strait, in about latitudes 69° 45′ S. and 71° S. respectively, across the area known as Graham Land which previously was thought to be united to the Antarctic Continent. Between the two straits he mapped roughly the Finley Archipelago. The British expedition, sledging along the west coast of Graham Land, to lat. 72° S., long. 67° W., or ninety miles south-west of where Sir H. Wilkins turned, found no trace of these two straits and believes that low glaciers must have been mistaken for ice-covered straits. Thus Graham Land south of Crane Channel in the Antarctic Circle is restored to its former continuity with the continent. A further discovery of importance is that Alexander I Land, discovered by Bellingshausen in 1821 and sighted by Charcot in 1909, is not a small island but a large land area at least two hundred and fifty miles from north to south and separated from Hearst Land by an ice-filled cleft-like strait fifteen miles wide and 200 miles long. The expedition charted the eastern coast line of this island. The strait appears to be a fault feature with the eruptive rocks of Graham Land on the east and fossiliferous sedimentary rocks on the west or island side.

Hooker's Work on Lapachol and Related Compounds

THE yellow crystalline pigment lapachol, found in Bethabarra wood (from West Africa) as well as in several South American timbers, provided the late Dr. S. C. Hooker, the eminent American sugar technologist, with an absorbing problem in chemical structure which lasted a lifetime and has given us an admirable model of chemical research, based upon highly skilled technique, close observation, patience and careful deduction. The publication during the present year of no fewer than eleven posthumous papers by Dr. Hooker in the *American Chemical Journal* after a silence of forty years must have come as a complete surprise to organic chemists. But the work to which Dr. Hooker was so devotedly attached was interrupted by his long period of activity in industry. On his retirement in 1915, he resumed the problems which had remained untouched since 1896, and he was reluctant to publish prematurely the numerous results which he was able to collect in the last twenty years of his life.

HOOKER was born in Kent of British parents, but after studying in London under Japp and at Munich under Bamberger, with whom he undertook the investigation of retene, he migrated to the United States. His published work contains an account of the properties and structure of lapachol and of many closely allied compounds. Many of his results were obtained by close observation of minute samples under a microscope. Lapachol is a β-amylene β-hydroxy α-naphthoquinone, which undergoes isomerism with mineral acids into lapachone, involving ring-closure with the hydroxy-group and sometimes also change to the orthoquinone structure. But further structural changes of an unusual type are readily induced and we cannot fail to admire the skill with which he solved the problems of change of structure from the *p*-quinone to the *o*-quinone type, of the exact location of the double bond in the amylene group and of the mechanism of the process of oxidation, whereby the quinone-ring is first broken with elimination of carbon dioxide and then re-formed from the side-chain, in such a way that the next lower homologue of the original compound is formed. A memorial volume containing an obituary notice from the *Journal of the Chemical Society*, together with reprints of twenty-two memoirs from the same journal and the *Journal of the American Chemical Society*, has been edited by Prof. L. F. Fieser of the Converse Memorial Laboratory, Harvard University, to whom application may be made for copies.

Saints and Martyrs

IN a lecture of this title recently delivered at the London Hospital and published in the *Lancet* of November 7, Dr. Donald Hunter, physician to the Hospital, remarks that the world to-day is too busy applauding successful military commanders, popular orators and authors to recognize that all its material advance has been achieved by men of science. He quoted numerous instances of scientific and medical men who were distinguished by having met dangers and often death for the sake of their work. In the first place he showed how our knowledge of toxic gases owed much to the self-sacrifice of pioneer workers, as in the cases of Gehlen, a Munich chemist, and Dr. K. C. Shierbeck, of Copenhagen, whose deaths in 1815 and 1920 respectively were due to arseniuretted hydrogen. In like manner, nitrous oxide proved fatal to Dr. S. R. Wilson in 1927, and hydrofluoric acid to Louyet and Nickles in 1869. In addition to numerous deaths among doctors and nurses due to attending patients suffering from acute infectious diseases, many laboratory workers have lost their lives in the investigation of certain dangerous tropical diseases, especially yellow fever, following experimental mosquito bites, as in the case of Lazear in 1900 and Walter Myers in 1901, pneumonic plague (T. C. Parkinson, 1909), verrugas (D. A. Carrion) and kala azar (W. R. Pirie). Numerous injuries and deaths from X-rays after many years of suffering occurred in radiologists before efficient means of protection were discovered, while it is not yet practicable to protect completely those who handle radioactive substances.

Work of the Meteorological Office

THE annual report of the director of the Meteorological Office for the year ending March 31, 1936 (H.M. Stationery Office, 1*s*. net), describes the work done by that Office in its eighty-first year. Military operations are now so dependent upon the help of organized meteorology that an atmosphere of suspicion, merely, between European nations causes repercussions that affect the development of meteorology. In the year under review the Royal Air Force expanded: the Meteorological Office did likewise. Early in October 1935, an Overseas Division was formed to deal with Empire air routes, including the projected trans-Atlantic routes and the Empire air mail scheme. In addition, new stations were opened during the year at Aden, Khartoum and Gibraltar. As additional trained staff could not at once be produced to meet the emergency, the staff at headquarters and some out-stations in Great Britain had to be drawn on for service abroad, in spite of the general increase of work at home, which was augmented by the decision to carry out the scheme of grading and pay recommended by the Committee on the Staffs of Government Scientific Establishments presided over by Sir Harold Carpenter. These activities were not, however, allowed to prevent proper attention being given to two important conferences, the Empire Conference of August 1935 held in London and the International Conference of the following month in Warsaw. The Empire Conference met for discussion of research; the subjects for discussion were set out in sixty-eight memoranda. The International Conference was a gathering of directors of meteorological services, which among other achievements arrived at a uniform system of construction of synoptic weather maps—a valuable aid to international co-operation. The year's changes included also the setting up of an Overseas Division and the introduction in the official library on January 1, 1936, of a revised classification of meteorological literature based on that employed by the International Institute for Documentation.

Overhead Line Insulators

IN a paper read to the Students' Section of the Institution of Electrical Engineers on November 30, Mr. C. H. W. Clark discussed the design, manufacture and testing of overhead line insulators. It is generally considered that 500,000 volts is the most economical pressure at which to transmit large quantities of electrical energy over long distances. The best material for insulating these lines has been found to be porcelain, as its insulating qualities remain practically the same when exposed to all weather conditions. It has low tensile strength but considerable compressive strength, and so most types of insulator are designed to utilize the porcelain in compression. Electrical failure follows a puncture through the porcelain or by 'flash-over' round its surface, which produces an arc short-circuiting the line. As puncture destroys the insulator, it is more serious than flash-over. Insulators are designed with a puncture voltage of about twelve times and a flash-over voltage of about six times the working voltage. Failures occurring in practice are usually due to lightning or to deposits of soot or sea salt on the insulator surface. Lightning affects the design of the transmission line rather than that of the insulators. Often no permanent damage is done by lightning flash-over. The problem of deposits on the surface of the insulators is a serious one and has not yet been completely solved, although many suggestions have been made for improving the standard types. For use near the sea, anti-deposit insulators have long, recessed, protected surfaces. For industrial areas, types with open exposed surfaces which can be cleaned by wind and rain have proved the best. For testing purposes, a percentage of the finished insulators are selected at random and tested for flash-over voltage both dry and in rain (produced artificially by a watering pot), impulse flash-over voltage, mechanical strength and electrical puncture.

Activities of the Imperial Agricultural Bureaux

THE seventh annual report (1935–36) of the Executive Council of the Imperial Agricultural Bureaux has now been published (London: H.M. Stationery Office, 5*s*.). In view of the British Commonwealth Scientific Conference held in London this September, the volume is somewhat fuller than

usual. Particular interest will perhaps be found in the individual reports of the several institutes and bureaux, where abundant illustration is afforded of the value now attached to them by the number and diversity of the inquiries sent from all parts of the Empire, quite apart from their regular work of preparing and distributing abstract journals. Research workers in South Africa, Queensland, Sierra Leone, Cyprus, Mauritius, Victoria, India, northern England and the Gold Coast have asked for and obtained assistance from the Mycological Institute in the identification of fungi. At the Entomological Institute, insects from every country in the Empire have been received for identification. Other bureaux have assisted in obtaining material for plant breeding work, in supplying seeds, in arranging for the analysis of foodstuffs; whilst the laboratory attached to the Imperial Institute of Entomology collected and sent to Canada nearly three million parasites to aid in controlling the insect pests which were attacking the forests in Quebec and the Maritime Provinces. In fact, the report marks for the seventh year the success of an Imperial service, organized on a co-operative basis and directly controlled by representatives of all parts of the Commonwealth.

Rock Gardening

THE art of growing plants among rocks disposed artistically is, perhaps, the highest form of gardening. It calls forth skill of an exceptional order, and provides a medium for expression of the highest sense of art. The Royal Horticultural Society and the Alpine Garden Society are therefore to be congratulated upon their very successful joint organization of a conference on rock garden matters, and an exhibition of tasteful grouping of alpine plants. The deliberations of this Conference, which took place at the Greycoat Street Hall on May 5–7, 1936, have now been published in book form by the Royal Horticultural Society ("Rock Gardens and Rock Plants." London: from the Office of the Society, Vincent Square, S.W.1, pp. 171, 6*s*. net, 1936). Mr. F. J. Chittenden has edited this report of proceedings. Practical considerations were well to the fore. The utilization of natural slopes and of flat sites, the cultivation of difficult alpine plants, methods of propagation, the use of an alpine house, and other problems, were discussed. The history of rock gardens was outlined, and a very pleasing international atmosphere was introduced by the speakers who described rock gardening in South Africa (Miss Stanford), in Quebec (Mr. Cleveland Morgan) and in Southern California (Mr. W. Hertrich). The impression gained from the volume is that the artistic side of rock gardening could scarcely be improved, and that present-day practice is enlightened and highly skilled. There are abundant indications, however, in the papers and in the energetic and constructive discussion which followed them, that there is a field where a sympathetic man of science, working upon rock-garden problems, might furnish great contributions to practice, and satisfy many botanical questions which must at present be left unanswered.

Forestry in British Honduras

THE report of the Forest Trust of British Honduras to the end of December 1934 (Belsize: Govt. Printer, 1935) shows some progress in forestry work after the severe experiences following the 1931 financial crisis. From the Colonial Development Fund grants were made towards forest development in the Colony. The chief of these grants was to provide the staff to undertake a forest resources survey of the country, provided that the local Government contributed towards the cost and that the officer seconded for the work was replaced on the executive staff by an additional officer. The step so taken furnishes evidence of a broad vision on the part of the officials forming the Forest Trust. The term 'research work' accorded to what is mainly ordinary stock mapping of a forest—the work, or part of it, of the trained forest officer—is rather out of place, if not misleading. The staff of the Department, consisting of three gazetted officers, is still too small to make any considerable advance in executive forestry work a possibility. It is not therefore surprising to find in the Report such remarks as "No new reserves have been created"; "No new demarcation work was undertaken"; and, in spite of the magnificent start made in the early years of this young Department, that "No sylvicultural work has been done since the completion of the mahogany improvements in 1931". The end of the year 1934, which appears very distant at the present day, seemed to show an upward tendency in a timber trade revival. It was estimated by the Trust that the export of mahogany, that magnificent forest product of the British Honduras forests, would not exceed five or six million board feet per annum in the immediate future, and that a large proportion of that export would be in lumber form.

Exhibition of Microscopes

MESSRS. W. WATSON AND SONS, LTD., held their fourth exhibition of microscopes at the Central Hall, Westminster, on December 7–11, when the manifold uses of the microscope were practically illustrated, and many different types of instrument were on view. Members of the Quekett Microscopical Club were helpful in explaining points of interest to the scientific microscopist and instilling enthusiasm for microscopy in the amateur. A large number of different microscopes, from the comparatively simple student's microscope to the more intricate type used for research purposes, was on view. Other apparatus being demonstrated included photomicrographic and other cameras, dyes and stains, dissecting instruments, micro-projectors, telescopes, and other optical instruments. Messrs. Chance Bros. supplied an exhibition of glass in various stages from the rough mass to the finished optical lens. Messrs. Kodak also had an exhibition, as also had Polarisers, Ltd. A catalogue of the exhibition forms a useful guide to scientific workers in the many branches of science in which the microscope is indispensable and also to the amateur microscopist. The catalogue can be obtained from Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C.1.

New Tests for Milk

THE Minister of Health has issued a pamphlet giving directions for carrying out tests to ascertain whether milks entitled to be called 'tuberculin tested', 'accredited' or 'pasteurized' comply with the prescribed standards for the bacterial content of such milks. These standards indicate the cleanliness and keeping qualities of the milk (Bacteriological Tests for Graded Milk (Revised Memorandum 139/Foods. London: H.M. Stationery Office. 3*d*.). Since June 1, 'tuberculin tested' milk has taken the place of 'certified' and 'Grade A (Tuberculin Tested)' milks; and 'Accredited Milk' that of 'Grade A' milk. In place of the previous 'plate-count' test, a new test, the methylene blue reduction test, will be applicable to these milks from January 1, and as before, there is a test for the presence of coliform bacilli. Pasteurized milk, whether 'tuberculin tested' milk or not, must comply with a 'plate-count' test. Full directions are given for carrying out these tests, and the pamphlet also explains how samples should be collected.

Marine Boring Animals

THE damage which may be done to submerged structures of both wood and stone by marine boring organisms is a subject of not only general interest but also of extreme economic importance. In 1919, therefore, the Trustees of the British Museum caused a general account of the habits and life-histories of these organisms to be prepared which, it was hoped, would prove useful to both zoologists and marine engineers. This hope has been amply fulfilled, and the Trustees have now issued a revised edition of the pamphlet incorporating the additions to our knowledge of marine borers which have been made since the publication first appeared (Marine Boring Animals injurious to Submerged Structures. By W. T. Calman. Second edition; revised by G. I. Crawford. British Museum (Natural History), 1936. 1*s*.).

Announcements

AT the annual meeting of the Royal Agricultural Society of England held on December 9, the Right Hon. Walter Elliot, a former Minister of Agriculture and now Secretary of State for Scotland, was presented with a certificate and badge of honorary life governorship of the Society. In the report presented at the meeting it is stated that the Society's Gold Medal and honorary membership for distinguished services to agriculture has this year been presented to Sir William Cecil Dampier. For some years Sir William has devoted his energies to the organization and development of agricultural research. He was the first secretary of the Agricultural Research Council and steered that body to success through its early difficult years.

AN important experiment in the prevention of malaria, according to the Soviet Union Year Book Press Service, was recently carried out by the Sanitary Department of the Central Asiatic Military District. Before the autumn manœuvres, every soldier was given a dose of acraquinine for several days, and although the manœuvres took place in malaria-infested districts and there were cases of bites by malaria-carrying mosquitoes, not a single case of malaria occurred.

THE Royal Statistical Society offers the Frances Wood Memorial prize, value £30, for competition in 1937. The prize is offered for the best investigation, on statistical lines, of any problem affecting the economic or social conditions of the people. Further information can be obtained from the honorary secretaries of the Royal Statistical Society, 4 Portugal Street, W.C.2.

ERRATUM.—In the note on p. 1003 in NATURE of December 12, Sir Robert Mond should have been described as president of the French Society of Chemical Industry and not as "past-president".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Technical officer at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (December 26).

Civilian engineer in the War Department—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (December 31).

Principal of Newport Technical College—The Director of Education, Education Offices, Charles Street, Newport, Mon. (December 31).

Assistant in the Art and Ethnographical Department of the Royal Scottish Museum, Edinburgh—The Director (December 31).

Research assistant in botany in University College, Exeter—The Registrar (December 31).

Assistant physicist in the Royal Cancer Hospital (Free), Fulham Road, London, S.W.3 (January 1).

