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British Chemical Industry.

DURING the past hundred and fifty years or less, scientific method in general and chemical research in particular have gradually invaded the industrial arena. Some of the results of this invasion are patent even to the least initiated, whilst others are accepted without a thought of their origin. Popular interest in scientific research is a thing of recent development; it is only in quite recent years that science, even industrial science, has been 'news', but there is now no lack at least of lip service to the part which it plays in industrial prosperity, as well as in providing the minor needs and newer comforts of everyday life. A few casual preparations excepted, chemical manufacture scarcely existed at the close of the eighteenth century; fifty years ago it was still but an apprentice in the world's workshop. Now it is one of the great fundamental businesses of the civilised world, and one which plays a large part in the maintenance of Britain's industrial, and therefore political, equilibrium. The industry is peculiarly one which depends for its very existence on discovery and invention; it is born in the test tube and nurtured on the laboratory bench in universities and in the research departments maintained by the State and by industrial concerns. It is an industry which demands continuous improvement in its methods, and offers unlimited opportunities of development and expansion; it cannot stand still, but must ever move forward along the paths mapped for it by an army of trained investigators.

Chemical industry is not, of course, exempt from the operation of the so-called laws of economics, and in the present period of world-wide depression it shares in the common suffering; how far the state of the market may be attributed to overproduction, to irrational or antiquated technique, or even to fundamental defects in our commercial methods or in our social system itself, must remain for the present a subject for study and discussion. Nevertheless, reports of progress assure us that the chemical industries are, on the whole, affected less than others, and that this circumstance is largely owing to the astonishing technical progress which is being made in every direction. It may also be due—in fact, it can scarcely fail to be due in some measure—to the familiarity of the directors of such concerns with the results accruing from the daily application of scientific methods of research and control, and to their determination to apply similar methods to management and salesmanship. The customer has to be studied no less critically than the process;

and to preach co-operation while ignoring the advantages of standardisation is to invite a well-founded charge of inconsistency. Standardisation is a word which, rightly, assails our social and artistic feelings, but in industry it is a potent economiser and an efficient lubricant; the attention which it is now receiving—exemplified by the formation of a new Standards Association which includes the chemical industries—is therefore a matter of surprise only in respect of its somewhat tardy appearance. In another report on applied chemistry we read that "in spite of the world-wide depression in the iron and steel industries . . . much attention has been devoted to improvements . . . and modifications . . .", whilst from yet another we learn that "the experience of the oil-seed, fatty oil, and allied industries has proved no exception to this general phenomenon [of depression, loss, and unemployment]. . . . These industries, however, owe much of their present strength to the extent to which rationalisation has proceeded in them, commercial foresight having made much use of scientific discovery and technical development."

One reason, evidently, for the citizen's new interest in scientific discovery and invention, and therefore in scientific education, is to be sought in a realisation of the close connexion between the acquisition of new knowledge and the stability of his own economic position; at the same time he may fairly be credited with an increasing interest in the knowledge itself, an interest which deepens as his own education widens. He will shortly have an opportunity of displaying that interest, and of surveying the circumstances in which the chemical industries have reached the position which they now occupy in Britain. This year the Society of Chemical Industry celebrates the fiftieth anniversary of its foundation. A scientific society fifty years old does not now rank as juvenile, yet how short a period is fifty years in a nation's life! As a contribution to the jubilee celebrations, Dr. Stephen Miall, editor of *Chemistry and Industry*, has written an account * of the development of chemical manufacture in Great Britain. For reasons which we have examined, his book will be regarded by many intelligent, although not scientific, people as one of the more important publications of recent years; scientific people will welcome it as a noteworthy work of reference which is unique in its authority and scope. Dr. Miall has accomplished a task of some difficulty, for until 1882 there was no journal devoted to British chemical industry, and, moreover, there were few books that attempted to describe the progress of any considerable parts of the industry. By combining the advantage of personal contact with its leaders with the goodwill shown by members for an object undertaken by their society, he has received a great mass of valuable information which otherwise might, in a few years, have been irretrievably lost; it is this fact, no less than the attractive manner of presentation, which recommends his story to chemists and non-chemists alike.

It might be thought that the manufacture of 'heavy' chemicals, such as alkali and sulphuric acid, is at least a simple, self-contained, and established process which offers little bait to the pioneer; yet we learn how complex it has become, how one part is dependent on others, and "almost every effort to prevent waste involved the manufacture of some new product". Unfamiliar names and unsuspected associations will whet the curiosity of the student of chemistry: Josias Christopher Gamble, who, like Joseph Priestley, was a minister of religion and devoted much attention to chemical experiment, became a manufacturer of bleaching powder, alum, sulphuric acid, and Glauber's salt; whilst Walter Weldon's fame is reputed to be shared by the history of bleaching and of ladies' fashions.

Economists tell us that prices depend on the gold output; Dr. Miall observes that the increase from about seven million ounces in 1887 to about twenty million ounces now is largely due to the invention of the cyanide extraction process by a chemist named MacArthur and two brothers, Glasgow medical men, named Forrest. It is obvious that material success will always be dependent on business acumen as well as on technical advance, and this subject is discussed in the chapter on the dyestuffs industry in relation to the acknowledged supremacy of the German dye industry during the forty years or so preceding the War. The reasons which Dr. Miall advances are concerned with the patent laws, with the lack of import duties, with relative business ability, with selling organisation, with inadequate opportunities for the publication of new discoveries, with our lack of chemical engineers, and with the fact that in the late 'sixties and early 'seventies there were far greater facilities for learning organic chemistry in Germany than in England. This reason is regarded as almost sufficient without any others, and its prominence is a striking commentary on the anxiety with which professors of organic chemistry in Great Britain recently regarded a proposal—since fortunately postponed—to remove certain importa-

* A History of the British Chemical Industry: Written for the Society of Chemical Industry on the Occasion of the Fiftieth Anniversary of its Foundation. By Stephen Miall. Pp. xvi+273+35 plates. (London: Ernest Benn, Ltd., 1931). 10*s.* 6*d.* net.

tion restrictions on dyes. Their knowledge of the history of the dyestuffs industry in Great Britain and of the intimate relation which subsists between the work of the universities and the future of this and allied industries aroused justifiable fears that organic chemistry itself, and with it the vitality of the dependent industries, would suffer severe damage by premature removal of that protection.

Abounding evidence is presented by Dr. Miall of the generous way in which successful industrialists have endowed the prosecution of scientific researches; the results have proved not merely a source of profit and a means of increasing employment, but also a source of inestimable material benefit to the human race. In some instances the endowment has taken the form of financial aid to existing research departments of academic institutions and of the creation of fellowships for the support of investigators; in others, of the foundation of new centres of research. A notable example of the latter form of service to humanity is to be found in the enterprises of the Wellcome Foundation, Ltd. These include a Bureau of Scientific Research, an Entomological Field Laboratory, a Museum of Medical Science, Tropical Medicine, and Hygiene, Physiological Research Laboratories, Chemical Research Laboratories, and a Historical Medical Museum. Thus a firm engaged in the manufacture of drugs and fine chemicals seeks to promote progress in the discovery, manufacture, and use of new and important means for the alleviation of human ills.

This outlook, this conception of social duty, is typical of a number of members of the British chemical industry, and the nation has reason to be grateful for the public spirit which is thus demonstrated; they will not be grudged the commercial advantages which their policy affords, and their example will be commended to other industrial firms in a position to do likewise. It may be true, as Dr. Miall says, that the man of business pursues money, the man of science pursues truth, and the man who attempts to do both is handicapped in each direction; the shrewd observation can scarcely be claimed to apply to co-operative effort by men of business associated with men of science. The former know that truth pays, and the latter nowadays at least escape the fate of Leblanc or Lavoisier. Moreover, fickle chance may smile upon them, as it did upon Caro's (but not upon Perkin's) alizarin patent, or upon Perkin's failure to synthesise quinine, or upon Spence's basin of alum. But accidents and failures are, on the whole, best avoided. A hundred years ago, Prof. Thomas Thomson published a history of chemistry which is still read with pleasure and profit by students of chemical science. "Let the science advance for another century", he wrote in 1831, "with the same rapidity that it has done for the last fifty years, and it will produce effects upon society of which the present race can form no adequate idea." In 1931 Dr. Miall writes: "Chemical research and technical research proceed in a manner which is satisfactory, and the skill of our chemists and chemical engineers is such that they can cope with all the demands of the industry. We may be confident, notwithstanding present difficulties, that there will be enormous advances during the next twenty years in the application of science to industry, and that much of this advance will be due to chemists." In a foreword, Sir Harry McGowan declares that "To be worthy of our fathers is to surpass them". What will be the historian's verdict in 2031?

Electron Diffraction.

The Wave Mechanics of Free Electrons. By Prof. G. P. Thomson. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University, Vol. 8.) Pp. v+172. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 12*s.* 6*d.* net.