Lecturer in chemistry, botany and zoology in the Technical College, Doncaster—The Secretary (January 2).

Head of the Chemistry Department of the Derby Technical College—Clerk to the Governors, Technical College, Green Lane, Derby (January 9).

Lecturer in native administration in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (January 15).

Research worker in nutrition in the Medical Research Department of the Government of India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (January 15).

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Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1060.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Liquid Crystalline Substances from Virus-infected Plants

STANLEY[1] has described the preparation of a crystalline protein possessing the properties of tobacco mosaic virus from the sap of infected tobacco and tomato plants. The crystals were small needles made by precipitation with acid ammonium sulphate. We have confirmed these results, but have found that by further purification the protein in neutral aqueous solution can be obtained in liquid crystalline states.

FIG. 1. Wake of a goldfish swimming in a dilute solution of protein from infected sap (observed between crossed nicols). *Photo by Ramsey and Muspratt.*

The sap of tobacco and tomato plants infected with strains of tobacco mosaic virus, after clarification by centrifuging, contains five to ten times as much protein as sap from similarly treated uninfected plants. This extra protein can be precipitated from dilute salt solutions at around *p*H 3·4 and from neutral solutions with from 10 to 12 per cent ammonium sulphate. The protein in uninfected sap is not precipitated under these conditions. Using these properties, 1–2 gm. of protein can be isolated from a litre of sap; the yield varying with the age of the infected plant and the duration of infection. No enzyme preparation has yet been found which can attack the protein at an appreciable rate, and some impurities can be conveniently removed by incubation with trypsin.

We have worked with three strains of tobacco mosaic virus, those causing common tobacco mosaic, aucuba mosaic and enation mosaic. No gross chemical or physical differences have been found between the three proteins isolated, but each reproduces its characteristic disease when inoculated to susceptible plants. Differences in detail, which will be described in a later publication, have been noticed. Solutions of the protein are antigenic, and the antisera produced in rabbits give specific precipitates with 1 c.c. of solution containing 10^{-7} gm. The three proteins are serologically related. Plants inoculated with 1 c.c. containing 10^{-9} gm. usually become infected, and occasional infections have followed inoculations of 10^{-11} gm.

These proteins, when precipitated with acid and dried, have the usual analytical figures: C 51 per cent, H 7·1 per cent, N 16·7 per cent. The sulphur contents vary from 0·2 to 0·7 per cent and there is 0·5 per cent phosphorus and 2·5 per cent carbohydrate. The last two constituents can be isolated as nucleic acid of the ribose type from protein denatured by heating. Neutral aqueous solutions of the proteins are almost colourless and faintly opalescent. The protein sediments in a centrifugal field of 23,000 times gravity at about 5 mm. per hour and is deposited as a very viscous layer containing up to 30 per cent of dry matter. Highly purified protein solutions, if stronger than 2 per cent, separate into two layers on standing. The lower layer, which may be water clear, is liquid crystalline. The birefringence depends on the concentration, but may rise to 0·002. The upper layer shows, on gentle agitation, the phenomenon of anisotropy of flow. This was noticed by Takahashi[2] in clarified sap. We have, however, been unable to confirm his later claim that the effect could be observed in healthy tobacco sap. The orientation will persist for several seconds in purified solutions, but if the solutions are impure or dilute the persistence is much shorter. This effect is illustrated in Fig. 1, where the wake of a goldfish swimming in a dilute solution is clearly shown; the cross of isocline will be noticed in the eddies.

Solutions can readily be orientated by electric currents, but not by magnetic fields of 6,000 gauss. The lower layer orientates itself by flow like the top layer and also tends to orientate parallel to glass or air surfaces. On flowing through small capillary tubes it can be thrown into a state of reversed spiral vibration[3]. When small portions of lower layer are in equilibrium with the top liquid, they appear as spindle-shaped bodies (see Fig. 2) which are characterized by an approximately constant meridional curvature. Large spindles are consequently nearly spherical and small ones practically linear. On standing there appear holes, filled with top liquid, of

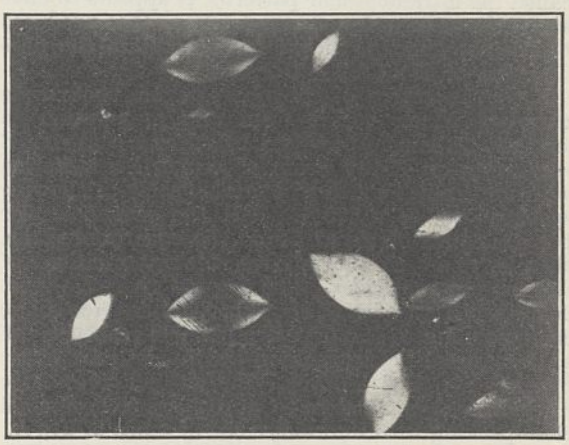

FIG. 2. Highly purified protein from infected sap, when stronger than 2 per cent, separates into two layers on standing. If there is very little of the lower layer, it arranges itself in spindles. Photographed between crossed nicols, × 30.

precisely the same spindle shape. All these phenomena indicate the presence of long fibres.

If any of these liquids be allowed to dry, a film forms on the surface consisting of three sharply distinguishable layers. The first formed is an extremely soft gel well orientated and with much higher birefringence, 0·007, than the liquid. The outer part of this wet gel shrinks by 50 per cent and forms a layer of higher refractive index, but lower birefringence, 0·003. Finally, on placing in air, extensive cracks appear in this dry gel and it becomes translucent and rather feebly doubly refractive. The dry gel is usually well-orientated but in certain conditions shrinks longitudinally to give a herring bone pattern, which indicates that little longitudinal shrinkage of the fibres themselves takes place.

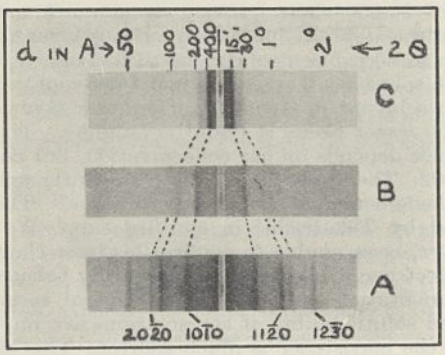

FIG. 3. X-ray patterns of dry gel (*A*), wet gel (*B*) and 13 per cent solution (*C*).

The X-ray patterns of these different forms show remarkable similarities and differences. For the large angle scattering there appears to be little difference, except in general intensity, between patterns given by all the different forms from the top liquid, orientated by flow in a Lindemann glass capillary, to the dry gel and the 'crystals', from ammonium sulphate solutions. This pattern is therefore entirely due to the protein molecules themselves and may be called the intramolecular pattern. It appears to have about the same order of complexity as that produced by feather keratin, with a repeat unit in the fibre direction of $3 \times 22{\cdot}2 \pm 0{\cdot}2$ A.

Near the centre of the photographs, spots were observed which varied from one preparation to another. A camera of 40 cm. length was constructed employing an X-ray beam of copper-$K\alpha$ radiation with an angular width of 3′ and capable of showing spacings up to 1,200 A. All the intermolecular pattern so far observed lies in the equatorial plane, that is, refers to the relative sideway positions of the rod-like molecules. The dry gel gives the most definite pattern (Fig. 3) showing five lines (see table) corresponding to the first five possible reflections of a hexagonal close-packing with intermolecular distance of $152{\cdot}0 \pm 0{\cdot}5$ A. The wet gel gives three distinct lines which seem to correspond to hexagonal close-packing with intermolecular distance of 210 A., but this varies slightly with the composition. The bottom layer liquid gives a pattern of three lines; two sharp lines the position of which depends on concentration, indicating a mean molecular distance ranging from 300 A. to 470 A., and a diffuse line at a spacing of 100 A. which is independent of the concentration and is thus plainly of intramolecular origin. The pattern of the liquid suggests that there exists a quasi-regular Debye-Hückel arrangement of parallel rod-like charged molecules in the solution. The sharp difference between the wet and dry gel can best be explained at the present stage by postulating somewhat triangular molecules that fit together in two ways, containing different amounts of water. The reflection at 100 A. supports this hypothesis. So far it has proved impossible to get any indication of intermolecular reflections in the other directions of the molecule, though any regularity of less than 1,200 A. would have been detected. This suggests strongly that the arrangement is regular only in cross-section and that no molecular sheets are formed.

OBSERVED INTERMOLECULAR SPACINGS IN ANGSTROMS.

h k i l	10$\bar{1}$0	11$\bar{2}$0	20$\bar{2}$0	12$\bar{3}$0	30$\bar{3}$0
Dry gel : obs.	131·8	75·75	65·90	49·75	43·5
calc.	131·8	76·00	65·90	49·75	43·9
Wet gel	188	106	93		
Liquid : 23 per cent	300	175			
13 „ „	397	225			

From the results already gained, it is legitimate to make certain conclusions as to the nature of the protein molecules. First, the molecules seemed to be identical in cross-section. Secondly, each molecule has quasi-regular structure and thus may be considered to be built up of sub-units of approximately the same character. The physical properties of the substance can best be explained by postulating rod-shaped molecules. The minimum cross-section area of these is 20,100 sq. A. for the dry gel. The molecular length is more uncertain. The extreme character of the orientation phenomena and the X-ray data point to a minimum length of not less than ten times the width, or greater than 1,000 A. This gives a minimum molecular weight in reasonable agreement with Svedberg's[4] estimate of 17×10^6, though there is nothing to show that the lengths of the molecules are uniform.

These results have a certain intrinsic interest, but this would naturally be greatly enhanced could it be shown that these rods are in fact virus particles. This conclusion seems to us both reasonable and probable, but we feel that it is still not proved, nor is there any evidence that the particles we have observed exist as such in infected sap.

Note added Dec. 3.

Wyckoff and Corey have published[5] an X-ray study of the ammonium sulphate crystals of tobacco mosaic and aucuba protein. Their measurements of the intramolecular spacings obtained with unorientated material agree with ours, notably the lines they record at 11·0, 7·44, 5·44 and 3·7 A. correspond to our measurements of the planes (0006, 9, 12, 18) respectively.

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Nov. 17.

[1] *Phytopathology*, **26**, 305 (1936).
[2] *Science*, **77**, 26 (1933).
[3] van Iterson, *Proc. Roy. Akad. Wetensch.*, **37**, 367 (1934).
[4] *J. Amer. Chem. Soc.*, **58**, 1863 (1936).
[5] *J. Biol. Chem.*, p. 51, Nov. 1936.

Natural Selection

IN NATURE of November 21, Prof. E. W. MacBride states that "Ordinary fluctuating variations which can be graphically represented on a 'curve of error' are certainly not inherited". He bases this statement on the work of Johannsen on pure lines of beans, and of Agar and Jennings on clones of *Simocephalus* and *Paramecium*. He does not mention the fact that Johannsen[1] found clear evidence that such variations are inherited within a mixed population of beans.

Variations of human stature "can be graphically represented on a 'curve of error' ". So can those of human intelligence as measured by the intelligence quotient. Most geneticists are convinced by the work of Pearson and others that such variations are to a large extent inherited. If, as Prof. MacBride holds, they "are certainly not inherited" there can, of course, be no objections to the breeding of the feeble-minded.

If Prof. MacBride is unconvinced by the work of Pearson and Johannsen, I fear that it is futile to ask him to consider that of Gonsalez[2] and Timoféeff-Ressovsky[3], both of whom have described mutant forms of *Drosophila* which are more viable than the normal type in the environments studied by them. Others, however, may take the work of these authors more seriously.

Prof. MacBride goes on to state that "The common flowering plant *Calceolaria* is a native of Mexico and produces bright yellow flowers. As all are aware, gorgeously coloured varieties of this flower are cultivated". A distinguished botanical colleague informs me that 173 species of the genus *Calceolaria* are listed in the "Index Kewensis", of which the great majority are not found in Mexico. They include species with yellow, white and purple flowers. Most, if not all, of the garden varieties have arisen by hybridization. There is no record of mutation within the genus. Hence the fact that, when garden varieties escaped from cultivation in India, only yellow-flowered forms survived, is entirely irrelevant to the topic of mutation. It may be an example of the universally admitted fact that some species of a large genus are better adapted than others to a given environment.

I should be the first to admit that a strong case may be stated against the evolutionary efficacy of natural selection. But such a case must, if it is to be effective, be based on a full acquaintance with the facts.

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Merton.

[1] "Elemente der exakten Erblichkeitslehre", p. 156 (1913).
[2] *Amer. Nat.*, **57**, 289 (1923).
[3] *Z. indukt. Abstamm. u. Vererb.*, **66**, 318 (1934).

IN NATURE for November 21, there appears a letter from Prof. E. W. MacBride in which he attempts to demonstrate that natural selection is not an agent in the evolution of mimetic resemblances. It is perhaps open to question how far statements of personal opinion on evolutionary mechanisms are worth making or answering, unless they are sufficiently detailed to include an analysis of the evidence and reasoning upon which they are based. However, Prof. MacBride's letter contains certain definite errors and misconceptions relating to genetics, and these require correction lest they should gain credence among readers not versed in that subject.

In the first place, it is not correct to state that "Ordinary fluctuating variations which can be graphically represented on a 'curve of error' are certainly not inherited". Even on the most superficial consideration, probably few would agree that the offspring of short or of tall parents may expect to attain the same average stature : and human height in a reasonably homogeneous population is an excellent example of variation falling within a normal curve of error. The fallacy of such a contention can, however, be demonstrated conclusively, for a positive correlation is found to exist between the heights of parents and offspring. Furthermore, the substantial equality of the correlation between the heights of the progeny and of their male and female parents respectively, demonstrates that the inheritance here involved is bi-parental. Finally, the important fact that the F_2 is more variable than the F_1 generation in such a cross shows that we are dealing with particulate, that is Mendelian, inheritance ; not with a blending system. The human species cannot, of course, be used to establish this latter point. Reference may, however, be made to much work on such characters in other forms, as that of Castle (1922)[1] on weight, or ear-length, in rabbits.

It is remarkable that Prof. MacBride supports his contention, that "fluctuating variations" are not inherited, by reference to a series of experiments which prove the contrary with particular clearness. This is the work of Johannsen on "pure lines" in beans. Two components may, of course, control the variation of an organism : the hereditary material and the environment. That due to the former is said to be genotypic ; that due to the latter, phenotypic. By interbreeding for a number of generations, a "pure line" can be established, in which genotypic variation is practically eliminated. Selection for any characters within such a line is therefore unavailing, since almost all the variation is environmental. It is to this fact, presumably, that Prof. MacBride refers. He has, however, failed to inform his readers that Johannsen was able to establish *a number of distinct pure lines having different average seed weights* (the character which he investigated) : thus clearly establishing that the fluctuating variation concerned is under hereditary as well as environmental control in the species which he studied.

Several other points in Prof. MacBride's letter require comment. We now distinguish between the terms 'sports' and 'mutations'. A mutation is the inception of an heritable variation. A sport is any deviation from the normal. This may be due to mutation, or to other causes such as a rare recombination of factors. An overwhelming majority of mutations are disadvantageous : but this does not bar the very types which we study in genetic experiments from representing the kind of changes used in evolutionary progress. Indeed it is precisely what we should expect on this view. Even the more lowly organisms must in reality be rather delicately adjusted. Any random change in their control will consequently very rarely result in harmonious working. Occasionally, however, we may expect it to do so, and this is what we find : as the chromosome doubling which gives fertility to a sterile hybrid (Haldane, 1932)[2], or the single dominant in the moth *Gonodontis bidentata* Cl., which produces a melanic form hardier, and capable of emerging at a lower temperature, than the typical insect (Bowater, 1914)[3].

Mutations may be induced by heat and X-rays, from which Prof. MacBride deduces that they are

degenerative changes produced by agents of destructive nature. He does not, however, mention that reverse mutations back to, or towards, the normal are also produced *by these means* (Timoféeff-Ressovsky, 1934)[4]: the agencies which inflict the wound in some instances, heal it in others! Actually, such observations show us that mutations, normally occurring in many directions, are merely increased in frequency by heat and X-rays.

We may well suppose that, in the vast majority of instances, the type best fitted to natural conditions is that occurring in Nature. Furthermore, it is a commonplace of genetics that if domesticated strains are allowed to cross, the normal allelomorphs, separated by artificial selection, may be brought together, reproducing the wild-type condition. Simple Mendelian control of flower colour in *Calceolaria*, and natural selection favouring the wild-type, are all that is needed to explain the interesting instance of "reyersion" quoted by Prof. MacBride.

E. B. FORD.

Department of Comparative Anatomy, Oxford.

[1] W. E. Castle, Carnegie Inst. Wash., Publ. No. **320** (1922).
[2] J. B. S. Haldane, "The Causes of Evolution" (London, 1932).
[3] W. Bowater, *J. Gen.*, **3**, 299–315 (1914).
[4] N. W. Timoféeff-Ressovsky, *Biol. Rev.*, **9**, 411–457 (1934).

Evidence for Linear Units within Protoplasm

IN his contribution to the "First Report on Viscosity and Plasticity", H. J. Jordan[1] has quoted only the measurements by W. Seifriz on protoplasm in 1924. But L. V. Heilbrunn does not find any conclusive evidence for elastic behaviour, apart from those cases where definite fibrillar elements can be observed in the protoplasm. In some recent papers, I have demonstrated the anomalous flow of protoplasm[2] and determined certain values interpreted as moduli of dilatability, transversal contraction and gliding[3]. Both the anomalous behaviour of protoplasm under varied shearing stresses and its elasticity are dependent on a structural organization of protoplasm not with respect to its grosser parts such as the nucleus, but in regard to the actual chemical molecules of which it consists[4]. So the next task was to find any substantial evidence for fibrillar or linear units within the protoplasm submitted to a stress along a definite axis.

My deformation apparatus[5] consists of a capillary, a water manometer, and a tube with an india-rubber aspirator bulb, the three being united by a *Y*-tube. The protoplasm is sucked up into the capillary. At right angles to the axis of the capillary, a beam of parallel, plane polarized light passes with its optic axis at a given radius through the flowing protoplasm. After crossing the space below the objective, the light passes through the microscope and the analysing nicol. As the light is rendered telecentric by two diaphragms, only beams which run parallel, or almost parallel, to the axis of the microscope can enter the ocular.

In the former experiments, I have used the naked cells obtained from the liquefying pericarps of berries, or other plant cells obtained by means of experimental denudation. With the behaviour of these I have compared cells present in saliva (resembling leucocytes) obtained from the human mouth. Now I have likewise accumulated data using living eggs of freshwater molluscs, such as *Unio* and *Anodonta*, which are useful on account of their frequency and large size. After being isolated from the branchiæ of adult animals, the eggs were immersed in the ovary liquid.

The phenomenon observed between crossed nicols agrees with the assumed structure of protoplasm. If we permit the protoplasm to flow through the capillary, a system of many-coloured interference veins appears parallel to the capillary direction. With increasing speed of flow the interference lines disappear. Near the capillary axis, the flowing speed is greater than near the wall, so the coloured strips here are unrecognizable. The interference veins disappear after the eggs are placed in distinct buffer solutions of increasing hydrogen ion concentrations. In interpreting the results of experiments with eggs of different *p*H, it must be remembered that cells often act much like amphoteric colloids having an iso-electric point[6].

Summing up the results, we cannot be sure that the results obtained are quantitative. To anyone who has surveyed the whole field, however, there can be no question but that in all types of protoplasm hitherto used, fibrils or linear units are really present, although only visible if the protoplasm is flowing through a capillary.

A detailed description of the experiments will be given in a paper being published next year[7].

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Nov. 12.

[1] H. J. Jordan, First Report on Viscosity and Plasticity. p. 214, 221 (Amsterdam: Noord-Hollandsche Uitg.-Maatsch., 1935).
[2] H. H. Pfeiffer, *Physics*, **7**, 302 (1936).
[3] Pfeiffer, *Cytologia*, **6**, 329 (1935). *Protoplasma*, **26**, 372 (1936).
[4] W. Seifriz, Protoplasm, 246, 261. (New York and London: McGraw-Hill, 1936.)
[5] H. Pfeiffer, *Protoplasma*, **23**, 210 (1935).
[6] H. Pfeiffer, *Trans. Faraday Soc.*, **29**, 822, 833 (1930).
[7] H. Pfeiffer, *Festschr. K. Fujii*, in the press (Tokyo, 1937).

Mechanism of Chemical Reaction in the Electric Discharge

IN view of the apparent renewal of interest in chemical reactions taking place under the influence of the electric discharge, I venture to put forward the following suggestions, which have not so far been published although frequently expressed at colloquia.

The close proportionality often found, for example, by Dr. Keith Brewer and his collaborators[1] between rate of reaction and current flowing in the outer circuit, has led to theories that positive ions are themselves the reacting bodies, clusters being formed, especially where more than one molecule of reaction product is obtained for each positive ion. Now although mobility data leave no doubt that surrounding molecules can exert a retarding effect upon an ion, to produce an effect which may formally be expressed in terms of ion-clusters, there is complete lack of both spectroscopic and positive ray evidence as to the existence of the reasonably stable aggregates which the theory necessitates. Moreover, it is not likely that the chemical properties of N_2^+, for example, will be the same as those of N_2, while a process such as :

$$N_2^+ + O_2 \xrightarrow[e]{} 2NO + 325 \text{ Cal.}$$

is so highly exothermic as to be incapable of giving the large yields, referred to ion-concentration, which have been reported. This same argument holds for many other reactions, since the ionization potentials concerned are generally of the order of 15 v.

If, however, we are prepared to regard the ions as forerunners of the true reactive species, with further reservations as to the accuracy of measurement of ion-concentration, the above-mentioned proportionality may be explained, as well as the onset of reaction, when controlled electrons are used, at the lowest ionization potential[2]. Once ions have been formed, a variety of processes may occur which cannot be observed while the current is purely electronic. Such processes are :

(*a*) ready dissociation, for example, of N_2^+ and H_2^+, to give the reactive atoms[3] ;

(*b*) genesis of excited states which may also be reactive or give rise to reactive bodies ;

(*c*) formation of fast neutral bodies by the electron interchange reaction

$$A^+ + B \rightarrow B^+ + A,$$

where A^+ and B^+ are the primary and secondary ions[4] ;

(*d*) production of similar high-speed species by the escape of an ion, after undergoing cathodic neutralization, with a considerable fraction of the kinetic energy which is acquired, while moving in the charged condition, under the influence of the applied fields[5] ;

(*e*) kinetic activation of molecule by ion, as a knock-on effect[6].

To indicate only some of the apparent advantages of this theory, processes (*c*), (*d*) and (*e*) can account for the influence of cathode material occasionally observed[7], as well as the production of several molecules of reactant for each ion present[1].

In another communication, shortly to be published elsewhere, these views will be further developed and shown to provide a ready explanation for the electrical synthesis of nitric oxide, treated, as is suggested, as an essentially thermal process.

E. J. B. WILLEY.

Davy-Faraday Laboratory
of the Royal Institution, London.
Nov. 12.

[1] Willey, summary at Faraday Society's conference upon Free Radicals, 1933.
[2] Caress and Rideal, *Proc. Roy. Soc.*, A, **115**, 684 (1927) ; Wansbrough-Jones, *ibid.*, A, **127**, 511 (1930).
[3] Smyth, *Rev. Mod. Phys.*, **3**, 347 (1931).
[4] Kallman and London, *Z. phys. Chem.*, **28**, 207 (1929).
[5] Compton, *Phys. Rev.*, **36**, 706 (1930) ; Oliphant and Moon, *Proc. Roy. Soc.*, A, **127**, 373 (1930).
[6] Kennard, *Phys. Rev.*, **31**, 423 (1928).
[7] Briner *et al.*, recent papers in *Helvetica chimica Acta*.

Continuous Absorption Band of Rubidium in the Presence of Foreign Gases

A NEW absorption band has been observed, with a Hilger E_1 glass spectrograph, on the shorter wave-length side of the second member of the rubidium principal series, in the presence of neon, helium, hydrogen or nitrogen. The position of the band depends on the nature of the foreign gas admitted into the absorption tube, which was kept at around 250° C. A pressure of a few centimetres of mercury of the foreign gas was sufficient to make the band appear distinctly. Fig. 1 is a sample spectrum taken when neon gas was present in the absorption tube of rubidium vapour, and Fig. 2 the corresponding microphotometer curve.

The bands due to other foreign gases are more diffused than that due to neon. All of them are partially superposed with the broadened line $5S$–$6P_{3/2}$. The wave-lengths of the maxima of these bands and their widths are given below :

Foreign gas	λ	Width
Ne	4194·5 A.	16 A.
N_2	4183·0	24
He	4182·5	35
H_2	4178·7	38

These bands have certainly nothing to do with those due to polarization molecules of rubidium observed by one of us[1], for the latter do not appear below 300° C. In fact, when the absorption tube was heated to 350° C. without addition of any foreign gas, we observed a band at 4188 A. This band was also observed without change of position, together with the new absorption band due to neon, when the latter was present as the foreign gas with a partial pressure nearly equal to that of the rubidium vapour.

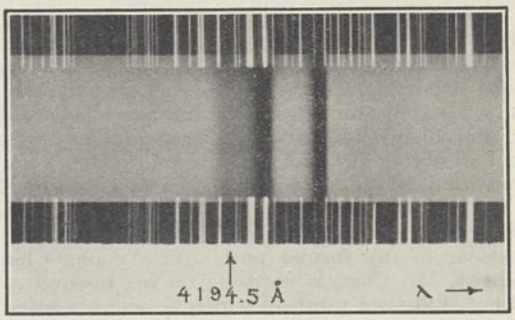

FIG 1.

The narrow continuous band of potassium in the extreme red recently observed by T. Okuda[2], is probably of similar nature. The presence of hydrogen would be necessary for its appearance.

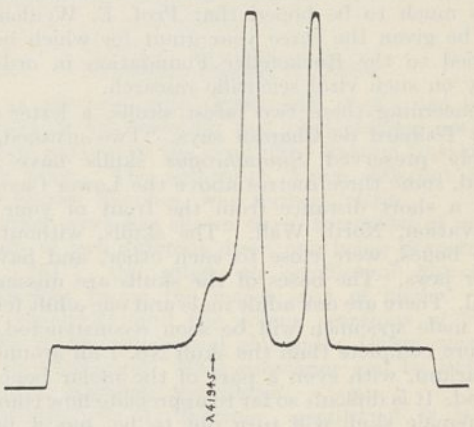

FIG. 2.

The existence of these diffuse bands may be explained as due to the inverse process of what has been observed by O. Oldenberg[3] in the fluorescence of mercury vapour with addition of rare gases, the absorption being produced by a rubidium atom at the moment of a collision with a foreign gas atom.

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National Academy of Peiping,
Peiping. Oct. 23.

[1] Ny Tsi-Zé et Choong Shin-Piaw, *J. Phys. et le Rad.*, **6**, 203 (1935).
[2] T. Okuda, NATURE, **138**, 168 (1936).
[3] O. Oldenberg, *Z. Phys.*, **47**, 184 (1928) ; **51**, 605 (1928) ; **55**, 1 (1929).

Peking Man

REFERRING to the notes published in *The Times* on November 20 and 28, concerning the recent discovery of two skulls of *Sinanthropus*, I am writing to confirm the fact that the information contained in these notes is correct. (*The Times* has since published, on December 8, an article announcing the discovery of still another skull. The information contained in this later article is now confirmed by letters of Dr. Young and Mr. Chia just received ; but I am awaiting further information for details of this fifth skull.)

Since the untimely death, in 1934, of my friend Dr. Davidson Black, the honorary directorship of our Cenozoic laboratory and the investigations of anthropological materials obtained by the laboratory have been carried on by Prof. F. Weidenreich, whose replacement of Dr. Black was recommended by Sir G. Elliot Smith.

In 1935, Dr. W. H. Wong, director of the National Geological Survey of China, of which our laboratory is one department, sent me to Europe expressly to study the Quaternary geology, human palæontology, and Palæolithic industry in Europe, under the personal direction of Prof. H. Breuil. The work in excavation at Choukoutien is carried on by Mr. L. P. Chia, who was appointed by the director of the Geological Survey of China as field director, as successor in my former post. This young Chinese scientist, Mr. Chia, is carrying on his research with patient skill, as a result of which he was rewarded on October 22 by the discovery of a lower left jaw with five teeth well preserved.

On November 16, to the surprise of scientific circles, Mr. Chia discovered two more skulls of *Sinanthropus* in addition to the two skulls which I found on the same site years ago. This site is turning out to be really a treasure house for human science. It is much to be hoped that Prof. F. Weidenreich will be given the three year grant for which he has applied to the Rockefeller Foundation in order to carry on such vital scientific research.

Concerning these two latest skulls, a letter from Père Teilhard de Chardin says, "Two crushed, but largely preserved *Sinanthropus* skulls have been found, some three metres above the Lower Cave and only a short distance from the front of your own excavation, North Wall. The skulls, without any limb bones, were close to each other, and have no lower jaws. The bases of the skulls are missing, as usual. There are one adult male and one adult female. The male specimen will be soon reconstructed, and is more complete than the skull No. 1 all around the calvarium, with even a part of the molar bone preserved. It is difficult so far to appreciate how complete the female skull will turn out to be, but it has at least several parts well preserved : the mastoid area (perfect), a part of the upper maxillary (above the molars), etc. The characteristics are typical, as in skull No. 1, but accentuated. The skulls were found in a place practically barren of bones and implements in a matrix sandy and brecciated in places." A later letter from Mr. Chia adds that the skulls, although badly crushed, will be easily reconstructed, since the fragments were found close together and the breakages are very sharp.

I would like to express my sincere appreciation for the sympathetic co-operation of English scientists, and my gratitude to the Rockefeller Foundation, which has, since the beginning, granted us all the financial support necessary for carrying on our research. In addition to the excellent leadership of Dr. W. H. Wong, director of the National Geological Survey, and Dr. C. C. Young, director of the Peking office of the Survey, we owe much to the co-operation of foreign scientists : Prof. Weidenreich, an excellent and experienced German anthropologist, by whose intensive studies our knowledge of early man in China is being extended and brought to the notice of scientific workers everywhere ; and Père Teilhard, the well-known French geologist, whose wide experience has enabled us to carry on work in keeping with recent progress in geological science.

W. C. PEI.

Institut de Paléontologie humaine,
1, rue Rene Panhard, Paris, 13.
Dec. 12.

Effects of Chemical Combination with Oxygen and Fluorine on the $K\alpha_{1,2}$-Doublet of some of the Lighter Elements

IT is well known that the $K\alpha_{1,2}$-doublet from the elements 12 (Mg) to 17 (Cl) is influenced by chemical binding, apparent, for example, through its displacement towards shorter wave-lengths. Earlier measurements I have made[1] with the elements 12 (Mg), 13 (Al) and 14 (Si), which were carried out with special regard to the effects from oxygen and fluorine on the $K\alpha_{1,2}$-doublet, have recently been extended by measurements with sodium. No conclusive evidence of any displacement in either direction could be found. These and previous results are summarized in the accompanying table ; the measurements on the oxygen compounds of phosphorus, sulphur and chlorine were made by Lundquist[2].