ALTHOUGH de Broglie's first suggestion that moving particles might be accompanied by a wave system was based primarily on the consideration of free electrons, the first development of the wave mechanics, subsequent to the advance made by Schrödinger, was largely concerned with stationary states of bound electrons and their immediate properties, such as their energies and the possibilities of transitions between them. This is not surprising, since any system of atomic mechanics must at least account for the existence of stationary states and their properties, and Schrödinger's development occurred at a time when the limitations of the orbital quantum theory, after its initial successes in this field, were becoming seriously felt.

Though its success in these applications was the first physical justification for the concept of waves accompanying moving particles, they are primarily theoretical, and to follow them in detail often demands considerable mathematical equipment. They appear somewhat sophisticated, and a physicist might well ask for some simpler and more direct evidence for the waves before taking them seriously and endowing them with some sort of physical reality. Such direct evidence is provided by the

diffraction and interference phenomena shown by electron beams, which form the subject of the book under review and which its author was one of the first to study. Here he provides an eminently readable account of the experimental material and relevant theory, the balance being more on the experimental side than in most books on wave mechanics.

In the account of the experimental evidence, the author has kept strictly to his title, and only considered the phenomena shown by electrons. The pioneer experiments of Davisson and Germer on the diffraction of electron beams by crystals, the author's own work, and that of Rupp and of Kikuchi are clearly and carefully discussed, with a certain amount of technical detail which should be useful to others working on similar lines, and other work is referred to more shortly.

In the final chapter are considered some applications of the phenomena of electron diffraction, mainly to the study of surface films on solids. Among the differences between X-rays and electrons as tools for the investigation of the structure of matter are the smaller penetrating power of the electron beam and the much smaller amount of matter required to give a diffracted beam of electrons of photographable intensity; and these properties make the electron beam particularly valuable for the investigation of surface effects. It seems likely that many other applications of this tool of physical research will be found in the next few years, and some may well come to have technological importance.

As well as the experiments on diffraction, for which the results are very definite and the interpretation clear and simple, an account is given of those on refraction and polarisation, for which neither the results nor their interpretation are so definite.

The account of the experimental evidence on the diffraction of electron beams is preceded by an introductory chapter in which the antithesis between wave and particle properties and the dual nature of light and electrons are clearly put, and by three chapters dealing with the properties of waves in general, their diffraction by a space lattice, and a preliminary formulation of wave mechanics.

Following the account of the diffraction experiments come two chapters on the effect of refraction on the diffraction of electrons by crystals, and the intensity of scattering of electrons, considered mainly experimentally, with references to the theory; then follow two chapters on the theoretical interpretation of the phenomena, and one on the magnetic electron.

The interpretation of wave mechanics is a subject on which it is notoriously difficult to obtain complete agreement, and while recommending Prof. Thomson's theoretical discussions, the reviewer cannot agree with him at all points. One of the fundamental questions is the physical interpretation of the wave function ψ, which seems to merit closer discussion than it is given, in view of its central position in wave mechanics as a physical theory. Schrödinger's interpretation of $|\psi|^2$ as electron density is adopted at first, without a suggestion of its limitations, and the transition to Born's probability interpretation seems to be made rather casually; the more general validity of the latter would have been strongly emphasised by an example, such as that of partial transmission and partial reflection of a wave packet at a potential discontinuity, in which the interpretation in terms of electron density does not hold.

The application of wave mechanics to a system containing many interacting particles is only considered very shortly, but seems to have a very close bearing on the physical significance of wave mechanics, as in general it is found to be quite essential to consider the wave representing the whole system as a wave in co-ordinate space, and not as a superposition in ordinary space of the waves of the separate particles (although the latter may sometimes be useful as an approximation). If the wave of one electron is given a physical reality, this can scarcely be denied to the wave of a two-electron system; but this means giving a physical reality to co-ordinate space, which most physicists probably regard as a purely mathematical concept.

This suggests one answer to a question asked by Prof. Thomson, "What is the medium which transmits electron waves?" But even without this argument we might reply, "For what is a medium wanted?" Surely by now we have a more general concept of a wave than one which needs a displaceable medium as "a nominative of the verb 'to undulate'". Even a sound wave can be regarded primarily as the propagation of a pressure variation (which happens to be accompanied by a displacement), and if we speak of a wave of epidemic sweeping across a country (as we could do accurately, not only figuratively), we mean that the measure of the incidence of the disease varies in a particular way, and there is no suggestion of displacement of a medium in this case. Even the treatment of light waves which pictures them as due to displacements of an 'ether', implies a 'sub-ether' to provide a frame of reference for the displace-

ments of the 'ether', and Prof. Thomson rightly objects to sub-ethers.

All who are interested in wave mechanics as a physical theory, and not only as a field for mathematical exercise, will find this book of interest and value, and stimulating in its discussion of points on which divergence of opinion is still possible. Among others, those who are making their first acquaintance with wave mechanics will find it valuable. In an introductory presentation, we may either follow the historical development, which may tend to upset the balance of the subject by unduly emphasising the stationary states, or we may start with the diffraction and interference phenomena of electron beams as established experimental facts and develop the theory from them. There is little doubt that the latter will usually be found the more convincing, and for this reason particularly we welcome a book in which the experimental evidence for these phenomena is collected and considered in detail, and especially one such as the present, in which theory and experiment are so well blended. D. R. HARTREE.

Auto-frettage, and the Theory of Strain.

War Office. Overstrain of Metals: and its Application to the Auto-Frettage Process of Cylinder and Gun Construction. By Major A. E. Macrae. Pp. ix+378. (London: H.M. Stationery Office, 1930.) 21*s*. net.

BETWEEN 1840 and 1850, Rodman, in the United States, investigated a new method of casting thick iron cylinders. He cooled the bore so that the inside hardened first. The outside, cooling afterwards, contracted and thereby placed the cylinder wall in a state of stress, compressive on the inside, tensile on the outside. Further work was done forty years later by Kalakoutsky in Russia, by Prof. Perry at the beginning of the present century, and by M. Malaval during and since the War; the modern method of achieving the same result being to expand a forged steel cylinder hydraulically into the yield range, so that on release of pressure the permanent set of the interior places the exterior in elastic stress. Major Macrae now gives us a very complete record of the work done at Woolwich on this subject. Written mainly for gun-makers, this book should be of interest and value also to engineers in general, who will find therein a vast fund of experimental data on the testing of metals under both tensile and compressive loads up to and exceeding the elastic limit, and on the most suitable heat treatment to restore elasticity that has been lost by overstrain.

No time is wasted by the author on the work of his predecessors, no doubt justifiably; but there is a notable omission in Chap. iv. from the list of hypotheses which determine the criterion of failure of a metal. No mention is made of the 'strain-energy' theory propounded by Prof. James Thomson. The derived relation, $T^2+P^2+2\sigma TP=E^2$, is not so convenient to work with as that of the shear theory, giving in its simplest form $T+P=E$, which fortunately appears to give good results up to a point, but it might have been included in such a general review.

The first two chapters are mainly concerned with definitions and a review of some accepted principles. Chap. iii. contains the results, both tabulated and diagrammatic, of the principal preliminary experiments on the overstraining of steels, gun-metal, and manganese-bronze, and on the most suitable heat treatment to be applied after the process. The results are well arranged, and it is in this chapter that the civil engineer will find most of the 'meat'. Chap. iv. is devoted to steel cylinders under elastic strains; Chap. v. to the theory and practice of the new 'auto-frettage' method of gun construction. The argument of this chapter, particularly at the beginning, is very well and clearly built up. The experimental results on which the theory is based are extremely well set out in a series of diagrams.

Of the mathematical treatment it is not possible to be so enthusiastic. The arithmetical development is laborious, frequently redundant, and not always strictly logical. The classical theory of elastic stresses in a cylinder is revised, and at first sight there appears to be a proof (on p. 124) of the assumption, usually specified, that longitudinal stress is constant throughout a section of a tube. The apparent proof rests on the finding that $T-P=$constant; but the fact that $T-P$ is constant is inherent in the two differential equations:

$$\frac{d(PR)}{dR}=-T, \quad . \quad . \quad . \quad (2)$$

and

$$\frac{d(TR)}{dR}=-P. \quad . \quad . \quad . \quad (3)$$

Where does (3) come from? The equation before (2) on p. 123, from which it purports to come, gives (2) but not (3). Actually (3) is only correct if it is already assumed that $T-P=$constant. In other words, this assumption is tacitly made, though not stated, when equation (3) is inserted, and the equation is then used to prove the assumption that has already been made.

The development of the shear theory that is used

considers stresses in two dimensions only, though in the majority of cylinders (gun tubes included) there are stresses in three dimensions. The author, on p. 137, advances an argument for neglecting longitudinal stress, but here he is not very convincing. There is evidently a need for a more general treatment of the theory.