Atomic number	Emitting atom	Maximum valency (p)	Displacement δV (volts)			
			oxygen binding		fluorine binding	
			obs.	calc.	obs.	calc.
10	Ne	0	—	0	—	0
11	Na	1	0·01	0·03	0·03	0·06
12	Mg	2	0·14	0·13	0·20	0·22
13	Al	3	0·31	0·30	0·52	0·50
14	Si	4	0·56	0·53	0·92	0·90
15	P	5	0·81	0·82		
16	S	6	1·18	1·19		
17	Cl	7	(1·62)	1·62		

Calling δV the displacement in volts towards shorter wave-lengths and p the maximum valency of the emitting atom, the following equations are found :

Oxygen binding : $\delta V_O = 0{\cdot}033\, p^2$

Fluorine binding : $\delta V_F = 0{\cdot}056\, p^2$; $\delta V_F / \delta V_O = 1{\cdot}68$.

The values of δV calculated from the above equations are given in the fifth and seventh columns of the table, the observed values in the fourth and sixth columns. The discrepancies are well within the experimental errors. The value given for chlorine within brackets refers to the displacement chloride – perchlorate. Provided the equation holds good also for an extrapolation, one would infer from the result that the displacement chlorine – chloride must be very small indeed.

With elements belonging to the second horizontal line in the periodic system the disturbing atom, oxygen or fluorine, is seen to produce a displacement of the $K\alpha_{1,2}$-line which appears to increase as the square of the maximum valency. Considering the highly complicated interaction between the ions or atoms entering into a chemical compound, the simple

nature of the relationship just stated is remarkable. Since the above equations were found empirically from measurements, they must be assumed to represent only a first approximation to the exact relationship.

N. G. JOHNSON.

Physical Institute,
University,
Lund.
Nov. 4.

[1] *Z. Phys.*, **102**, 428 (1936).
[2] *Z. Phys.*, **102**, 768 (1936)

Mechanism of Carbohydrate Oxidation

SOME new facts have been found suggesting that the first stage in the biological oxidation of carbohydrate is its conversion to glucose-6-phosphoric acid (or Robison ester), which is oxidized[1] to 6-phosphogluconic acid. Dehydrogenation by a specific dehydrogenase co-enzyme system yields 6-phosphoketogluconic acid, probably the 2-keto acid, which is then decarboxylated. In animal tissues, where there is evidence[2] that decarboxylation is oxidative, phospho-arabonic acid would result. Yeast carboxylase, which converts keto-acids to aldehydes, would yield arabinose phosphate, as recently suggested by Lipmann[3]. Further oxidation to the 3-carbon systems would then consist in a repetition of these reactions.

Respiration of brain slices (guinea pig, rat) is supported by addition of glucose and, to a lesser extent, of glucose monophosphate, but not by 6-phosphogluconic acid, gluconic acid or 2-ketogluconic acid. After destruction of the cells by grinding with sand, oxidation of glucose is no longer appreciable, but that of glucose-monophosphate, 6-phospho-gluconic acid, gluconic acid and 2-ketogluconic acid is clearly evident. These facts are explicable as follows: (1) the entry of glucose into the cell is accompanied by its phosphorylation; (2) in all the above substances, phosphorylation is the physiological mechanism of their activation; (3) primary oxidation products of carbohydrate are unable to penetrate the cell, whether phosphorylated or not.

Evidence that in yeast gluconic acid is attacked only when phosphorylated is provided by a study of the specific phosphohexonic dehydrogenase. The existence of this enzyme in Lebedew fluid, indicated by the work of Lipmann[3], is proved by its isolation from this source by precipitation with acetate buffer at *p*H 4·6. The washed enzyme may be kept in the dry state. It is active only after addition of both Warburg oxidation co-enzyme (0·04 mgm.) and yellow enzyme, when the oxygen uptake with 6-phosphogluconic acid at 37·5° is theoretical for dehydrogenation to ketogluconic acid. A ketone fixative (0·1 *N* hydrogen cyanide) is necessary, otherwise the reaction ceases after 30 minutes, as with animal lactic dehydrogenase[4]. Co-zymase, active in the lactic system, is inert; gluconic acid is not attacked whichever co-enzyme is used. Purified Warburg *Zwischenferment* contains little of this enzyme, which it closely resembles. Addition of carboxylase[5] causes further oxidation and evolution of carbon dioxide equal to the oxygen uptake. Since this work was completed, a preliminary note by Warburg and Christian[6] has appeared, in which they obtain further degradation of phosphohexonic acid by an apparently different enzyme preparation, hence the publication of this work in its present form.

Both dehydrogenase systems are insensitive to cyanide. In the ground-up brain *M*/500 hydrogen cyanide inhibits reversibly 80 per cent of the oxygen uptake with hexose monophosphate or phosphohexonic acid as substrate. It is concluded that, in biological oxidation of carbohydrate by this system, indophenol oxidase and cytochrome participate. Theorell[7] has shown that H-transport via yellow enzyme – cytochrome can occur. The above experiments suggest that this may be the actual mechanism of carbohydrate oxidation *in vivo*. As yet our attempts[8] to reconstruct the system from heart indophenol oxidase, cytochrome *c*, and the above enzymes, have resulted only in an inhibition of oxidation; other links, possibly cytochromes *a* and *b*, may also be necessary. These experiments are being continued.

I am greatly indebted to Prof. O. Warburg for generous gifts of his enzyme and co-enzyme preparations.

F. DICKENS.

Cancer Research Laboratory,
North of England Council,
British Empire Cancer Campaign,
Royal Victoria Infirmary,
Newcastle-upon-Tyne.
Nov. 26.

[1] Warburg, Christian and Griese, *Biochem. Z.*, **282**, 157 (1935).
[2] Weil-Malherbe, NATURE, **138**, 551 (1936); *Chem. and Ind.*, **55**, 838 (1936).
[3] Lipmann, NATURE, **138**, 588 (1936).
[4] Green and Brosteaux, *Biochem. J.*, **30**, 1489 (1936).
[5] Axmacher and Bergstermann, *Biochem. Z.*, **272**, 259 (1934).
[6] Warburg and Christian, *Biochem. Z.*, **287**, 440 (1936).
[7] Theorell, NATURE, **138**, 687 (1936).
[8] Dickens and Weil-Malherbe (unpublished).

Chemical Nature of Citrin

IN a previous note (Rusznyák *et al.*) one of us reported on the isolation and physiological activity (vitamin nature) of the crystalline flavone fraction of lemon juice. The substance, being different from other known flavones, was termed 'citrin'.

Further work has shown citrin to consist of mixed crystals of two different dyes, one being hesperidine (m.p. 261°), the other an eriodictyol glucoside. Hesperidine forms the major part of citrin. The great reactivity and the colour reactions of citrin are due to the eriodictyol glucoside. Citrin contains no free eriodictyol. This substance can be isolated only after complete hydrolysis.

According to its formula, eriodictyol is but a demethylated hesperetine. This makes it probable that both glucosides constituting citrin are but two forms of the same flavanone glucoside. Eriodictyol glucoside was not found in any considerable quantity in unripe oranges, which, however, contain great quantities of hesperidine. This makes it probable that the eriodictyol glucoside is formed from hesperidine by demethylation on ripening of the fruit.

This research is being sponsored by the Josiah Macy Jr. Foundation, New York.

V. BRUCKNER.
A. SZENT-GYÖRGYI.

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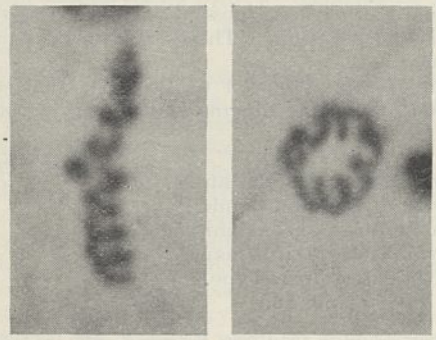
Szeged.
Nov. 21.

Spiral Structure of Chromosomes in *Osmunda*

THE accompanying photographs (Fig. 1) show the kind of results which are being obtained by application of Sax's method[1] for spiral structure to the meiotic chromosomes of the Royal Fern (*Osmunda regalis*). Both photographs represent gemini at the metaphase of the first division of the spore mother cells; Fig. 1(*a*) is a photomicrograph of a pair of chromosomes united by a single sub-terminal chiasma, Fig. 1(*b*) is a photomicrograph of a pair joined by two chiasmata, one at each end. Both show major spirals of about five coils per chromosome, the two chromatids in each chromosome being in close contact, except at the chiasmata, and occupying the same spiral path.



a *b*

FIG. 1. Photomicrographs of single gemini at the first meiotic metaphase in *O. regalis*, from smears stained in gentian violet. ×4000.

Spiral structure promises to become a cytological phenomenon of very considerable theoretical importance, for it may be a clue to a structural explanation of salient features of chromosome behaviour. For this reason it is particularly desirable that the initial facts should be established beyond dispute, and one of the most essential of these is to ascertain the universality or otherwise of the phenomenon. With few exceptions, the published figures refer to monocotyledonous plants belonging to a relatively small number of families, namely, Liliaceæ in *Lilium*[2,3], *Fritillaria*[4], *Trillium*[5,6], *Tulipa*[7], etc.; Comellinaceæ in *Tradescantia*[8,9], *Rhœo*[1], *Zebrina*[10]; Alismaceæ in *Sagittaria*[11]. Among dicotyledons, details are available for *Lathyrus*[12] and *Vicia*[1] with unfigured verbal reference to a few other genera. Similar verbal reference without figures has been made for one gymnosperm, namely, *Cryptomeria japonica*[10]. A significant widening of the field is thus effected by the addition of *Osmunda* to the list, a plant classed as a relatively primitive vascular cryptogam and with a fossil record extending back to the Carboniferous period.

Fuller details for the Osmundaceæ will be given elsewhere.

Botany Department, I. MANTON.
University of Manchester.
Nov. 21.

[1] Sax, *J. Arnold Arboretum* (1935).
[2] Kato and Iwata, *Mem. Coll. Sci.*, B, Kyoto Imp. Univ. (1935).
[3] Iwata, *ibid.* (1935).
[4] Darlington, *Proc. Roy. Soc.*, B, (1935).
[5] Huskins and Smith, *Ann. Bot.*, (1935).
[6] Matsuura, *Cytologia*, etc. (1935).
[7] Upcott, NATURE, **135**, 957 (1935).
[8] Fujii, Report Jap. Assoc. Advan. Sci., (1926). Kuwada and Sugimoto, *Bot. Mag.*, Tokyo (1926). Kuwada, *Bot. Mag.*, Tokyo (1926 and later). Sakamura, *Bot. Mag.*, Tokyo (1927), etc.
[9] Nebel, *Z. Zellforsch.*, (1932), and others.
[10] Shinke, *Mem. Coll. Sci. Kyoto Imp. Univ.*, B (1930).
[11] *ibid.*, (1934).
[12] Maeda, *Bot. Mag.*, Tokyo (1928).

Feeding Habits of Stick Insects

THE observations[1] from the Notre Dame Training College, Glasgow, on the eating of dead cellulose by *Carausius*, are very interesting in view of our experience at Strand School, where we have kept stick insects for upwards of twenty-five years, incidentally, without having detected a male.

Ours are fed on green privet, but on occasion, we have tried them with the golden variety, and, while some would eat it quite readily, others refused to touch it, though we never found any difficulty in starting them on it straight from the egg.

We have records of the insects devouring their sloughs, and on one occasion I saw one eating the front legs and antennæ of another insect which had assumed the akinetic condition in which, as is well known, they lose all sense of feeling. This seems worth recording, as it illustrates how a new habit might be formed through the miscarriage, as it were, of a protective device.

SIDNEY T. E. DARK.

Strand School,
London, S.W.2.
Nov. 21.

[1] Carmela Hayes, NATURE, **138**, 886 (1936).

Genetics in the Universities

THE essence of a satisfactory course in cytology and genetics is that it should be treated as a branch of biology, rather than as something taken from botany added to something taken from zoology. In a word, the course should be given by a cytologist and geneticist. A composite course shared between a botanist and a zoologist, however sympathetic their co-operation, would be likely to reveal incomplete fusion and to result in overlapping, although admittedly it would be vastly preferable to the two separate and entirely uncorrelated courses often given at present.

The subject matter of cytology and genetics is sufficiently homogeneous yet distinct from other branches of biology (and of sufficient importance) to warrant treatment by a specialist. In a university like that of London, in which I happen to be specially interested, it is unreasonable to expect that every constituent college should possess such a specialist on its botanical or zoological staff, and the obvious solution would appear to be for the University to organize courses dealing with aspects of cytology and genetics from among its teachers as a whole, rather than to leave it to each individual college to provide such courses.

The University of London is in process of acquiring a new central building and now would seem to be an appropriate moment to consider whether the centralization of courses on special aspects of biology should not be attempted, not only on behalf of overworked teachers who are compelled to cope with aspects of their subject on which they cannot speak with authority, but also for the sake of degree students who waste more time in hearing the same subject-matter reduplicated in different courses of college lectures than they would do in attending a coherent course at a common centre.

W. NEILSON JONES.

Bedford College for Women,
University of London.

Aptitudes of the Bantu

THE aptitude of the Bantu when brought into contact with new ideas is sometimes almost startling. One cannot foresee whether he is likely to display remarkable aptitude or stark incapacity. A question, for example, that psychologists might investigate is why the average African native can quickly learn to handle a complicated agricultural tractor or compressed air drill, while the most sophisticated of them seem quite incapable of running a small country store (or general shop) on their own account.

Ten quite ordinary natives in Salisbury, Southern Rhodesia, were induced, as an experiment, to attend classes in Red Cross work and recently sat for their examinations, as first-year candidates. There were five subjects: (1) hæmorrhage control; (2) slings or dressings; (3) fractures; (4) drowning or asphyxia; and (5) transport.

For (1) hæmorrhage control, one got full marks and the average was 76 per cent. For (2) slings and dressings, every candidate's average was 80 per cent. For (3) fractures, two got full marks and the average was 80 per cent. For (4) drowning, and asphyxia, two got full marks and the average was 83 per cent. For (5) transport, six got full marks, three 90 per cent and one 80 per cent.

For the whole examination the best man scored 94 per cent and the lowest 80 per cent.

Judged by any standards, this is a remarkably fine performance and, by the way, also reflects great credit on the Rhodesian Red Cross authorities.

F. M. C. STOKES.

41 Talbot Road,
Highgate, N.6.
Nov. 23.

Some New Phenomena produced by Sound Vibrations

Acoustic jets and liquid diaphragms.

USING as a source of sound the singing tube recently shown by me to the Physical Society[1], I have obtained some effects at the interface between a shallow layer of liquid and the gas above it, which do not appear to have been previously described[2].

A glass tube, two or more feet in length, about one inch in diameter, and open at both ends, is slightly curved in a vertical plane so that it may hold a shallow layer of water, oil, or other liquid. When one end of this tube is brought sufficiently close to an open end of the singing tube, one or more liquid diaphragms may suddenly be formed right across the tube. The positions and behaviour of these liquid diaphragms vary with their thickness. Diaphragms five or more millimetres thick are covered with a ripple pattern and appear to be still. Thinner diaphragms erupt a stream of liquid or droplets from both surfaces, while still thinner diaphragms disintegrate in an explosive manner soon after their formation. The formation and breakdown of the liquid diaphragms is often accompanied by 'tides' in the liquid simulating the seiches observed on lakes. The addition of powdered mica to the liquid permits the formation of a semi-permanent membrane across the tube which persists after the sound is cut off.

A sonic amplifier and pendulum maintained by sound vibrations.

A short length of glass tubing, closed at one end by a stretched thin rubber diaphragm, when slipped over the end of a sounding Knipp's tube[3], re-enforces its note for a relatively wide range of positions. A position can be found in which a slight touch on the diaphragm stops the sound. If the bob of a bifilar pendulum be allowed to impinge on the diaphragm when it is in this sensitive position, the vibrations of the pendulum may be maintained and the noise of the impacts exalted to the tappings of a drum.

A frequency demultiplication factor exceeding one hundred may easily be obtained with the system.

F. L. HOPWOOD.

Medical College,
St. Bartholomew's Hospital, E.C.1.
Dec. 8.

[1] Meeting of Phys. Soc., Oct. 23, 1936.
[2] Robinson and Stephens, *Phil. Mag.*, Ser. 7, **17**, 27, have studied the effects of sound waves on soap films.
[3] C. T. Knipp, *Phys. Rev.*, Dec. 1918.

Adjustable Resonators and Orchestration

THE description of the Hammond organ by Sir James Barrett in NATURE of August 15 (p. 297) prompts the physiologist to ask why orchestration does not yet employ the method of the adjustable resonator so important in human speech and song. A very slight alteration in the calibre of the supra-laryngeal passages will make a profound difference in the quality of the voice, as every singer knows. In a few instruments of minor importance there can be found a series of resonators, but these are incapable of change. A good violin player can, by alteration of pressure and of bowing, make some adjustments in the resonance, but the range of such is small compared with the human voice.

One can picture the orchestra of the future placed on a huge resonator with electrically worked pistons, bulkheads and dampers. The conductor, it is true, would have one more score to direct with eye and baton. When on this topic, may I ask if experiments have been made to construct acoustic membranes for reception or emission on the principle of the mammalian ear-drum?

W. A. OSBORNE.

University of Melbourne.
Oct. 12.

Directions of Homogeneous Auroral Arcs

THE Oxford University Arctic Expedition 1935–36 wintered in North-east Land at 80° 23′ N., 19° 31′ E., where single photographs of the homogeneous auroral arcs were taken in order to determine their direction. The photographs were reduced by the method used by Wesöe[1] and Störmer[2]. Persistent cloudiness prevented many photographs being made, but the average of fourteen measurements was 73° E. of N. for the region 80° N. to 76° N., 15° E. to 40° E. The individual determinations were 84°, 78°, 65°, 68°, 91°, 65°, 66°, 70°, 73°, 67°, 70°, 95°, 85°, 48° E. of N.

I wish to express my thanks to Dr. Harang, who reduced the photographs at the Auroral Observatory, Tromsö, and gave us much assistance.

R. A. HAMILTON.

Merton College,
Oxford.
Nov. 27.

[1] The Norwegian North Polar Expedition with the *Maud*, 1918–1925. Scientific Results, **1**, No. 6 (Bergen, 1928).
[2] *Geof. Publ.*, **4**, No. 7 (Oslo, 1926).

Nitrogen Fixation with Cow-Dung

WHEN freshly collected cow-dung (containing 0·368 per cent nitrogen and 7·5 per cent carbon) is mixed with soil and exposed to sunlight daily for six hours in dishes, nitrogen fixation is observed. Thus the nitrogen content of a mixture containing 500 gm. soil and 100 gm. cow-dung rose from 0·0905 per cent on July 27 to 0·14 per cent on November 4, 1936.

In field trials, when 25 tons of cow-dung were added per acre, the total nitrogen was increased from 0·052 per cent to 0·061 per cent in a month. When the same amount of cow-dung and 25 tons of molasses were added per acre in fields, the total nitrogen was increased from 0·053 per cent to 0·07 per cent in the same time. Hence cow-dung, which is used as a manure for its content of nitrogen, potash and phosphate, has been found to supply to the soil not only the nitrogen it contains, but also it can add nitrogen to the soil from the nitrogen of the air by fixation. The cellulose and pentosans present in the cow-dung undergo oxidation on the soil surface and liberate the energy necessary for nitrogen fixation.

N. R. DHAR.
S. K. MUKERJI.

University,
Allahabad.
Nov. 9.

Points from Foregoing Letters

BY further purification of the crystalline protein preparation having the property of producing the mosaic virus disease in tobacco plants, F. C. Bawden, N. W. Pirie, J. D. Bernal and I. Fankuchen have obtained solutions which (in concentrations greater than 2 per cent) separate into a lower liquid crystalline layer and an upper layer showing optical anisotropy when flowing. The liquids form gels on drying. X-ray investigations show a common pattern corresponding to a 'repeat unit' of $3 \times 22{\cdot}2$ A. in the crystal, liquid and gel stage; other features of the X-ray pattern indicate hexagonal close-packing in the gel stage and parallel, charged, rod-like molecules in solution. The authors estimate their length to be greater than 1000 A. and their width about one tenth of that length. This corresponds with a molecular weight agreeing with Svedberg's estimate of 17×10^6. It is not yet conclusively proved, however, that these are actually the 'virus' particles.

Prof. J. B. S. Haldane and also E. B. Ford criticize several of the statements made by Prof. E. W. MacBride when discussing the mechanism of natural selection. Both authors give examples of inheritable variations which can be graphically represented on a 'curve of error', and they claim that the return of the garden variety of *Calceolaria* to the wild type is irrelevant to the topic of mutation.

When protoplasm (for example, cells from human saliva, eggs of freshwater molluscs, liquefying pericarp of berries) flowing through a capillary is observed between crossed nicols, a system of many coloured rings appears parallel to the capillary direction. This, Dr. H. H. Pfeiffer states, is in accordance with the hypothesis of a fibrillar structure of protoplasm.

To explain the close proportionality between the flow of current and the rate of chemical reaction in certain cases of electric discharge, for example, in the formation of NO from nitrogen and oxygen, it has been suggested that positive ions are the reacting bodies. Dr. E. J. B. Willey states that the hypothesis that the positive ions are forerunners of the 'reactive species' explains a larger number of observed facts.

A continuous absorption band observed in rubidium vapour in presence of certain gases (neon, helium, hydrogen or nitrogen) is described by Ny Tsi-Zé and Ch'en Shang-Yi. The position of the band varies with the gas. The authors suggest that the absorption is produced by a rubidium atom at the moment of collision with a foreign gas atom.

Dr. W. C. Pei, who was until recently in charge of the excavations at Choukoutien and is now studying in France, writes to confirm recent reports of new discoveries of material relating to early man in China at the well-known site at Choukoutien (see NATURE, Dec. 12, p. 1004).

A table showing the displacement of the $K\alpha_{1,2}$-doublet in the X-ray spectrum of the lighter elements (magnesium to chlorine), when they combine with oxygen and with fluorine, is given by Dr. N. G. Johnson. The displacements appear to increase as the square of the valency. In the case of sodium the evidence for displacement is not conclusive since owing to its smallness it falls within the experimental error.

Evidence is brought forward by Dr. F. Dickens suggesting that the early stages in the oxidation of carbohydrate are hexose monophosphate, phosphogluconic acid and phospho-ketogluconic acid, the latter being decarboxylated by different routes in animal tissues and in yeast. Phosphohexonic dehydrogenase has been isolated from yeast; it converts phosphogluconic acid into the corresponding keto-acid, and for this it requires Warburg oxidation co-enzyme and yellow enzyme to complete the dehydrogenase system. In the biological oxidation of carbohydrates by this system, indophenol oxidase and cytochrome probably take part, since oxidation of hexosephosphate and phosphohexonic acid by brain tissue is strongly and reversibly inhibited by cyanide.

'Citrin', a physiologically active constituent of lemon juice having vitamin properties, consists, according to V. Bruckner and Prof. A. Szent-Györgyi, of a mixture of hesperidine and eriodictyol glucoside.

Photomicrographs showing spiral structure of chromosomes in the spore mother cells of the Royal Fern (*Osmunda regalis*) at the metaphase stage of the sexual nuclear division (meiosis) are submitted by Dr. I. Manton. Similar structures hitherto described have belonged mainly to monocotyledonous plants.

Sidney T. E. Dark records that the common stick insect (*Carausius*), while occasionally refusing to change its food plant, will sometimes inadvertently eat other stick insects in the immobilized (akinetic) condition even in the presence of plenty of its normal food.

Prof. F. L. Hopwood describes the formation of liquid diaphragms in a partly filled bent tube under the influence of sound vibrations, and also a simple sound amplifier consisting of a short glass tube with a thin rubber diaphragm slipped over the end of a Knipp's tube.

Research Items

Origins of the Russian Population

IN discussing the evidence for a pre-Aryan element in the population of southern Russia, Dr. A. Bachmakoff compares conditions in prehistoric France, where, notwithstanding the evidence of Cæsar, there is reason to believe that the Veneti were a pre-Aryan people, possibly related to the Picts, while in the south the Ligurians and Basques represent two branches of a race which may have extended from the Pyrenees to the Atlas (*Z. Rassenkunde*, 4, 2). In south Russia there is evidence for the existence of a similar pre-Aryan or Japhetic element, upon which the Aryans impinged about 1500 B.C. North of lat. 50° were impenetrable forests inhabited by Finns, but south of this line in the steppe country was a special kind of pre-Aryan population, which appears to be related to that of the Circassians (Kimmerians) of the Caucasus. The Aryans first impinging upon this population were Scyths or Iranians. The Slavs did not move before the Christian era, although it is possible that there were Slavs around Kiev, who were known to the Greeks in 450 B.C. These Proto-Slavs, however, remained quiescent for a thousand years. The effect of this Japhetic element on the Aryans can be estimated at two epochs—first on the Scyths in antiquity, and secondly on the Slavs in the Middle Ages. The first question to be decided is that of the Kimmerians. It would appear that they were a branch of the Circassians, who settled on the banks of the Kouban. They seem to be persistent in Anatolia from the time of the Hittites. The evidence for the existence of this race as a principal element in the substratum of the Russian population is mainly linguistic. The name "Tcherkesses" is found in Kiev. Little Russian names end in *-ko* instead of *-off*. The suffix *oukh*, which appears in Russia, is of frequent occurrence in various forms in names in Asia Minor in antiquity, and there is also evidence for it in Elamite, Mitanni and Proto-Hittite.

Rock-Drawings and Paintings of the High Plains, U.S.A.

IN the course of seven seasons' work, the Archæological Survey of the South-Western High Plains area instituted by the Anthropological Department of the University of Colorado, on the initiative of Prof. E. B. Renaud, recorded a large number of rock-paintings and drawings in Wyoming, South Dakota, Colorado, Arizona and New Mexico, particulars of which have been given from time to time in the reports of the Survey. In the recently issued eighth annual report, Prof. Renaud has brought together and collated the evidence given in these reports, now mostly out of print, and has prefaced the summary description of sites and recorded examples with a general appreciation and discussion of this regional manifestation of aboriginal art, which is not without interest for European archæologists, more especially as it approximates in its conventionalization of representations of the human form to certain phases of the art of the Stone Age in Europe. No very high antiquity is to be assigned to this High Plains art. The cave paintings of the Cimarron Valley, in which representations of the human form with characteristically square shoulders are outlined in red paint, have been assigned tentatively by Dr. A. V. Kidder to the Basket Maker culture, with a possible antiquity of some three thousand years; but as was shown quite conclusively by an inspection made when the Survey was at work in New Mexico in 1929, this group stands outside the field of High Plains art. Subject, style and technique in High Plains art corroborate the chronological evidence afforded by the superposition of paintings and drawings one upon another on the rocks and stones upon which they are found, while the representation of the horse indicates that all but the oldest class cannot be prior in date to 1680–90. As regards the significance of these paintings and drawings of human and animal forms and conventional signs, some are obviously phallic, while others equally clearly show relation to the symbolism of religious belief. The remainder appear to record tribal or personal events, or the occurrence of game and water-holes nearby.

Study of Airmen's Reactions

AN apparatus for listening to the beating of an airman's heart and recording it to the ground, where it can be reproduced on a sound film, has recently been devised by the Medical Aviation Department of the Soviet Civil Air Fleet. The apparatus will enable the physician to study the condition of an airman without having to accompany him in his flight, and also to ascertain the effect of different altitudes on the human heart. The apparatus resembles a small laryngophone or osteophone, and is fixed to the airman's chest above his heart. It is connected with a radio transmitter in the cockpit, which transmits the impulses to a special receiver installed in the ground laboratory, where it is recorded on a ribbon for reproduction on a sound film.

Food of Passenger Pigeon

ALTHOUGH the passenger pigeon has been extinct for many years, the stomachs, with food-contents, of eleven individuals have recently been discovered in the collections of the U.S. Biological Survey (according to a report circulated by Science Service, Washington, D.C., Oct. 21). The food materials were examined by Phœbe Knappen, who records that nine tenths of the items were of vegetable origin, the remaining tenth of animal origin. Acorns formed the greatest part of the food, next came oak-galls, followed by fruits of the pokeberry, a common weed, and grains of wheat. It is suggested that the predominance of acorns and oak-galls points to the disappearance of the primeval forests of North America at the hands of the woodman, as sharing with the activities of hunters, in the extermination of this once abundant bird.

Bee-Keeping in India

ATTENTION may be directed to the appearance this year of a third edition of the bulletin on bee-keeping by Mr. C. C. Ghosh, published by the Imperial Council of Agricultural Research, India (Mis. Bull. No. 6. Delhi: Manager of Publications. 3*s*. 3*d*.). This brochure has helped to stimulate bee-keeping in India besides being used in several other

countries. In the present edition not much change has been deemed necessary beyond the incorporation of some new facts about enemies and the hives of the Indian bee, together with the addition of some fresh illustrations. It may be added that while the native Indian bee is easily kept, its yield of honey is much smaller than that of the hive bee in Europe.

Japanese Brachyura

Two papers on crabs from Japan have appeared (*Sci. Rep. Tokyo Bunrika Daigaku*, Section B, **2**, Nos. 37 and 39; 1936). The first, by T. Sakai, "Report on the Brachyura collected by Mr. F. Hiro at Palao Islands", describes a large number of species, chiefly inhabitants of coral reefs, mainly from Kororu Island and Iwayama Bay, but some forms usually inhabiting the muddy or sandy shores are also included. There are 36 species belonging to 24 genera, one of the species, *Chlorodopsis* (*Cyclodius*) *palaoensis*, belonging to the Xanthidæ being new to science. Several of these had not been recorded before from Japanese waters. Good photographs are given of a number of forms, but we look forward with interest to the promised work "Crabs of Japan" in which coloured figures are to be published. The second paper, by K. Koba, "Revision of the Specific Name of a Crab as a Second Intermediate Host of *Paragonimus westermani* in Formosa", corrects the identification of the crab *Potamon* (*Geotelphusa*) *obtusipes* (Stimpson) which was found by Nakagawa in 1915 to be the intermediate host of a trematode *Paragonimus westermani* (Kerbert) from the Sintiku District of Formosa. The crab is now determined to be *Potamon* (*Potamon*) *rathbuni*, and the author gives a revised description of the species with figure.

Copepods from the Great Barrier Reef

THE systematic account of the pelagic Copepoda, by Mr. G. P. Farran, is now published (British Museum (Natural History) Great Barrier Reef Expedition 1928–29. Scientific Reports, **5**, No. 3. Copepoda. 1936). Further work on habitat, relative abundance, and seasonal and vertical distribution will follow in a separate paper. The species fall into three groups: the reef forms which have their centre of distribution in the shore waters of low salinity, though also often found outside the reef, the open epiplankton, and the deep-water fauna. Of these the first group has been well sampled, but the second and third are not so complete. The greater number belong to the Calanoida—53 from the open sea with 3 new species and a new genus, 37 from deep water with 8 new species and a new genus, and 30 (or 31) from the coastal waters with one new species. The new genus *Tanyshinus* is formed for the new species *T. naro* from the open sea. Its systematic position is in the neighbourhood of *Spinocalanus*, *Mimocalanus* and *Monacilla*. In *T. naro* the rostrum consists of a single stout point with no trace of rostral filaments. As *Monacilla tenera* has a 2-pointed asymmetrical rostrum with one of the points much stronger than the other, it is suggested that a single rostral process might arise by the suppression of the smaller point. The second new genus, *Scolecalanus*, from deep water, is formed for the two new species *S. galeatus* and *S. lobatus*. There are only seven species belonging to the Harpacticoida, the remaining forms being members of the Cyclopoida, chiefly from the open sea. One new genus from deep water is formed for the new species *C. parva*.