A very convenient assumption made throughout the book is that the cross-sectional area of a cylinder remains constant during strain. But a word of caution is necessary. "By the Conservation of Volume . . ." is written on p. 201, much as if it were a principle analogous to the conservation of energy. As a principle it should, it is thought, be regarded with considerable reserve. The experimental evidence is interesting. Some figures support the assumption; others do not. On p. 275 it is wrong by $1\frac{1}{2}$ per cent and on p. 279 by 5 per cent. Yet it is an extremely useful assumption to make, and it is hard to see how we can get along without it.

The last three chapters are devoted to problems that mainly concern the gun-maker. To him, the book is full (perhaps too full) of formulæ designed to give an answer to every numerical question that is likely to arise in his work. It is easy to criticise such a book: by a stringent revision of its mathematics there is no doubt that a considerable saving of space would have resulted, together with a great increase in readability. Classification and headings of sections, and indexing also, leave something to be desired. But as a record of an immense amount of careful and organised labour during years of experiment and research; to the engineer for its copious experimental results; and to the scientific worker for its unexplained curiosities—such as the bending in of the recovery curve before the stress on a test piece has been fully released (shown in the pull-push diagrams in Chap. iii.); the change in stress without change in strain after the application of heat (section F, Chap. v.); or the significant similarity between the cyclic curves in Chap. ii., and the *BH* curves obtained in finding magnetic hysteresis loss—it is a valuable contribution to that foundational fringe by which we are approaching a new aspect of scientific knowledge. To refer only to one parallel investigation—Herbert's recent work on the remarkable hardening properties of a metal when rotated in a magnetic field (*Proc. Roy. Soc.*, vol. A, 130, No. 814)—it is evident that a new line of inquiry requires attention. The question which all this subject brings so insistently before us is: Why do the atoms of a metal cling together at all? What really are the forces that oppose strain? Why, in fact, is a metal a metal, and not, for example, a gas?

Major Macrae's book is written for engineers and is not directly concerned with questions of this kind. But it is an important work, with which everyone interested in these matters should make himself familiar.

Indian Ethnography.

The Mysore Tribes and Castes. By the late H. V. Nanjundayya and Rao Bahadur L. K. Anantha-krishna Iyer. (Published under the auspices of the Mysore University.) Vol. 3. Pp. viii + 619 + 76 plates. (Mysore: Government Oriental Library; Bangalore: Government Book Depot, 1930.) 12.8 rupees.

THOSE interested in Indian ethnography will welcome the appearance, after an interval of twelve months, of vol. 3 of the Mysore Survey Records, carrying the reader from C to K. The volume opens with a somewhat lengthy article on Christians (Roman Catholic and Protestant), which might clearly have been very considerably curtailed. In a work such as this, which deals primarily with tribes and castes, any attempt to convey the essentials of the Christian creed and ritual seems at first sight a little out of place. We are given parts of the marriage service, and certain well-known prayers which are obviously available elsewhere; whereas, a detailed description of such caste distinctions as the Roman Catholic Church has thought it wise to tolerate as a concession to the engrained prejudices of converts is unfortunately not to be found. In Goa and the adjacent Portuguese territory, it has been found that three classes, Brahman, Charado (that is, Kshattriya), and Sudra Christians, remain as an indication of the converts' former Hindu status. We should have been interested to learn whether, in Mysore, the caste distinctions permitted, as indicated on p. 56, take a similar or a more detailed form.

The student, however, will find in the rest of the volume much that will amply repay the effort of careful study. Unquestionably, one of the most valuable additions to our present knowledge of the castes of Southern India is the admirable tables on pp. 579-582 giving details of the exogamous divisions of the trading caste known as Komatis or Shettis. According to the author of the article on Komati, these traders style themselves Vaishyas, claim to have come to Mysore from Ayodhya, and to have been divided into 102 exogamous *gotras*. These *gotras*, as the writer points out, are really totemistic

divisions named for the most part after well-known trees, plants, fruits, and flowers. We recognise at once the *Rui* (*Calotropis gigantea*) and the *Shami* (*Prosopis spicigera*) which apparently constitute the totems of the Kausika and Valmiki *gotras*. A comparison of the 101 entries in his list with the well-known *devaks* of the Marathas and kindred tribes in the Deccan discloses a remarkable series of coincidences, and is therefore of no little importance.

We are informed (p. 542) that the use of the article known as the totem is eschewed; and that when there is any doubt concerning the correct totem for a subdivision, it is usual to fall back on the screw-pine (*Pandanus odoratissimus*), itself a well-known totem in the Deccan and elsewhere, which they must abstain from using.

In Indian ethnology, it is well known that the lower the status of the tribe or caste dealt with, the more usual it is to find marriage regulated by totemistic divisions, and the larger the number of articles embraced by such totem lists. It is particularly noteworthy that Komatis, as we have found in the case of the Marathas in the Bombay Presidency, still possess so much evidence of a primitive origin.

As was to be expected, we find in this volume a good list of similar divisions among the Holeyas, a low caste of scavengers and dealers in horns and hides. Reference should also be made to the articles on Gollas, Halepaiks, Helavas, and Kadu Gollas by those interested in further lists of totemistic divisions. The lists would have been more valuable if the writer could have supplied, in each case, the botanical name of the tree or plant referred to, in order to assist identification and comparison with the contents of other lists. On pp. 169-174 and on pp. 540-541 will be found a list of words used by Dombars and Komatis that may be of interest to philologists. Many of them seem, at first sight, to be mere corruptions of other and well-known forms of the same words.

An interesting sidelight on primitive customs is furnished by the note on p. 168 under the article on Dombars, a wandering tribe of acrobats and tumblers. It appears that it is considered a great sin among Dombars to kill a cat; but that this offence can be washed away by eating the cat afterwards! This seems a very simple way of avoiding the wrath of the cat-godling involved.

There is so much good material in this volume that a critic is disposed to restrict adverse comment to a minimum. But a few such comments seem called for. The cross-references in the case of synonyms and subdivisions have again been omitted. It is understood that this defect will be made good when vol. 1 is finally published; but such cross-references ought to be in alphabetical sequence in each volume, to be of real value to the student.

Misprints are undesirably frequent; on p. 518, footnote, "Tile" for "Title" makes nonsense of a translation of the Kanarese word *biradu*; on p. 580, "Hilly Basil" scarcely suggests the "Holy Basil" (*Ocymum sanctum*), for which it seems to be intended. The name of the writer of this review has been spelt in three different ways, and we again find the late superintendent of the Ethnographical Survey of the Central Provinces unfairly referred to repeatedly as Russel. The illustrations are in many cases excellent; but here again a little more care in correcting the spelling would have been useful. *Kare okkalus* are black cultivators (corresponding to Kala Kunbis in Marathi); *Kara okkalu* does not convey the same meaning. The tailor caste, which is the subject of an excellent article, appears as Dārzi in the text and Darji in the illustrations. Such small blemishes are surely both avoidable and unnecessary.

However, we may genuinely offer our congratulations to the compiler on the progress that is being made with the publication of these valuable records; and we shall await the two remaining volumes with much interest. R. E. E.

Short Reviews.

Instinct and Intuition: a Study in Mental Duality. By G. B. Dibblee. Pp. 394. (London: Faber and Faber, Ltd., 1929.) 25*s*. net.

MR. DIBBLEE was led into researches into the nature of intelligence, instinct, and intuition by his previous work on the "Psychology of Supply and Demand and of Economic Value". His conviction that demand is dependent upon value, and that value is determined by "plain human unreasoning instinct" rather than by intelligent judgments, made him desire to understand more about the psychological process underlying human reasoning and what he calls extra consciousness, as well as about its physiological basis.

According to Mr. Dibblee there are, physiologically speaking, two areas of intelligence in man. There exists "an instinctive intelligent faculty, lying on the physiological side of our central faculty of conscious reason, and . . . an intuitive faculty, lying on the intellectual side, a partner, in fact, of the intellect, but outside the limits of conscious operation". The seat of the first is in the thalamus, that of the second in the cortex. He thus breaks away from Lloyd Morgan, who finds the seat of human intelligence mainly, if not solely, in the cortical area.

Mr. Dibblee is not afraid of frankly metaphysical hypotheses—nay, prophecies. He believes in the coming of telepathy: "We shall recognise as a commonplace fact, that unknown vibrations and waves are passing between individuals all the time. The method of physically tuning waves and vibrations, so as to be serviceable in personal communications, will no doubt be becoming as much a branch of psychology as now it is to study the internal mechanism of the eye or the ear." Whether this horrible prophecy will come true is, fortunately, not certain, as most physicists would agree. We should obviously be deprived of the last resort of privacy, morals, and decency, and life itself would become intolerable.

In the last paragraph of the book, Mr. Dibblee tells us that "the parallel capacity in our intuitive faculty brings us extra-consciously into intimate relations with minds or a mind quite probably very different from our own". Thus the book will no doubt be taken up by the metaphysical schools of thought in our modern culture, and if the argument be physiologically sound, it certainly provides a charter for a new psychology of religious revelation.

Exploring for Plants. By David Fairchild. From Notes of the Allison Vincent Armour Expeditions for the United States Department of Agriculture, 1925, 1926 and 1927. Pp. xx+591. (New York: The Macmillan Co., 1930.) 21*s.* net.