Development of the Cotton Hair

ON this subject, Dr. F. M. L. Sheffield has recently published a note of considerable interest (*Empire Cotton Growing Rev.*, **13**, No. 4; 1936). This note makes it clear that a state of affairs exists in the outer coat of the developing cotton seed in the early days following fertilization, which has not been sufficiently considered when attempts are made to generalize on these developmental processes. As growth proceeds in the expanding ovule, naturally cells of the epidermal layer continue to multiply and divide, but these dividing cells are interspersed among other cells or cell groups, which are rapidly expanding into hairs, so that fully differentiated and meristematic cells are ultimately interspersed. Dr. Sheffield directs attention to this unusual state of affairs and contrasts it with the apical meristem or the cambium, though it will be recalled that in the cambium there are usually ray cells interspersed between the long cambium initials which are clearly in a different state of differentiation. Hair production in early stages of leaf development is probably also associated with similar appearances in the epidermal sheet. Dr. Sheffield concludes that the amount of variation, associated with hair development, occurring from cell to cell of a single seed and from seed to seed within a single boll is greater than the differences in development between varieties or even between Old and New World types of cotton. Cell divisions were seen in the epidermis of Sakel cotton seeds up to the tenth day after pollination and probably occurred later than this—but the general trend of these observations is to minimize the significance of the exact length of time for which cell divisions were seen and to stress the great variety of conditions of cell development to be found over the surface of the seed.

Gas Storage of Apples

IN view of the increasing interest of commercial growers in gas storage methods, a recent paper by Kidd and West (*J. Pom. and Hort. Sci.*, **14**, 3, 276; 1936) is deserving of attention. The experiments described were carried out with Cox's Orange Pippin apples at the Ditton Laboratory over a period of three years. It was found that low-temperature breakdown increased in severity with increasing carbon dioxide concentration, but did not occur at temperatures above 34° F. Fruit stored at 34° F. in September reached the end of its storage life by the end of October whatever the storage atmosphere. Brownheart, which appears early in the storage life, developed most severely in high carbon dioxide atmospheres (15 per cent) and was accentuated by low oxygen, whilst 'core flush' or browning in the core region increased with increasing oxygen concentration. Very little fungal rotting occurred, and this seemed unaffected by the composition of the atmosphere. In general, for long-period storage, minimum wastage from the above causes was obtained with an atmosphere containing 2·5 per cent oxygen and 5 per cent carbon dioxide at 34° or 39° F. The same atmosphere, at 37·5° F. and 39° F., also proved best for the development of the characteristic Cox flavour, which is only fully apparent after the fruit has been removed from store and kept in air at room temperature for a few days. Development of good yellow ground colour was favoured by high temperature and high oxygen concentration, whilst retardation of softening appeared to be due to the effect of carbon dioxide.

Whilst there was some variation in different seasons, it was concluded that the maximum storage life of Cox's Orange Pippin (about seven months) was obtained at 39° F. in an atmosphere containing 2·5 per cent oxygen and 5 per cent carbon dioxide. These conditions cannot be obtained by simple controlled ventilation, but require some means of removing the excess carbon dioxide. It is worthy of note that disastrous results followed the storing of ripe Worcester Pearmain apples along with unripe Cox's, the storage life of the latter being reduced almost to one third, due to the stimulating effect of ethylene evolved by the Worcesters.

Distribution of Earthquakes in the Kwanto (Japan) District

SINCE the great Kwanto earthquake of September 1, 1923, a network of thirteen seismological stations has been arranged in the district round Tokyo. The quarterly Seismometrical Reports issued by the Earthquake Research Institute give a list of all the earthquakes that were sensible in Tokyo, with, in most cases, the position of the epicentre and the depth of the focus. Two interesting papers, in which the distribution of these earthquakes is considered, are included in a recent *Bulletin* of the Institute (**14**, 420–426, 427–437; 1936). In the first, Mr. T. Nagata examines the distribution of the foci in two regions in which they are chiefly clustered, the northern part of Tokyo Bay and along the Rivers Kinugawa and Tonegawa. During the years 1924–30, the foci in the former region lay as a rule at depths of 70–80 km.; but, during the years 1931–35, there were few foci at a greater depth than 60 km., showing that the instability produced in the lower part of the crust by the Kwanto earthquake of 1923 is gradually diminishing. In the second region, the earthquakes were most frequent at depths of 40–50 km. in both intervals. Messrs. N. Nasu, T. Hagiwara and S. Omoti deal with the same subject. By projecting the foci in five sub-regions on vertical planes, it is shown that the distribution is funnel-shaped, and that there are two sources at depths of more than 100 km., one below Kumagaya and the other beneath the northern part of Sagami Bay.

Effect of Hydrogen on Photo-electric Cells

IN a paper read to the Physical Society on November 27, Dr. N. R. Campbell and R. S. Rivlin continue the investigations on the effect of hydrogen on the time lag of argon-filled photo-electric cells, the results of which were published in previous papers to the Society. In a paper read last April, the proportion of hydrogen required to produce the decrease in time-lag was left undetermined as it was thought that elaborate apparatus would be required. It has been found that the problem can be solved very simply and with sufficient accuracy by using a Pirani gauge. The gauge is of the simple type in which a constant potential difference is maintained across the bridge, and the out-of-balance current is read. The experiments show that all that is necessary is to attach such a gauge to the cell, fill it with argon to a suitable pressure, and carry out the tests by adding or withdrawing hydrogen and plotting the results. When the pressure of the argon in the cell is about 0·2 mm., the effect of introducing a small proportion of hydrogen into the argon, keeping the voltage constant, is to decrease the magnification and decrease the time lag. Both these effects increase rapidly as the amount of hydrogen is increased up to about 2 per cent by volume. The rate of increase then falls off and becomes negligible at about 6 per cent. The exact variation of the effects with hydrogen is complicated and depends on the nature of the cell. It is pointed out that the effects were correlated with hydrogen free in the cell, and that it is conceivable that the direct cause was hydrogen adsorbed on the cathode in an amount which is in equilibrium with the amount free in the cell.

Aetylcholine containing Heavy Hydrogen

IT is well known that the pharmacological activity of choline is very greatly increased by acetylation. It is announced in a communication to the Editor by Prof. H. Erlenmeyer, H. Lobeck and Prof. K. Fromherz, University and the Roche Research Laboratories, Basle, that replacement of the hydrogen in the acetyl group by heavy hydrogen yields a product the action of which on the frog's heart is indistinguishable from that of acetylcholine itself, but is about thirty per cent less active on the blood pressure and on leech-muscle. Details of the work are to be published in *Helvetica chimica Acta*.

Ignition of Explosive Gases

G. MOLE (*Proc. Phys. Soc.*, **48**, 857) has put into a quantitative form the theory of Finch and his collaborators that ignition and self-propagating combustion of an explosive gaseous mixture are determined by the building up of a suitable concentration of excited molecules. A differential equation is set up for the activation and deactivation of molecules. The solution shows that the mixture can remain in equilibrium indefinitely unless a source of activation greater than a critical value is applied. When such a source is applied, an explosion begins after a calculable time. The igniting power of a high-frequency source of activation, for example, an electric spark, can be calculated as a function of frequency, and from comparison of this result with experiment, the average life of an activated molecule of carbon monoxide is found to be about 0·4 microsecond.

Thin Metallic Films

Up to the present, it has been found that metallic films only a few atoms thick show no electrical conductivity, and that the resistivity of films many atomic layers thick is much higher than that of the bulk metal. A. C. B. Lovell (*Proc. Roy. Soc.*, A, **157**, 311) has succeeded in depositing films of rubidium on pyrex glass which show conductivity when the number of atoms deposited is less than that for a complete monatomic layer. The films were deposited by evaporation on a surface which had been cleaned by prolonged heat treatment in high vacuum. The films show a decay of conductivity with time, but this decay became slower with low temperature and thicker films. A film of 40 A. thickness was completely stable at 90° K. The thickest films (up to 90 A.), though still invisible, carried currents up to 0·5 amp. and obeyed Ohm's law, the current density being at least 10^6 amp./sq. cm. The variation of resistivity with temperature and film thickness agreed quantitatively with a simple theory of the shortening of the mean free paths of electrons by collision with the boundaries of the film. The decay of the conductivity of the film with time may be qualitatively explained by the aggregation of the rubidium into islands under surface tension forces. The presence of traces of impurities on the surface influences these surface tension forces and leads to a rapid break-up of the film (see also NATURE, **137**, 493; 1936).

Wave Forms of Atmospherics at Madras

MR. C. V. RAJAM, writing from the Presidency College, Madras, reports observations on the wave-form of atmospherics received in Madras (13° N. 80° E.) made in the first months of a year's programme. The apparatus used is based on that of Appleton, Watson Watt and Herd, and their eye-and-hand method [now superseded by photography] is used. We are unable to find space to print the report in full, but the following account brings out the principal points.

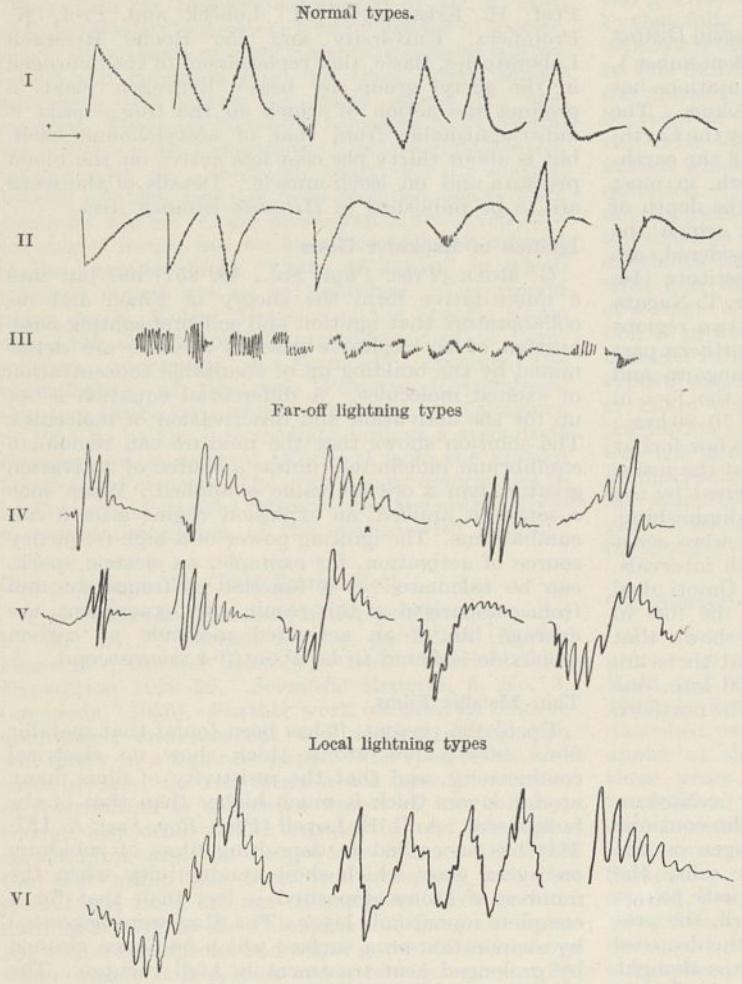


FIG. 1.

Mr. Rajam divides the observed types into three, the normal, the far-off lightning and the local lightning types. These are illustrated in the accompanying figure (Fig. 1). The types shown in rows I and II produce clicks; low-intensity atmospherics of the complicated forms shown in row III produce sustained "frying" sounds. Aperiodic clicks are predominantly negative on 60 per cent of normal days; durations lie between 1,000 and 4,000 μsec. and intensities between 0·1 and 0·3 volts/metre. Short aperiodics of similar intensity have a decay time of 100–700 μsecs. Next in prominence are negative quasi-periodics with a short negative peak of about 0·15 v./m. followed by a rounded positive portion of about 0·05 v./m. peak value; the total duration is 800–1,500 μsec. The most prominent positive type is quasi-periodic, with a brief positive peak followed by a longer rounded negative half-cycle. Here the total duration is 2,000–5,000 μsec., intensity 0·1–0·28 v./m., peak ratio about 6. A small percentage with three half cycles have total durations 4,000–8,000 μsec., intensities 0·2–0·35 v./m.

On 90 per cent of observed forms are found high-frequency ripples of 10–40 per cent relative amplitude; ripple periods range from 25 to 120 μsec., corresponding to frequencies of 8,000–40,000 cycles per sec. A rippled atmospheric produces a jarring click while a ripple-free atmospheric of the same gross form produces a mild click tolerable to the ear.

The "frying" types occur generally in the evening hours, persisting to about 10 p.m., and again before sunrise. They occur in quickly succeeding groups; the group duration is 100–700 μsec., intensity 0·03–0·75 v./m.

With distant visible lightning come the far-off lightning types, rows IV and V. These consist of a close succession of 3–10 impulses of normal type. The most prominent and frequent type (x in row IV) has a steep negative rise followed by further impulses on the negative side of the base line. Total durations are 1,500–8,000 μsec., intensities 0·2–0·5 v./m.; 10 per cent show ripple structure of 30–100 per cent relative amplitude and ripple-frequency 8,000–15,000 cycles per sec.

Local lightning types, associated with audible thunder, are shown in row VI. These have durations of 1/25–1/10 sec., intensities 0·7–2 v./m.

The diurnal variation in atmospheric activity on a normal day runs as under. From 1 a.m. to 5 a.m. activity is low, with occasional negative aperiodics. Just before sunrise there is a slight rise, and "frying" type atmospherics appear; just after sunrise there is a marked fall and "frying" ceases. From 8 a.m. to 12 noon activity is very low; until 2 p.m. this state is modified only by the intrusion of low-intensity negative aperiodics and quasi-periodics. From 3 p.m. there is a slow rise to a maximum about 5.30 p.m., with frequent atmospherics. This maximum persists through 6 p.m., with slight decrease to 9 p.m., and an accelerated decrease from 10 p.m. to a midnight minimum.

The work is continuing, and apparatus for automatic recording of wave-forms is under construction.

The Agent of Virus Disease in Plants*

By Dr. John Caldwell

MOST of the detailed work on the nature of the virus agent has been carried out on the virus of the mosaic disease of tobacco. This virus is very easily obtainable in a fairly pure condition, is easily inoculable by rubbing virus preparations into healthy tissues and is resistant to storage and to chemical treatment. This resistance to ageing makes it possible to store the virus *in vitro* in powder form or in liquids over periods of years, and its presence as an active pathogen is easily demonstrable quantitatively as well as qualitatively by the use of the host-plant *Nicotiana glutinosa*, the leaves of which develop local lesions after being rubbed with virus material. It has long been known that there is a definite relationship between the number of lesions and the amount of virus present in the inoculum.

The most outstanding recent development in the study of the virus is the preparation by Stanley of a crystalline protein from the juice of plants infected with mosaic disease. The agent is separable from the crude, expressed plant juice by treatment with protein precipitants, and the virus has an intimate connexion, at the least, with the proteins of the tissues, as evidenced by the effect of pepsin in destroying the activity of the virus and by its antigenic reaction. While it has not yet been clearly demonstrated that the crystalline protein is, in fact, the virus agent in a pure state, Stanley's demonstration of the existence of the virus in the crystallizable protein fraction constitutes a step forward in the isolation of virus [see also p. 1051].