THE author of this work is the head of the Foreign Plant Introduction Service of the U.S. Department of Agriculture. To deserve his attention, plants must have at least some political economic value, though he delights in the charm of the settings where his subjects occur. Every effort must concentrate on the introduction and establishment of the plant within the United States; all standards and comparisons are by American values. It is given to few to be allowed to indulge their fancies; Dr. Fairchild had a unique opportunity to follow his hobby and the work in which he delights, thanks to the assistance of Mr. Allison V. Armour and his yacht the *Utowana*. His party visited the Canaries and Mediterranean countries, parts of Malay, and West Africa.

"Exploring for Plants" is the record of the expert economic botanist, who recounts, with the freshness of first impressions, the plants and plant products he observed and collected, the food, peoples, and customs of the countries visited, and the vicissitudes of the three expeditions. There was little that escaped the keen eye of Dr. Fairchild, and toll was levied of every plant bearing seed, in the hope of being able to establish it in some part of the United States.

The book is profusely illustrated with pictures, but the only maps are two line blocks tucked away towards the end. The author is an experienced traveller, and on the far eastern tour he, unfortunately, had several opportunities of proving his conviction that one must be ill in a foreign country in order to know what the civilisation of that country is like.

The Elements of Analytical Geometry. By J. I. Craig. Vol. 1: *Straight Line and Circle.* Pp. xiv+415. (London: Macmillan and Co., Ltd., 1930.) 12*s.* 6*d.*

IT is not often that the writer of a mathematical book is privileged to have such a varied experience as the author of this volume. Mr. Craig declares in the preface that he has been called upon to "deal with questions in fields as diverse as Celestial Mechanics, Sport, Geodesy, Hydrography, Meteorology, Ballistics, Census, Agriculture, Food Supply, Statistics, Pensions, Public Health, and Currency Theory". In all these, he pays a tribute to the value of the mathematical habit of thought, in general, and to the practical utility of analysis applied to geometry, in particular. The course embodied in the book is the immediate outcome of lectures delivered at the Royal School of Engineering, Cairo, and these are based to a large extent on a long experience in the application of analytical geometry to the solution of practical problems. The straight line and circle form the subject matter of this first volume, and the treatment is not only full—trilinear and tangential co-ordinates and vector equations of the circle being included—but also, as might be anticipated, is characterised by numerous practical applications. Amongst these, such interesting topics as railway curves, circular nomograms, and sound-ranging are excellently dealt with. Whilst, however, the book certainly has a practical bias, the theoretical side is not only well covered, but also appears to be mathematically sound. The volume, which has also been translated into Arabic, should be very useful, especially to the engineering student who desires more than a superficial knowledge of analytical geometry.

Chemische Thermodynamik: Einführung in die Lehre von den chemischen Affinitäten und Gleichgewichten. Von Prof. Dr. Hermann Ulich. Pp. xvi+353. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 18·50 gold marks.

IT is a pity that some universal agreement cannot be attained in the symbolism employed in thermodynamics. Prof. Ulich in this volume on chemical thermodynamics uses symbols which differ from those employed by Nernst, Gibbs, and G. N. Lewis, and thus does not subscribe to either a European or an American standard. This defect is to some extent mitigated by the fact that a compilation of the thermodynamic symbols employed by different authors is given in the introduction. Many books on chemical thermodynamics are inclined to stress the purely mathematical treatment, without bringing the significance of the various equations home to the physical chemical reader by examples. This volume may be commended, in that numerous applications of the three laws are given. It is agreeable to find entropy tables both for elements and compounds now included in a text-book on thermodynamics, as well as exemplification of the practical utility of Gibbs's chemical potential function μ. The last chapter in the book, on surface phenomena, is the least satisfactory; but in the others the reader will find much of interest and of value. E. K. R.

Development of the Hudson Bay Region and the North-West Territories of Canada.

By Dr. BRYSSON CUNNINGHAM.

THE romance of the mythical 'North-West Passage' which inspired the hopes and fascinated the imaginations of the pioneer navigators of the sixteenth century and their successors for several generations thereafter, has had a curious and interesting sequel of recent years, culminating, after some hesitations and two changes of programme, in the approaching completion of a new commercial port and harbour on the western coast of Hudson Bay, forming the terminal of a branch railway line from the Winnipeg-Prince Albert section of the Canadian National Railways, and the contemplated inauguration of a regular service of steamers through Hudson Strait to the North Atlantic Ocean. No longer is the extravagant and visionary idea entertained of a new sea route from Europe to India; in its place has arisen a much more rational and feasible project for the effective development of the spacious and, at present, sparsely occupied regions lying in Manitoba, Saskatchewan, and the great North-West Territories of the Dominion, and the systematic exploitation of their enormous wealth of natural resources, by providing them with a direct outlet to the ocean highways of the world.

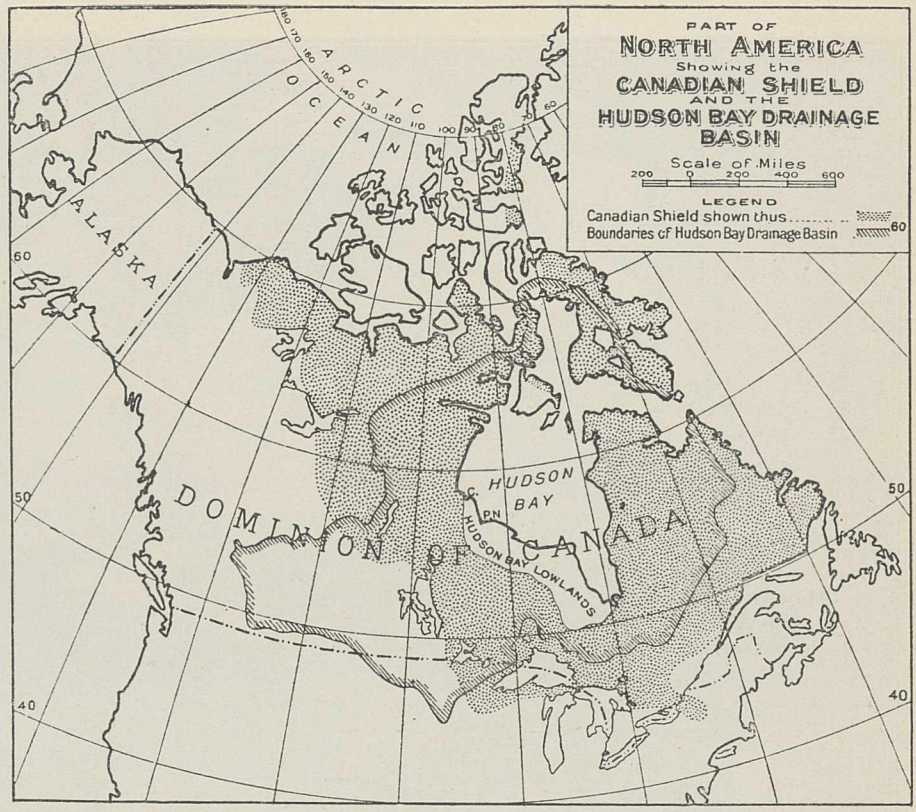

FIG. 1.—Churchill and Port Nelson, on the shores of Hudson Bay, are indicated by C. and P.N. respectively. From "The Hudson Bay Region", by F. H. Kitto, issued by the Department of the Interior and the Natural Resources Intelligence Service, Ottawa.

The vast inland sea, with an area of well over half a million square miles, called Hudson Bay after the famous navigator, penetrates far and deep into the North American Continent (see Fig. 1), and were it not that the sole avenue of communication with the outer Atlantic lies through a region so far north (within 5° of the Arctic Circle, in fact) as to be blockaded for the greater part of the year by a formidable and impassable barrier of ice, it would be a network of busy trade routes, since its waters lap a coast-line fully as extensive as the entire Atlantic seaboard of the United States. Unfortunately, too, Hudson Bay, which is fairly deep in itself, except along some parts of its south-western shore, is lacking in serviceable natural harbours. On the western and southern coasts (excluding James Bay, which is quite shallow) there are only two inlets which afford any pretensions to shelter and anchorage for vessels of modern draught. These are Nelson and Churchill, situated at the mouths of rivers bearing the same names.

The harbour of Nelson, however, is scarcely more than an open roadstead; it is exposed, shallow, and difficult of approach. Despite the fact that a terminal at Churchill would involve a longer railway line and the consequent drawback of a correspondingly longer haul for traffic, the authorities decided at the outset in its favour, and work was commenced in 1911 on the new branch line, with Churchill as its objective, on a route entirely north of the Nelson River, which measured 474 miles in length from the junction at The Pas with the existing line. For some reason, however, the impression gained ground that the constructional difficulties of a line to Churchill would be considerable and even prohibitive, and before much progress had been made, this consideration, combined with the economical question of haulage, caused the Government to alter its plans and to locate the

railway with the view of an approach to Nelson. This change enabled the route to be shortened by 50 miles, and the line was actually laid for a distance of 332 miles as far as Kettle Rapids (Fig. 2), where the river Nelson is crossed for the second time, the first occasion being at Manitou Rapids. At this stage of progress, the War intervened and operations were suspended.

It was not until 1926 that work was actively resumed, and then the whole question of the rival merits of Nelson and Churchill as prospective port terminals came up for reconsideration. A special Committee of the Senate recommended that expert advice from a leading authority on harbour development should be obtained, with the result that Mr. F. Palmer (now Sir Frederick Palmer) was commissioned by the Government to investigate the position and report. Mr. Palmer's conclusions were formulated in the autumn of 1927. He had no difficulty in deciding that, on all the evidence, the balance of advantages as a port terminal is definitely and unmistakably on the side of Churchill. Moreover, the constructional difficulties of the land route were found to have been greatly over-stated, and it was ascertained that it would be no more difficult to construct a line of railway to Churchill than to Nelson, the only drawback being that the distance is 87 miles greater.

The cost of the longer line, however, could be more than compensated by the saving in artificial harbour protection works. For, as regards protected harbourage, Churchill presents features indubitably more favourable than those of Nelson. The former port has an easy approach from deep water to a sheltered situation, with ample draught for the requirements of modern shipping. "At Churchill", states Mr. Palmer's report,[1] "Nature has provided magnificent breakwaters, consisting of rocky cliffs rising to heights of from 40 to 70 feet, enclosing a harbour 6 miles in length and from 1 to 2½ miles in width at low water and 1½ to 4 miles at high water. The entrance to the harbour consists of a narrow gap between these headlands, with a low water width of 1600 ft., a width of 850 ft. at 30 ft. depth, and 750 ft. of width having depths exceeding 60 ft. Inside the entrance there exists an area of 140 acres with depths of 30 ft. and over at low water, and a further area of about 180 acres with depths varying from 18 to 30 ft. at low water, beyond which there is a vast area of lesser depth."

FIG. 2.—View of Kettle Rapids, Nelson River, showing the railway line and crossing. By courtesy of the High Commissioner of Canada.

The Government promptly acquiesced in the findings of this Report, and since that date it has been energetically pursuing the realisation of the project, which, as stated earlier, is now within reach. The site of the wharves and terminal is shown in Fig. 3. The port is expected to be fully open for traffic in 1932, and it is hoped that an experimental shipment of grain will be made during the summer season of this year.

The great problem (and the one uncertain factor

in the case) is the question of ice. The sole seaward approach to the new port will be through Hudson Strait and the navigability of this passage is only practicable during a season of very restricted extent. As soon as the decision was finally made to adopt Churchill as the strategic point of sea contact, steps were taken to study the environment and navigable channels of the Strait, and an aerial expedition was sent out by the Department of Marine and Fisheries, which established itself for observational purposes on three bases at points on Hudson Strait. The reconnaissance extended from the spring of 1927 to the autumn of 1928, covering two navigational seasons.

FIG. 3.—View of Churchill Harbour, looking east, and showing the site of the new port terminal.
By courtesy of the High Commissioner of Canada.

The report of Capt. N. B. McLean, the officer in charge, cautiously indicates the duration of free navigational movement as about four months in the year. "Taking July 19 as an opening date for the Strait, and November 16, when ice was first reported at Nottingham in 1927, as a closing date, we get a season of 120 days, or practically four months, during which commercial vessels could have navigated with safety and without the assistance of ice-breakers. It must, however, be borne in mind that data obtained during two seasons only is entirely insufficient on which to base any accurate statement in regard to the opening, closing, or length of the season of navigation." [2]

The navigational period is obviously very restricted, and the prospect of any appreciable extension by modern ice-breaking operations is not altogether too promising, but, on the other hand, it must be remembered that much can be done by intensive seasonal working. Montreal is a port similarly handicapped in regard to ice conditions, though perhaps not quite to the same extent, yet in a short summer season of about seven months no less than 200 million bushels of grain have been shipped and dispatched to Europe. Careful organisation and capable working may lead to correspondingly effective results at Churchill.

Should the experience of the new route prove satisfactory and its commercial feasibility be confirmed, the prospects of developing the almost illimitable hinterland behind the Bay are very alluring. The harvests and agricultural products of the western provinces have hitherto reached the British market either by way of the Great Lakes and the ports of eastern Canada or, alternatively, by the Pacific ports and through the Panama Canal. To Liverpool, the distance from Edmonton or Calgary by the latter route is between 10,000 and 11,000 miles, and by the former about 5200 miles. The Hudson Bay route will mean a further saving of practically a thousand miles.

Apart from the abundant crops of grain and cereals for which Manitoba, Saskatchewan, and Alberta are renowned, there are numerous fields of exploitation in other directions in a region rich

in natural resources of many kinds. Trapping for furs has long been an established feature, and the Hudson Bay Company, formed so long ago as the year 1670 under the governorship of Prince Rupert, nephew of King Charles I., has carried on a prosperous trade for more than two centuries. The rivers teem with fish. Water power is plentiful and invites conversion at numerous falls into electricity for adaptation to various industries. Forests in the southern areas provide an abundance of timber, with the promise of extensive supplies of pulpwood for paper manufacture, in addition to the considerable number of trees available for constructional and commercial purposes.

Not less remarkable is the scope for mining minerals and precious metals. The great pre-Cambrian area covering very nearly the whole of the Hudson Bay region, and known as the Canadian Shield, has given startling evidence of being one of the world's largest storehouses of mineral wealth. The famous Hollinger mine is third among the largest gold producers in both hemispheres. There are impressive copper-zinc ore deposits in northern Manitoba and massive bodies of ferriferous ore on the Belcher Islands in Hudson Bay.

The country is still largely in the exploratory stage, and much of its wealth yet remains to be discovered. From such evidence as has accumulated to date, it is clear that there is every ground for believing that the internal resources of the Hudson Bay region will prove highly remunerative and profitable to the capable prospector. The opening of the new route to Europe will afford a means of facilitating the initiation of further enterprise, and will doubtless lead to a great era of commercial, industrial, and agricultural development in the inland provinces of western Canada.

[1] "Report on the Selection of a Terminal Port for the Hudson Bay Railway", October 1927.
[2] "Report of the Hudson Strait Expedition, 1927–8." Ottawa, 1929.

Modern Whaling.

SO far as historical records show, whaling was first begun in the twelfth century by the Biscayans in the Bay of Biscay. From that time until the beginning of the present century, all whaling stations were situated on land.

Towards the end of the nineteenth century, Svend Foyn had tried to operate a floating factory, but the venture failed. The next attempt in this direction was made by Commander Christensen when, in 1903, he sent a wooden steamer fitted as a temporary factory and accompanied by two attendant catchers to Svalbard (Spitsbergen). So much success attended this expedition that Christensen afterwards bought the steel steamer *Admiralen* and fitted her out as the first fully equipped floating factory. This proved to be an epoch-making vessel. In 1925 she was sent to South Georgia, accompanied by two catchers, and from that date the great modern Antarctic whaling era may be said to have begun. There are now one Argentine, three British, and four Norwegian companies operating at South Georgia, and seven Norwegian companies at South Shetland, in addition to various other shore and pelagic factories working elsewhere in the Antarctic.

Prior to the outbreak of the War, some twenty-four steamers had been converted into whaling factories, but all worked in or near harbours, depending—in part at least—upon water and other supplies from the shore. Since the War about the same number of ships have been converted, but the majority of the latter are designed to work in open seas entirely independent of any shore base. The pioneer in this field of development was the renowned whaler, Capt. C. A. Larsen.

Until roughly five years ago, all the working up of whales was done in the water alongside the factory ships, the blanket of blubber and severed pieces of the carcass being hoisted on board by winches and derricks. To avoid the labour and discomfort involved in such a trying and uneconomical method, by means of some kind of slipway which would enable the entire carcass to be hauled on board, had long been the dream of many a whaleman. Numerous suggestions were put forward and a number of ships fitted with various types of slipway. These were located in different parts of the vessels—from bow to quarter—but not one proved satisfactory. Not until the introduction of a *straight* slipway through the *stern* was success eventually achieved. The great obstacle in the way of a straight slip was the profound respect with which all sailors regard the stern frame and rudder post of a ship.

In 1925 the "Globus" Company bought the s.s. *Flackwell* (now *Lancing*) for conversion into a pelagic whaler. Mr. Chr. Fred Christensen, in co-operation with Capt. H. G. Melsom, supervised the reconstruction of this ship. With commendable courage they decided to make drastic alterations and arranged a straight and permanent slipway down to the waterline *through the stern*—a process which necessitated the cutting away of about eleven feet of rudder stock and stern frame post.

This revolutionary design proved highly successful, and has formed the model for all subsequent slipways. Improvements quickly followed until what the designers consider full efficiency was attained in the *Vikingen*—a new ship designed and built specially as a pelagic whaling factory at Messrs. Swan, Hunter and Wigham Richardson's Wallsend shipyard in 1928.