The study of the virus from the point of view of its possible protein nature is complicated by two main factors. It is apparently easily absorbed and inactivated by native proteins and, further, tests for virus activity must be carried out on host plants, since it is the pathogenic effect of the virus which ultimately demonstrates its presence in a given juice.

This biological test requires that, to demonstrate the activity of the virus, there be present no substance which prevents the entry into or subsequent increase of the virus in the host tissues. It has been shown that dead cells do not permit the entry into, or the movement of the virus in, the tissues, and absence of infection in the leaves of the test plant *Nicotiana glutinosa*, in some instances, may be due to the death of cells in the regions of inoculation and not to the absence of active virus. A test has recently been devised which makes it possible to distinguish between an inhibitory effect on the virus itself and a toxic effect on the tissues of the treated leaves. If the inhibitory substance be added in the same concentration to different concentrations of the virus material, that concentration not being too great to prevent lesion formation on the leaves of the host plant at some concentration of the virus, then the effect of the inhibitor will be different if it is acting on the virus, from its effect if the action be on the host tissues. If the action of the inhibitor be on the virus, then its effect will be most marked at the lower concentrations of virus and will be less obvious as the concentration increases until at high concentrations of virus it may not be demonstrable at all. If, on the other hand, the effect of the inhibitor is on the host tissues, the effect will be most marked at high concentrations of virus, when far fewer than the expected number of lesions will be formed, while at low concentrations of virus the effect of the inhibitor may not be demonstrable, since there are comparatively large numbers of possible points of entry of the virus.

The question of the entry of the virus into the tissues has received some attention recently. I demonstrated some time ago that it is possible to inject into the intercellular spaces of leaves large quantities of virus, to spray the leaves of a tomato or tobacco plant with virus material or to immerse the roots in virus juice without subsequent infection of the plant provided the tissues remain undamaged. It was concluded that virus is unable to enter an unbroken protoplast. This conclusion was challenged by Duggar, who reported that if tobacco virus No. 1 material was sprayed with an atomizer on to the leaves of tobacco plants, infection followed, in the course of a few days, entry of the virus being affected apparently through the stomata of the treated plants. In the light of these results, the work on the spraying of tobacco plants with virus material in an atomizer has been carefully repeated and it has been found that no infection was obtained under our conditions even after repeated spraying at three- or four-day intervals, when rigorous precautions were taken to prevent the rubbing of the leaves of the plants and special care was taken in watering them. All plants so sprayed and with one leaf lightly rubbed developed symptoms after only one spraying. This conclusion has been confirmed in a paper published last month by Dr. F. M. L. Sheffield at Rothamsted, whose experiments are reported to show "quite conclusively that the virus is unable to enter uninjured cells".

I have shown that the virus of tobacco mosaic does not travel across areas of dead cells but is confined to the living tissues, and that the weight of evidence suggests a fairly rapid passage along the protoplasmic strands between the cells. I have also shown that there is little evidence that the virus moves mechanically with the main food-streams. This conclusion has been questioned by various workers and further experiments have been carried out to examine this point. Experiments carried out in Exeter have shown that virus activity seems to be associated more with the activity of growing cells than with the movement of materials from the inoculated leaves. Three groups of tobacco plants were used in the experiments. One group was inoculated on the youngest available leaf, the second on a half-grown leaf and the third on the oldest leaf, all the plants being in the 4th–5th leaf stage. All the inoculated leaves were covered with tinfoil or black paper immediately on inoculation. Symptoms appeared first on the plants of the first group, then on most of the plants of the second group and rarely on the plants of the third group. The treated leaves of the first two groups of plants grew rapidly under

* Based on a paper read on September 11 before Section K (Botany) of the British Association meeting at Blackpool.

the covers ; while the adult leaves of the third group withered and died in the course of a week. It was evident that the virus could and did move rapidly out of the younger leaves, and that the movement of food materials into them had little effect on the movement of virus out of them.

The conclusion that the movement of the virus takes place along the protoplasmic strands was confirmed by the observation that the embryo of the seeds of infected tobacco and tomato plants has been shown by the work of myself and others to be healthy and to contain no virus. This may be due to the irregular distribution of virus in the plant tissues and to the absence of direct protoplasmic connexion between the embryo and the parent plant.

The conclusion that the protoplasmic strands are not the paths of movement has also been supported just recently by another paper of Dr. Sheffield, in which she shows that the guard cells of the stomata of *Solanum nodiflorum* do not contain inclusion bodies, while the epidermal cells of this plant on infection with tobacco mosaic virus develop very characteristic inclusion bodies. It has been possible to demonstrate the existence of protoplasmic strands between the epidermal cells of this plant and their complete absence between the guard cells and the neighbouring epidermal cells.

The work on the nature of the virus has opened up some interesting fields for further study. Evidence is being accumulated which indicates that the virus is protein in nature and that it can develop only in living tissues, with which it is intimately connected. This conclusion is of special interest when it is remembered that tobacco virus No. 1 has been shown to exist in some sixty strains, most of which are known to be mutually antagonistic in the plant.

The Electrical Machinery Laboratory, Polytechnic, Regent Street, London

THE newly-equipped Electrical Machinery Laboratory at the Polytechnic, Regent Street, was formally opened on December 10, by Sir E. Henry Pelham, permanent secretary to the Board of Education. The occasion was the jubilee commemoration of the School of Engineering, which first provided an organized engineering training in 1886.

A feature of interest at the meeting was the presence of all three heads of the School, Mr. H. J. Spooner, the first head, who retired in 1922, Prof. A. R. Horne, professor of mechanical engineering at the Heriot-Watt College, Edinburgh, who retired in 1929, and Mr. Philip Kemp, the present head.

The Electrical Machinery Laboratory was first equipped in 1911 when the Polytechnic was re-built, and the machines and apparatus then installed did good service both before and after the Great War. It was realized, however, that if instruction had to be given on up-to-date lines, a thorough re-organization was necessary, and accordingly, plans were prepared for a complete new equipment. The London County Council was approached for financial assistance and a very generous grant was made, enabling the work to be begun in 1933.

The main supply to the Laboratory, which has an area of 4,800 sq. ft., is obtained from the Borough of St. Marylebone three-phase mains at a pressure of 416 volts and a frequency of 50 cycles per second. This is fed to three 20 kva. three-phase transformers in order to step the voltage down to 100 volts, which is the value chosen for the operation of the experimental plant. These three transformers can be operated singly or in parallel, and are each provided with an auxiliary boosting transformer for the purpose of maintaining a constant voltage on the experimental circuits. This voltage is ultimately maintained at a constant value by means of an automatic voltage regulator.

Direct current supplies are obtained from two 15 kw. rotary converters, each with its own transformer. A 540 ampere-hour secondary battery is also available for D.C. work demanding a steady voltage. This battery is connected to the main D.C. bus bars, but has its own separate charging plant. The experimental D.C. supply is taken to a special distribution board, before going away to the various experimental circuits.

The whole of the A.C. experimental supply is brought to a large plug board enabling single-phase or three-phase supply to be delivered to any of the experimental machines at will. If necessary, a particular circuit can be fed from one particular transformer, which can be isolated for the purpose. Signal lights are provided at various points to indicate live circuits.

Instead of using the transformers directly, alternative 100 volt A.C. supplies can be obtained from four 3 kva. three-phase alternators, these also being connected to the main plug board. Two of these alternators are separately driven by two three-phase synchronous motors, a third by a three-phase commutator motor of the Schrage type, whilst the remaining alternator is driven by a D.C. motor.

A feature of the laboratory is the large-scale diagram printed on the wall, showing the whole of the experimental supply circuits.

The four motor-alternator sets mentioned above can be used for experimental purposes as well as for supplying other machines. The synchronous motors of the first two have their stators mounted on a rack and pinion, for the study of load conditions, and they are also each provided with a Joubert contact equipment for wave form investigations.

The D.C. testing plant consists of two 3-h.p. shunt motors, two 3-h.p. series motors and two 3 kw. motor-generator sets, the motors of which can be uncoupled at will.

Converting plant is represented by a 3 kw. three-phase rotary converter and a 3 kw. six-phase rotary converter direct coupled to a 3-h.p. three-phase induction motor, so that the combination can be run as a motor-converter if required. Both these sets are provided with Joubert contacts for wave form work.

Two mercury arc rectifiers are also installed, one being a 3 kw. single phase unit, whilst the other is a 3 kw. six-phase rectifier with grid control.

Alternating current motors are represented by two three-phase induction motors of 2 h.p. and 3 h.p.

respectively, a 3-h.p. synchronous-induction motor, a 3-h.p. three-phase Schrage type commutator motor, and a 5-h.p. commutator motor which can be operated in a number of ways both single and three-phase.

A number of transformers are also available for experimental work of various types, including an equipment which can be used for three- to two-phase transformation.

Oscillatory Discharges in a Magnetic Field

HIGH-FREQUENCY oscillations produced in electrical discharges under the influence of a magnetic field have attracted considerable attention in recent years. In addition to their purely physical interest, they have proved of value to the engineer in the magnetron oscillator, a device which is quite closely related to the cyclotron, or proton accelerator, of Lawrence and Livingston. The secondary emission electron-multiplier of P. T. Farnsworth provides another example of a device in which oscillations can be produced by means of the co-operation of electric and magnetic fields; it differs from the magnetron in that the two fields are aligned instead of being approximately perpendicular.

Prof. T. V. Ionescu has recently described (*C.R.*, **202**, 1160 and 1842; **203**, 57; 1936) some interesting results relating to a somewhat similar type of discharge tube having a thermionic cathode, two ring-shaped electron-accelerating electrodes and a circular plate which could be given a positive or negative potential with respect to the cathode. A magnetic field was directed along the common axis of these electrodes. (Some results obtained with a similar kind of discharge tube were reported by Prof. K. Okabe recently in NATURE, **138**, 685; 1936). Measurement of the voltage-current characteristics of the plate at a gas pressure of the order of 10^{-7} mm. (reported by Prof. Ionescu and Mr. C. Mihul) showed that an electron current could reach that electrode when its potential was below cathode potential (presumably indicating the presence of electronic oscillations) without any magnetic field. The effect of the magnetic field was to increase this current and apparently to split it up into components having different velocities.

In further experiments at a pressure rather less than 10^{-4} mm., a luminous column appeared along the axis of the tube, between the second accelerating electrode and the plate, at a definite value of magnetic field strength. The form of this column varied with the electrode potentials, the cathode emission, and the magnetic field strength, but it apparently did not show the nodes and loops characteristic of ordinary magnetic focusing. The luminous column was found to persist for an appreciable time after the cathode emission was stopped. Electron currents up to several times the cathode emission were observed to flow away from the plate (secondary emission) and regions of negative resistance were obtained.

The tube appeared to be generating powerful high-frequency oscillations, but the available power does not seem to have been determined; the frequencies were of the order of 100–1,000 mc./s. In the last paper a theory of the oscillations is given which treats them as plasma electron oscillations modified by the magnetic field; two oscillation frequencies then arise in a way reminiscent of the Zeeman effect.

Educational Topics and Events

CAMBRIDGE.—The General Board has recommended that Dr. U. R. Evans continues as assistant director of research in metallurgy for five years from January 1, 1937, or for so long as the Iron and Steel Industrial Research Council continues its grant to the University for scientific research on corrosion, whichever period be the shorter.

It is recommended by the General Board that a readership in plant physiology be established as from October 1, 1936, and that G. E. Briggs (St. John's College) be appointed to that post.

LEEDS.—Mr. Frank Parkinson, head of the firm of Crompton Parkinson, Ltd., and an old student of the University, has given £200,000 for the proposed main frontage to the University in connexion with the reconstruction scheme now proceeding. Earlier this year, Mr. Parkinson gave £50,000 for the establishment of a scholarship fund.

SHEFFIELD.—The following appointments have recently been made: J. L. A. Grout, to be honorary lecturer in radiological anatomy: G. Clark, to be junior assistant bacteriologist; W. A. Timperley, to be research fellow in the Department of Physiology.

DR. H. S. RUSE, lecturer in mathematics in the University of Edinburgh, has been appointed professor of mathematics at University College, Southampton, in succession to Prof. R. C. J. Howland, who died in August last.

THE British Film Institute's third annual report tells of much useful work done and in progress: of answering inquiries from all parts of the Empire; supervising production of thirteen films illustrative of physical training; helping to produce thirteen films for use in the teaching of physics, ecology, and history; publishing a catalogue of British medical films; preparing for the Child Welfare Committee of the League of Nations a report on entertainment films for children, and organizing a conference for discussing the same subject; publishing a new leaflet on non-theatrical apparatus and films for schools; and maintaining the publication of the quarterly *Sight and Sound* and monthly film bulletins. Nine local branches were in operation in England and Ireland, and a Scottish Film Council represents the Institute in Scotland. All this is good so far as it goes, but it must be admitted that the growth in membership has been disappointing. On June 30 there were 597 full and 1,700 associate (branch) members. If any substantial progress is to be made towards realizing the Institute's object "to influence public opinion to appreciate the value of films as entertainment and instruction", its efforts will need to have much more vigorous and widespread backing than they have hitherto received. No local education authority in Great Britain could deny the enormous importance of the objects for which the Institute was formed, and every one of them might well be a full member and help towards the formation of a local branch; but in fact the total number of education committees in Great Britain which have joined is 36.

Science News a Century Ago

Rev. J. B. Reade on Solar Rays

AT a meeting of the Royal Society on December 22, 1836, the secretary, J. G. Children, communicated a paper by the Rev. J. B. Reade entitled "Observations and Experiments on the Solar Rays that occasion Heat; with the application of a remarkable property of these rays in the construction of the Solar and Oxy-Hydrogen Microscope". The method employed by the author for obtaining, by a combination of lenses, the convergence to foci of the 'colorific' solar rays, together with the dispersal of the 'calorific' rays, consisted in making a beam of solar light, after it had been converged to a focus, pass through a second convex lens placed at a certain distance beyond that focus; that distance being so adjusted that the calorific rays were collected into a focus more remote from the first lens than the colorific rays, and consequently nearer to the second lens. By this means, the calorific rays emerged either parallel or divergent while the colorific rays could be brought to a focus which would exhibit a brilliant light without manifesting any sensible degree of heat. The light so obtained could be advantageously applied to the solar, and to the oxy-hydrogen microscope, producing no injurious effects on objects enclosed in Canada balsam or even on living animalcules.

The Rev. Joseph Bancroft Reade (1801–70) was known for his work as a chemist, microscopist and photographer. Educated at Trinity and Caius Colleges, Cambridge, he was successively rector of Stone, Ellesborough and Bishopsbourne. In 1861 he invented "Reade's kettledrum", a hemispherical condenser for the microscope.

Specific Inductive Capacity Apparatus

TOWARDS the end of 1836, Faraday's mind was much occupied with the problem of electrostatic induction. He had been led, by the experiments in electrostatics which he had begun in November of the previous year, to speculate on the mechanism of induction, in particular, as to what was happening in the intervening air or other substance between two opposed conductors. In December he made some experiments with metal plates, charged inductively, to see if the induction measured by an electrometer varied on the introduction of plates of shellac in the space between the conductors.

Although these experiments were inconclusive, he suspected that the induction was affected by the nature of the interposed material, and hit upon a new device to test this, an arrangement of two concentric metal spheres, one within the other, with the non-conducting material or "dielectric" introduced between. The first use of this method is recorded in the "Diary" on December 23, 1836. He says: "Have had two apparatus made for Induction through air and liquids, in which an inner and an outer ball are kept at fixed distances and serve as coatings of Leyden Phials, air being between. They are numbered i and ii and are in all general respects alike. The insulation of the inner ball is by a metallic wire enclosed in a glass tube, the latter being covered well over with lacquer."