In a very valuable and intensely interesting handbook* just published, Mr. Christensen describes this ship. Plans of the vessel are given, along with detailed information regarding the arrangement of

* The Whaling Factory Ship *Vikingen*, with some Notes on Whaling. By Chr. Fred Christensen. (Newcastle-on-Tyne: North-East Coast Institution of Engineers and Shipbuilders, 1931.) Pp. 24+2 plates. n.p.

the machinery and plant on board and the methods of working them. Photographs of the *Vikingen* and of her catchers at work are also included. To this are added a brief outline of the history of whaling and an account of various important modifications and improvements in whaling operations.

Mention is also made of the immense value of the whaling industry both to Norway and Great Britain. Since 1928, new factory ships totalling 140,000 tons and costing £2,500,000 have been built, excluding catchers. In addition to these new vessels, the whaling companies have bought in Great Britain about 250,000 tons of steamers for conversion into factories and transports. The approximate figures of expenditure in Great Britain during this period are :

Steamers converted into factories . .	£1,000,000
Floating factories (new buildings) . .	2,500,000
Transport ships for factories . .	950,000
Repairs to all types of vessels . .	550,000
Whale catchers (new buildings) . .	2,200,000
Total	£7,200,000

In addition to the above, the purchase of coal, oil, and equipment in Great Britain has amounted to millions of pounds, and the British Government derives a large income from licences and duties paid by the companies on the oil and guano they produce. G. A. S.

Obituary.

Dr. Louis Dollo.

DR. LOUIS DOLLO, who died at Brussels on April 19, will always be remembered for his numerous and valuable contributions to our knowledge of extinct vertebrate animals. Early in 1882 he was appointed assistant-naturalist in the Royal Museum of Natural History, Brussels, where he afterwards became conservator, and was actively engaged in research until his retirement in November 1925. He arranged and labelled the unique collection of Belgian fossil vertebrates in the new museum which was opened in the Leopold Park in 1905, and he published preliminary descriptions especially of the fossil reptiles in a series of remarkable papers, besides preparing a general guide-book to the vertebrates, both living and fossil.

Dollo was born at Lille on Dec. 7, 1857, and completed his education in the university of that city, where he graduated as a civil engineer. He studied geology under Prof. J. Gosselet, and he also devoted much attention to the zoological sciences both at Lille and in the marine biological station at Wimereux, under the direction of Prof. A. Giard. His inclination was towards natural history, and he abandoned an engineering career as soon as the opportunity for biological research presented itself in the appointment at Brussels in 1882. His early training, however, influenced him throughout life, and nearly all his writings are in the peculiarly mathematical form of brief numbered statements and proofs.

In the Brussels Museum, Dollo began immediately to study the fossil reptiles, and his first paper, published in October 1882, was a description of *Mosasaurus* and a new allied genus, *Pterycollasaurus*. The finest specimens of Mosasaurians in Europe were found in the Upper Cretaceous rocks of Belgium, and Dollo in subsequent years made many contributions to our knowledge of these extinct sea reptiles. In 1882, however, much progress had already been made in extracting from the rock the wonderful skeletons of Iguanodon and other reptiles which had been discovered four years previously in the Wealden of Bernissart, near Mons. Dollo was then entrusted with the study of this collection, and he soon produced a series of "Notes" in the Museum bulletin which described whole skeletons of Iguanodon for the first time, made known many new facts, and discussed them in a brilliant manner. He also published notes on the associated crocodiles and turtles, and the oldest known newt. These papers were intended to be preliminary to an exhaustive monograph on the whole collection which he hoped to prepare, but difficulties arose which unfortunately prevented the accomplishment of the task. Dollo, indeed, was forbidden by the director of the Museum at the time to proceed with his researches on fossil reptiles, and was ordered to pay attention to the fishes. Thus originated his classic paper on the evolution of the Dipnoi, and many other suggestive papers on evolutionary problems which made fundamental advances in the methods of studying fossils. He established the general principle that during evolution "an organism never returns exactly to its former state even if it finds itself placed again in circumstances identical with those through which it has passed". He described this as the irreversibility of evolution, and it is sometimes termed Dollo's law. He also emphasised the importance of 'ethology', or the study of organisms in relation to their natural surroundings, and furnished many striking examples in his later papers. His last paper, on the carpus and tarsus, published in 1929, fully maintained his old standards, and was written in the characteristic logical form.

Dollo had many ardent admirers among contemporary biologists, and a distinguished group of his friends made contributions to the first volume of a new serial *Palæobiologica* which was published by Prof. O. Abel in Vienna in 1928 in honour of his seventieth birthday. He was a foreign member of the Linnean, Geological, and Zoological Societies of London, and was awarded the Murchison Medal of the Geological Society in 1912. He was also an honorary Sc.D. of Cambridge. He was professor in the University of Brussels, and member of the Royal Belgian Academy. He was also a corresponding member of the Academies of Science of Berlin, Munich, and New York. He was an acknowledged leader, with a devoted following in the new generation. A. S. W.

LIEUT.-COL. H. T. MORSHEAD, D.S.O., R.E.

ON May 17, Col. Morshead, of the Survey of India, was shot dead while riding in the jungle near Maymyo, the hill-station of Burma. He was forty-eight years of age, and his death deprives the Government of India and its Survey Department of an officer whose special attainments and rare experience had proved of frequent advantage.

To the north of India lies the mountain mass of Tibet: its people belong to the Mongolian family, but they have been shut off by their mountains from the outer world for many centuries, and they have developed a language that differs from both Chinese and Burmese.

Col. Morshead was a skilled mountain surveyor and a Tibetan linguist; and his boyish, modest charm of manner won for him the friendly confidence of Himalayan hill-tribes. The value of such a man has been great, and the discoveries which he made have led to scientific advances in Himalayan geography.

In 1901, when he was nineteen years of age, Morshead passed out of Woolwich Academy and received a commission in the Royal Engineers. In 1904 he was ordered to India, and was posted to Dehra Dun: he was there employed on the designs and construction of new lines for the Gurkha Regiment. Dehra Dun is a cantonment situated in the outer Himalayas, and when Morshead found himself surrounded by mountain peaks, the instincts born in him were stirred. An office of the Survey of India is at Dehra Dun, and Morshead, though modestly doubtful of his own qualifications, began to envy his brother officers who were employed on the Survey. His inclinations were towards exploring, and the idea of taking theodolite observations from hill summits seemed to him a glorious prospect. He was posted to the Survey of India in 1906, and except for the three years 1915 to 1918, when he served in the trenches in France, his whole career from 1906 to 1931 was passed in the Survey.

In 1912 the Himalayan peak of Namcha Barwa was discovered by Captains Morshead and Oakes. This discovery was the most important advance that had been made in Himalayan geography since the height of the Kashmir peak Nanga Parbah was determined in 1855. No high snow peak had been found by the Survey in the Assam Himalaya east of Bhutan. In 1880 the Surveyor-General of India had come to the conclusion that the Assam Himalaya carried no peaks above 20,000 feet. The height of Namcha Barwa is 25,455 feet; like Mount Everest, it is not visible from the plains of India, being concealed by intervening hills. Its discovery has led to the prolongation of the Great Himalayan crest-line for 300 miles.

In 1913, Capt. Morshead and Capt. F. M. Bailey discovered the gorge where the Tsangpo river, of Tibet, escapes from the highland through the Himalayan range.

In 1921, the Mount Everest expedition was organised by the Royal Geographical Society and by the Alpine Club. Col. Howard Bury was in command of the expedition, and Morshead was attached to it as a surveyor. His knowledge of the Tibetan language proved of great service on this expedition. An authority on the Tibetan language had been led to believe that the six names for Mount Everest and its surrounding peaks were recorded in a book of Tibetan ritual, and he was confirmed in this view by Tibetans from the district. But Morshead when in the field with the Mount Everest expedition had learnt from local Tibetans the six Tibetan names of the peaks of Gaurisankar, which are thirty-six miles from Mount Everest. When the names from the book of ritual came to be compared with Morshead's names obtained by him from the people on the spot, it was found that the book of ritual had been incorrect in applying these names to Mount Everest.

When we are looking back upon an officer's career, we recall his scientific achievements. But now that Col. Morshead has been suddenly cut down in all the vigour and activity of middle age, the thoughts of his brother officers turn not to his successes, great as they were. The sorrow which they feel for his widow and children, to whom he was so devotedly attached, fills their minds, and leads them even to forget for the moment the services he rendered to geography. S. B.

MR. HERBERT TOMLINSON, F.R.S.

THE death on June 12 of Mr. Herbert Tomlinson will bring to the minds of many of our older physicists the kind of work that engaged the attention of the research workers of the late Victorian days. Mr. Tomlinson was born in 1845 and went to St. Peter's School, York, from which he gained a scholarship at Christ Church, Oxford, where he studied mathematics and physics, receiving the B.A. degree in 1868. This appears to have completed his connexion with Oxford, for he never took his M.A. degree.