This was the famous specific inductive capacity apparatus, still preserved at the Royal Institution. With it, during 1837, he made an exhaustive series o experiments, comparing the induction through gases liquids and solids such as glass and shellac, which h cast in hemispherical form to fit between the con ductors; until he came finally to the conclusion tha each of the interposed materials had its own character istic and measurable capacity for induction, or as w should say, its specific inductive capacity or dielectri constant.

Dr. James Johnson on Health

IN the *Athenæum* of December 24, 1836, is a review of "The Economy of Health; or the Stream of Human Life, from the Cradle to the Grave: with Reflexions Moral, Physical and Physiological on the Septennial Phases of Human Existence, by James Johnson, M.D., Physician Extraordinary to the King". Dividing the life of a man into periods of seven years each, Dr. Johnson said: "the first seven years embrace the *hygiene* of the nursery; the second that of education; the third of the sexual crisis; the fourth of station in life and matrimony; the fifth and sixth of ambition; the seventh may be termed the pathological septennary, or that in which the accumulated venom of numerous petty chronic abuses of health, incidental to a civilized life, break out in positive diseases; and the eighth, ninth and tenth contain the melancholy history of the progressive decline of life, and the gradual breaking up of the effete machinery." In speaking of the seventh septennial, he said, "the immense increase not only of the pleasures, but the pains of existence resulting from a high state of civilization make calls upon the nervous system for a corresponding increase in activity. The result is a morbid increase of sensibility in the nervous system, which operating by sympathy on the nerves of the stomach, liver and other organs, changes their action and deranges their function." The subject, said the *Athenæum*, was investigated by Dr. Johnson "with much acumen and exposed with a vigour of style that is entitled to rank as eloquence".

Melloni's Investigations on Light

"THE Italian natural philosopher Melloni," said the *Athenæum* of December 24, 1836, "has recently invented a mode of depriving the rays of light of caloric, which seems to open the way to great discoveries, respecting the nature of light, thus insulated. His method is very simple: he passes the sun's rays through a combination of transparent bodies (water, and a particular sort of glass coloured green with oxide of copper), which bodies absorb all the caloric, and but little of the light. The light thus separated from its caloric is very yellow with a green tinge; and when so concentrated by lenses, as to be as bright as the direct ray, the most delicate thermometer does not show the smallest degree of warmth. It has long been known that the prism, besides dividing the ray into its several pencils of colours, separated at one end of the spectrum a pencil of heat-making rays, and at the other a pencil of chemically-acting rays, both perceptible only by their effect; but this mode of separating the heat from the light offered little means of experimenting upon the unadulterated light, of which Melloni's discovery seems to give the philosopher as complete command as he has of the gases, etc."

Societies and Academies

London

Royal Society, December 10.

A. G. MACGREGOR: Preliminary report on the geology of Montserrat. Montserrat, in the Leeward Islands, is a small member of the series of islands that form the volcanic arc of the Lesser Antilles or Caribbees. The island consists of six mountain masses and hills, each of which represents an old volcano modified by erosion. Active soufrières, emitting hydrogen sulphide gas and steam, have, however, persisted on the flanks of the Soufrière Hills, the youngest volcano, until the present day. Temperatures at the soufrières have remained low from a volcanological point of view during the abnormal gas-emission that accompanied the recent earthquakes. The eruptions of the Soufrière Hills volcano were of the Peléan explosive type, characterized by incandescent avalanches of gases, rock fragments and dust. Part of a large crater with a central "dome" and andesite can still be recognized. True lava flows are found only in the south of the island, where they were emitted from a volcano somewhat older than that of the Soufrière Hills.

C. F. POWELL: Preliminary report on seismic observations in Montserrat. An account is given of the results obtained with the Wiechert seismograph and Jagger shock recorders installed in Montserrat in April 1936 by the Royal Society Expedition. The general seismic intensity during this year has been appreciably less than in 1934 and 1935. The monthly number of observed tremors shows a succession of pronounced maxima at roughly six-monthly intervals, the times of greatest activity being May and November–December. The shocks were highly local in origin, most of the foci lying under the island. By comparing the amplitudes of the shocks recorded on the Jaggar shock recorders maintained at different points in the island, the epicentres were found to lie in a broad belt running across the middle of the island. This belt also embraces the active soufrières, but the epicentres are not confined exclusively to the immediate neighbourhood of the active soufrières. A considerable number of shocks originated at a comparatively few "active" foci. Many twin earthquakes, originating at the same focus, were observed. A number of temperature measurements were made, together with observations on the concentration of the hydrogen sulphide and sulphur dioxide.

Paris

Academy of Sciences, November 23 (*C.R.*, 203, 1037–1104).

LOUIS BLARINGHEM: A new case of mosaic in a hybrid of wallflower, *Cheiranthus Cheiri* × *Erysimum cheirantoides*.

MARCEL GODCHOT and MLLE. GERMAINE CAUQUIL: The action of hydrocyanic acid upon active 3-methylcyclohexanone.

GEORGE ALBERT BOULENGER: The genus *Herperhodos* (Rosaceæ).

J. NEYMAN: Verification of the hypothesis concerning the law of probability of contingent variable.

GEORGES KUREPA: Souslin's problem and abstract spaces.

GEORGES BOULIGAND: Partial differential equations of the first order.

VICTOR VALCOVICI: The relative movement of a solid in a viscous fluid.

JEAN MARIANI: The universe interval in relativist wave mechanics.

ARCADIUS PIEKARA and BRUNO PIEKARA: Electrical saturation and the critical point of solution.

MLLE. SUZANNE VEIL: The systematic construction of batteries with two liquids on gelatine.

RAYMOND HOCART and MAURICE FALLOT: The structure and magnetic properties of manganese boride, MnB. Results of X-ray studies on the crystals and behaviour in the magnetic field.

JEAN J. TRILLAT and SHIGUÉO OKETANI: Studies on the transformations produced in certain metals by heating in a vacuum or in air. The changes in structure produced in thin films of gold and silver by heating to 500° C. have been studied by electron diffraction.

LOUIS GUITTON: Application of potentiometric methods to the prediction of corrosion in ferrous alloys.

PIERRE DONZELOT: Structure of methyl and ethyl selenides. Deductions made from Raman and infrared spectra.

GUY EMSCHWILLER: An optimum of chemical reactivity of gases adsorbed at their critical temperature.

MLLE. YVONNE GARREAU: Oxidation of hydroquinone by air in the presence of monomethylammonium sulphite. Oxidation of hydroquinone monosulphonic acid in the presence of methylamine.

MAXENCE MEYER: Some ethylenic α-ethoxyacids.

JEAN DÉCOMBE: Condensation of ketones with formaldehyde in alkaline medium.

JEAN GOGUEL: The Cevennes border.

PIERRE AUGER, PAUL EHRENFEST, JUN., and ANDRÉ FRÉON: Studies on the cosmic 'showers' at high altitudes.

JEAN PIVETEAU: The origin and morphological evolution of tailless amphibians.

FRÉDÉRIC MARIE BERGOUNIOUX: Origin of the group of the Trionychoides.

MME. PANCA EFTIMIU HEIM: Presence and evolution of the micro-nucleolus in the Cucurbitaceæ.

MLLE. MARIE THÉRÈSE GERTRUDE: Action of the aquatic medium on the nitrogen nutrition and phosphorus nutrition of a herbaceous plant.

ROBERT LAMI: Value and variations of the salinity and alkalinity of the water contained in the cavity of *Codium Bursa*.

HENRI GESLIN: The evaporating power of the air and the humidity of the soil.

JEAN SERVY: A new index characterizing the dryness factor in agronomy.

PIERRE MENARD: Suppression of the causes of errors in measurements of arterial pressures.

MAURICE DOLADILHE and CHARLES MOREL: Contribution to the study of the influence exercised by alexin on the dispersion of a colloidal complex by a blood serum.

Moscow

Academy of Sciences (*C.R.*, 3, No. 6, 1936).

L. B. ROBINSON: A functional equation satisfied by a lacunary function.

M. KRAVČUK and C. LATYŠEVA: Application of the method of moments to the approximate solution of linear differential equations with unitary coefficients.

S. JANČEVSKIJ : Complex equation of Fredholm.

B. V. NUMEROV : Compiling a fundamental catalogue of faint stars.

B. V. NUMEROV and D. CHRAMOV : Determination of the shape of the geoid by gravity measurements.

B. V. NUMEROV : Principles of the method for the determination of the geoid on the basis of gravimetric and astronomical-geodetical observations.

S. I. VAVILOV : Productivity and duration of fluorescence.

S. I. VAVILOV and A. N. SEVČENKO : Extinction of fluorescence by the solvent.

P. BAŽULIN : Absorption of ultra-sonic waves by acetic acid.

N. DOBROTIN : Absorption of neutrons in silver, cadmium and boron (2).

L. A. DREMLJUG : Morphology and cytology of the hybrid of *Nicotiana paniculata* × *N. langsdorfii*.

K. V. KOSSIKOV : A new duplication in the *X*-chromosome of *Drosophila melanogaster* and its evolutionary significance.

V. M. KATUNSKIJ : Short periodical illumination as a method of controlling the development of plant organisms.

P. J. SCHMIDT, G. P. PLATONOV and S. A. PERSON : Anabiosis of fish in super-cooled water (see NATURE, Dec. 5, p. 977).

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 567–619, Oct. 15).

CLAUDE E. ZOBELL and HELEN M. MATHEWS : A qualitative study of the bacterial flora of sea and land breezes. Wind is an important factor in the exchange of land and sea bacteria. Although many marine forms may survive in the soil, and few terrestrial bacteria survive in the sea, yet exposure of culture plates showed the presence of marine bacteria 30 miles inland, and terrestrial forms 130 miles at sea during relatively calm weather. Bacterial content may aid in indicating the origin and course of large air masses.

L. J. STADLER and G. F. SPRAGUE : Genetic effects of ultra-violet radiation in maize. (1) Unfiltered radiation. Irradiation of pollen greatly increased the frequency of both entire and fractional endosperm deficiencies, and point mutations affecting seed and seedling characters were induced ; but no increase in frequency of translocation was observed. (2) Filtered radiation. Radiation of wave-length λ 3130 and longer is relatively ineffective, while λ 3022 and shorter wave-lengths are effective in inducing deficiencies. (3) Effects of nearly monochromatic λ 2537, and comparison of effects of X-ray and ultra-violet treatment. With radiation from a quartz mercury discharge tube, the relative frequency of induced deficiency is about the same as that for longer wave-lengths, but the maximum dose tolerated is much lower. X-rays (1333 r.) produced deficiencies most of which affected the whole endosperm, while a large proportion of deficiencies produced by filtered ultra-violet light affect approximately half the endosperm. The frequency of germless seeds produced by pollen irradiated with X-rays was very much higher than for pollen treated with filtered ultra-violet light.

B. P. KAUFMANN : A terminal inversion in *Drosophila ananassæ*.

TZE-TUAN CHEN : Observations on mitosis in Opalinids (Protozoa, Ciliata). (1) The behaviour and individuality of chromosomes and their significance. In *Zelleriella intermedia*, from the rectum of a toad, there are two identical nuclei, each with 24 chromosomes arranged in twelve pairs ; the chromosomes are recognizable by constant differences of size, structural peculiarities and position of point of fibre attachment. The behaviour of the chromosomes in cell division is fundamentally the same as that of chromosomes of higher animals and plants. (2) The association of chromosomes and nucleoli. Nucleoli, four, six or more number according to the race of *Z. intermedia* under investigation, are found, each pair occupying a definite non-terminal position on a specific pair of chromosomes. Unlike the nucleoli of higher organisms, they maintain their relation with the chromosomes during cell-division, dividing with the chromosomes. The nucleolar material is considered not to be identifiable with the macrochromatin of the macronuclei of other ciliates.

H. BATEMAN : Progressive waves of finite amplitude and some steady motions of an elastic fluid. A theoretical discussion.

Official Publications Received

Great Britain and Ireland

Croydon Natural History and Scientific Society. Regional Survey Atlas of Croydon and District. Pp. 19+12 plates+Locator template. (Croydon : Roffey and Clark, Ltd. ; London : Thomas Murby and Co.) 12*s.* 6*d.* [212

P E P (Political and Economic Planning). Report on the Supply of Electricity in Great Britain : a Survey of Present-day Problems of the Industry with Proposals for Reorganisation of Electricity Distribution. Pp. vi+171. (London : P E P.) 6*s.* net. [412

Twenty-seventh Report of the Commissioners of His Majesty's Customs and Excise for the Year ended 31st March 1936. Being the 80th Report relating to the Customs and the 79th Report relating to the Excise. (Cmd. 5296.) Pp. 219. (London : H.M. Stationery Office.) 3*s.* 6*d.* net. [412

The Teaching of General Science : Science Masters' Association Interim Report of the Sub-Committee appointed in 1935, adopted by the General Committee in 1936. Pp. v+49. (London : John Murray.) 2*s.* 6*d.* net. [712

Electricity (Supply) Acts, 1882 to 1936 : Sixteenth Annual Report of the Electricity Commissioners, 1st April 1935 to 31st March 1936. Pp. 195. (London : H.M. Stationery Office.) 3*s.* net. [812

Technical Publications of the International Tin Research and Development Council. Series A, No. 47 : The Preparation of Tin and Tin Alloys for Microscopic Examination. By H. J. Taffs. Pp. 9+5 plates. (London : International Tin Research and Development Council.) Free. [912

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 5 : The Uses of Rubber in Stable Management. By Alexander Hay. Pp. ii+16. (London : Rubber Growers' Association.) Free. [912

Other Countries

Les bases de l'influence des phénomenes solaires en météorologie. Par Henri Mémery. Pp. 32. (Talence : Observatoire de Physique solaire et Météorologie.) [112

Astrophysica Norvegica. Vol. 2, No. 1 : On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Applications to the Theory of Cosmic Radiation. By Carl Størmer. Pp. 124+20 plates. (Oslo : Jacob Dybwad.) [112

A Compendium of Minerals and Stones used in Chinese Medicine from the Pen Ts'ao Kang Mu, Li Shih Chen, 1597 A.D. Compiled by B. E. Read and C. Pak. (Published by the Peking Natural History Bulletin.) Second edition. Pp. viii+98. (Peiping : The French Bookstore.) 1.50 Chinese dollars. [412

II Internationalen Kongress für Krebsforschung und Krebsbekämpfung (IInd International Congress of Scientific and Social Campaign against Cancer.) Vol. 1 : Referate (Reports). Pp. xvi+503. (Bruxelles : Comite National d'Organisation.) [412

U.S. Department of Agriculture. Circular No. 401 : Control of the Japanese Beetle and its Grub in Home Yards. By W. E. Fleming and F. W. Metzger. Pp. 15. 5 cents. Circular No. 410 : Results from Breeding Rabbits that are Suckling Young. By Chas. E. Kellogg. Pp. 8. 5 cents. (Washington, D.C. : Government Printing Office.) [712

Report on the Administration of the Meteorological Department of the Government of India in 1935–36. Pp. ii+37+2 plates. (Delhi : Manager of Publications.) 14 annas ; 1*s.* 6*d.* [712

Catalogues, etc.

Second-hand Books in many Departments of Literature, together with a Selection of Remainders. (Catalogue 400.) Pp. 74. (Oxford : B. H. Blackwell, Ltd.)

Calendar for 1937. (Newcastle-on-Tyne : C. A. Parsons and Co., Ltd.)