Shortly after graduating, Mr. Tomlinson went as a demonstrator and lecturer under the late Prof. Grylls Adams at King's College, London. His work enabled him to devote much time to research, which he followed most assiduously until about 1890. The subjects that specially attracted him were the various properties of matter, and a reference to the *Proceedings of the Royal Society* shows that in 1886, for example, he investigated the viscosity of air, the internal friction of metals and the effects of temperature and magnetism on this friction, and the velocities of sound in wires. Such subjects formed the matter of many extensive papers in the Royal Society's *Transactions*, and for this work he was elected a fellow on June 6, 1889. Among the others elected at the same meeting were: John Aitken, Horace T. Brown, Latimer Clark, Prof. McKenny Hughes, and Prof. Sollas.

In 1894, Mr. Tomlinson gave up the work at King's College for the post of principal of the newly built South-Western Polytechnic at Chelsea, and this work in technical education absorbed his activity until 1904. Among the many classes that he instituted was a Saturday morning class for

team work in research. He and a number of the more advanced students met for the purpose of a united attack on some problem in elasticity or magnetism. The results were difficult to utilise, for although an experienced research worker himself, his assistants could claim but little facility at practical work.

In 1904, Mr. Tomlinson gave up the principalship and retired to Bexhill, where he devoted much time to wireless telegraphy, then in its infancy. It was characteristic of him that when he left London he told the present writer that he would never revisit it; and so far as the writer knows, he kept his word. Unfortunate circumstances deprived him of his small fortune, and as he was ineligible for any educational pension, he received a Civil List pension for his scientific work. During the War he served for a time as a science teacher at Lancing College.

Mr. Tomlinson was a man of intense devotion to a task that interested him, but he had also the capacity of putting aside a subject and taking up another with equal intensity. He was a most pleasant and cordial principal and received the devotion of his staff and students. The late Prof. Reinold was one of his most intimate friends, but he was not known to many of the younger school of physicists. His work was of importance in tracing the changes in properties of matter under varying conditions, and he brought to general notice many of these properties, which at his time were little appreciated. S. S.

Dr. Karl Bělař.

We regret to announce that Dr. Karl Bělař, of the Kaiser Wilhelm Institut für Biologie, Berlin, was killed in a motoring accident near Victorville, California, on May 24. He was returning with friends from a collecting trip in the Mohave Desert. Dr. Bělař's death at the age of thirty-six years is a tragic loss to the science of cytology. He combined a zeal for experiment and observation with a quite remarkable gift for the artistic expression of their results. After he left his native country, Austria, he was chiefly occupied with studies on animal cytology at the Kaiser Wilhelm Institut and at the Zoological Station at Naples. He was privat-dozent in zoology at the University of Berlin and a secretary of the Genetical Congress held there in 1927. In 1928 he was invited to the John Innes Horticultural Institution, where he spent two months that were highly profitable to all with whom he came into contact. In 1929 he was invited to visit the newly equipped California Institute of Technology, where he has since collaborated with the Morgan school of geneticists. He was about to return to Europe at the time of his death.

Bělař will be chiefly remembered for his masterly review of the behaviour of the nucleus in the Protista, and for his text-book of genetical cytology. In both these works, by critical analysis of discordant observations, he went a long way in reducing confusion to order. He contributed the article on Protozoa to the present edition of the "Encyclopædia Britannica". He will also be remembered for his remarkable ability in handling living and fixed cells. His technique (and his untiring industry) enabled him to show most satisfactorily the relation between what we see in permanent preparations and what is present in the living cell.

Bělař's friends in Great Britain and abroad will not easily forget the zest he put into his studies and the charm with which he instructed those less skilful than himself. C. D. D.

Miss Anne L. Massy.

On April 16, after a few days' illness, Miss Anne L. Massy died at Howth, Co. Dublin. Living in her earlier years in the neighbourhood of that classical collecting ground of the old conchologists, the Velvet strand near Malahide, she soon acquired a very thorough knowledge, for an amateur, of the Irish marine mollusca, and when, in 1901, she was employed by the Irish Fishery Department in connexion with its biological work under the late E. W. L. Holt, her field of research was widened and she rapidly put herself in touch with the most recent systematic work on the Mollusca, taking a special interest in the pteropods and cephalopods.

With great industry and with that unconscious appreciation of differences and resemblances indispensable to a systematic worker, Miss Massy worked steadily through the Irish fishery collections and published from time to time papers containing sound original work on Atlantic pteropods, deep-water and pelagic cephalopods, brachiopods, holothurians, and other groups. Later, as a more independent worker, she published several papers on collections from other parts, amongst which may be mentioned the *Terra Nova* Reports on Cephalopoda and Pteropoda; a very useful paper on the Cephalopoda of the Indian Museum (1916), useful papers on South African Cephalopoda, and an account, in collaboration with Mr. G. C. Robson, of the remarkable sexual dimorphism in *Doratosepion*.

Apart from marine studies, Miss Massy was keenly interested in birds, and for many years acted as honorary secretary to the Irish Bird Protection Society. Her death, unexpected and all too soon, takes away a careful, critical, and efficient though retiring zoologist with no ambition but to do her work thoroughly, and a valued friend to all who knew her.

We regret to announce the following deaths:

Prof. S. W. Beyer, dean of the industrial science division of Iowa State College, known for his work in economic geology, on June 2, aged sixty-six years.

Prof. F. Wigglesworth Clarke, formerly chief chemist of the United States Geological Survey, honorary member of the Chemical Society and foreign member of the Geological Society, on May 23, aged eighty-four years.

News and Views.

IN his presidential address to the British Association at Oxford in 1926, and on many other occasions, the Prince of Wales has shown that he is fully aware of the part that scientific research and invention can play in promoting the welfare of the human race. He returned to the subject in the course of his presidential address to the Congress of the Universities of the Empire, delivered in Guildhall on July 3. "It is borne in upon us daily more clearly", he said, "that the material progress of mankind will depend in an ever-increasing degree on the application of modern science to modern industry". In our leading article this week (p. 45), we have dealt with the chemical industry of Great Britain, and it is shown that while it is suffering from the present world-wide economic depression, yet it has suffered less than other industries. It owes its position to the technical progress which has been made, and to appreciation of scientific methods in research, management, and salesmanship. Here is an immediate justification of the Prince of Wales's remarks, if such be needed. By his wide travels within and beyond the British Empire, the Prince has had unrivalled opportunities of acquiring broad views of men and affairs. This gives added weight to his words, which will, we hope, help towards a fuller recognition of the value of the scientific worker to the community. At the same time, the scientific worker must himself be prepared to take his share of civic responsibility, as indeed in most cases he is fully competent to do.

TWO American aviators, Messrs. Post and Gatty, landed in New York on the night of July 1, having flown round the earth on a 'small circle' course in the northern hemisphere, in nine days. The approximate length of the flight was 16,000 miles, the longest single day's 'hop' being 2500 miles from Khabarovsk to Solomon, Alaska, crossing the Bering Strait. The machine used was an American-built Lockheed "Vega" specially prepared for fast long-distance flying. This has been hailed by the press generally as a flight round the world—a misnomer, in that a passage round the globe on a 'great circle' course would have needed a flight of approximately 24,000 miles. As a feat of physical endurance on the part of the crew this performance is probably unsurpassed, but it was carried out on a special machine and in such a manner that it does not prove that such flights are yet commercially possible, or that the repetition of such risks is even advisable. It is, however, a tribute to the steady technical improvement in aeroplane and aero engine design. The only previous occasion of a similar flight was in 1924, when it was attempted by four U.S. Army aeroplanes. Only two completed the journey, after considerable delay due to the necessity for many repairs and the substitution of several new engines *en route*.

ACCORDING to a dispatch from the Paris correspondent of the *Times* in the issue of June 29, the Public Prosecutor of Cusset has reported in favour of dropping the prosecution for fraud against M. Émile Fradin, who was responsible for the discovery of inscribed clay tablets and other alleged antiquities at Glozel. The Public Prosecutor finds that there is no evidence to show that M. Fradin was responsible for placing these objects in the ground, and further that, as he did not profit, it would not be possible to maintain an action for fraud, as it must be shown that the deceit was practised for profit. The report, which must of course be accepted as in accordance with the principles of French law, is, to say the least, unfortunate from the point of view of the archæologist, if, as it suggests, it means that anyone is at liberty to foist an impudent imposture on an unsuspecting public, provided care is exercised to avoid the appearance of direct financial gain. It must be obvious that many advantages might, and indeed did, accrue to the Fradins and those associated with them, even if up to the time the bubble burst they had not actually exploited financially any of their 'precious' finds.

CITRUS growing in Southern Rhodesia is yet in the early stages; the total export for the year 1930 was 170,000 cases, 91 per cent of which was grown on the British South Africa Company's estates. The directors of this Company, which owns more than one half of the present plantings in this Colony, have adopted the policy of basing the industry on scientific research. With this object in view, they have increased the research staff in Southern Rhodesia, and on April 1 created a citrus experimental station of their own, with headquarters on the Mazoe Citrus Estate. The director of this station is Dr. W. J. Hall, assisted by a staff consisting of a chemist, plant pathologist, entomologist, and research horticulturist. Adequate laboratories are nearing completion, and will be suitably equipped, and a large plot of land has been allotted for use as an experimental plot for all field experiments. The prime function of the station is research, and all work undertaken will be in accordance with the practical needs of the citrus industry in Southern Rhodesia. Some of the major lines of investigation will be to establish those varieties most suitable to local conditions; improvement of strains by continuous and intensive bud selection; investigation of stock and scion relationships; the entire manurial programme; breakdown and wastage in transit; study of plant diseases and insect pests with the view of devising control measures and reducing the losses from their causes to a minimum. It is hoped to print an annual report, and also to publish from time to time such results as may appear worthy of record.

DELESSERT, in his work "Voyages dans les Deux Océans", published in 1848, says on p. 94, when referring to parrots in Australia, that the budgerigar (*Melopsittacus undulatus*) is the rarest and most charming, and that it is most amusing to hear it speak, which it can easily be taught to do. Gould, eight years before, had taken to England what he believed were the first living specimens to be imported: abundant importations soon followed, but the bird

has turned out to be so readily bred in captivity that for a good many years now, until the recent ban on the importation of parrots, owing to the fear of psittacosis, the market was chiefly supplied by French-bred specimens, which were finer than the Australian-caught birds. Yellow varieties have been recorded among the wild Australian stock, and this variation has long been fixed among the tame birds. A blue form had been heard of here, but passed almost into a legend among aviarists, having originated in Belgium so long ago as 1880. In 1910, it was exhibited in London, and aroused very keen interest, which was renewed by further introductions after the War. Blues were eagerly sought for and bred, either pure or crossed with greens, which dominated this colour as well as yellow. Cross-bred budgerigars, on the whole, conform to Mendelian expectation, but the main interest of the impetus given by the new colour and the ban on parrot importation is that the birds are now often taken when young and taught to talk, showing, according to accounts which have recently appeared in *Cage Birds*, as much proficiency as an average grey parrot. A thoroughly domesticated creature which can be taught to speak should be of interest to any laboratory of eugenics, and the budgerigar is as clean and frugal as it is attractive, so that it is ideal for experimental breeding.

THE Committee on Organisation of the Sixteenth International Geological Congress has decided to postpone the meeting of the Congress for a year, to the latter part of June 1933. It was felt that the generally adverse economic conditions throughout the world made this postponement desirable. The following topics for discussion have been tentatively adopted: Measurement of geological time by any method; batholiths and related intrusives; zonal relations of metalliferous deposits; major division of the Palæozoic system; geomorphogenic processes in arid regions and their resulting forms and products; fossil man and contemporary faunas; orogenesis. The routes of the excursions have been selected and work is well advanced on the preparation of the guide-books. A series of excursions before the Congress of from five to twelve days in length will cover the eastern and central States. These will, so far as is possible, be arranged to appeal to specialists in various branches of geology. There will also be a number of short excursions in the vicinity of New York. During the session of the Congress, which will last about a week, several short trips will be made to points of interest in the vicinity of Washington. The excursions after the Congress will include two in the north-central States—one for glaciologists in Illinois, Iowa, and Wisconsin, and the other for mining geologists in the Lake Superior iron and copper districts, each of about ten days duration—and two transcontinental trips, each of about thirty-five days. Further particulars can be obtained from the Secretary, Sixteenth International Geological Congress, U.S. Geological Survey, Washington, D.C.

"CRIMINAL STATISTICS", being the statistics relating to crime, criminal proceedings, and coroners' investigations for the year 1929 (London: H.M. Stationery Office, 1931. 3*s*. 6*d*. net) raises some interesting problems. It is impossible to follow up all the questions suggested, but one that must be of importance to everyone is the significant relation between crime and industrial depression. The report states that even in normal times there are certain differences between the incidence of crime in industrial areas and non-industrial areas. In 1921 the incidence of crimes against property and of sexual offences was higher in the north of England than in the south, although in crimes of violence against the person it was slightly lower. In 1929 the position in the north had become relatively worse; although the population had increased only by 4 per cent, while that of the south had increased by 5 per cent, yet the increase in the incidence of all classes of indictable offences was 34 per cent as against 24 per cent in the south. The report suggests that the reason is the state of industrial depression from which the north of England is suffering. Analysis of the ages of the offenders shows that the incidence of crime among men above thirty years of age has not increased, but that as regards boys under sixteen years of age, the number found guilty in the north of offences of dishonesty is much higher than in the south. Industrial depression introduces conditions particularly detrimental to the young in destroying the direct incentive of good prospects, quite apart from the bad effects of idleness or inadequate work. The hope is expressed in the report that, when trade and industry improve, this kind of crime will diminish.

IN the last number of the *Archives de l'Institut de Paléontologie Humaine*, Prof. Charles Fraipont, of Liège, has published a memoir on the "Cerebral Evolution of the Primates, with special reference to the Hominidæ", which he dedicates to the distinguished editor, Prof. Boule, whose anthropological views he, for the most part, adopts. Although references are made to the works of Dubois and Tilney, the author seems to be unacquainted with the significant researches on the distinctive attributes of the human brain and their biological significance which have been accomplished in Great Britain, the United States, Germany, Austria, and other countries, besides those in France and Belgium, during the last thirty years. If Prof. Fraipont had made himself acquainted with these works he would scarcely have made such surprising claims as he puts forward in this memoir. Among other bizarre arguments, he states that the refinement of the hand made possible the reduction of the muscles and bony parts of the face, and that the latter changes permitted the hypertrophy of the frontal lobes of the brain, and consequently the emergence of human intelligence. There are some excellent photographs and radiograms of the bones of the leg to illustrate the evolution of the lower limb in apes and men.

M. FERDINAND LOT in his Sir John Rhys Memorial Lecture for 1930 on "Bretons et Anglais aux V^{e} et VI^{e} siècles", which has recently been issued by the British Academy (London: Oxford University Press,

1931. 1*s.* 6*d.* net), refers to the sources of information on this period in terms which fully justify our recent comments in these columns on the suggestion put forward by the editor of *Antiquity* that a chair for the study of English archæology is badly needed. He points out that, with the exception of Gildas, there is no literary authority of weight for the invasion and early years of domination of the Saxons in England; and that study of archæological remains and their distribution alone, within certain limitations, will afford any basis for our knowledge of the relation of Saxon and Briton in this and the succeeding period. Yet, as M. Lot points out, the fact that the Saxons found a place of refuge in England where they were able to develop an independent political and economic life of their own undisturbed, while other migrant peoples on the Continent were unable to find any settled resting-place, constitutes the Saxon invasion of Britain as one of the most important events in the history of the world. This, which a moment's reflection will show is no exaggeration, makes it all the more remarkable that so little provision should be made for systematic study of the earlier stages of Anglo-Saxon and English culture.

FROM the fourth annual report of the Australian Council for Scientific and Industrial Research it is evident that important results of economic value have already been obtained, and that the necessity for further development along scientific lines, if prosperous conditions in the Commonwealth are to be restored, is fully recognised. Through the discovery of methods for controlling plant disease, notably in the cases of bitter-pit in apples and bunchy top in bananas, large savings have already been made. The eradication of weed pests such as St. John's wort and prickly pear, by means of the introduction of insects which feed upon these plants, continues to prove amazingly successful, the monetary value of this line of work amounting to millions of pounds. The outstanding achievement in connexion with animal research is the discovery of an effective vaccine against black-disease of sheep, and animal nutrition investigations, though but recently begun, are already yielding valuable results. Since the establishment of the Council's Viticultural Research Station at Merbein the yield of dried fruit per acre has been doubled and the quality considerably improved. Marked success has also attended the division of forest products research, satisfactory paper pulp being obtained from hardwoods previously regarded as entirely unsuitable for this purpose. Many other fundamentally important lines of research are being carried out, and, to quote from the report, "it is obvious that, despite its comparatively recent formation, the Council has already been responsible for large national savings many times greater than its annual cost, and that its possibilities in the not far distant future are even greater."

METEOROLOGISTS have not yet succeeded in giving a clear account of the general circulation of the earth's atmosphere, that is to say, of the distribution of the prevailing winds at various seasons. It is true that the main features of the surface circulation are known, and that attempts have been made to show the circulation at greater heights by deductions based on surface pressure and temperature and the known relationships between horizontal pressure gradient and wind. Such theoretical representations cannot be accepted indefinitely as a substitute for accounts based on actual observation. On land, owing partly to the stimulus received from the needs of aviation during the War, the gaps in our knowledge are gradually being filled by organised exploration with the aid of pilot balloons. One is glad to learn from an article by Commdr. L. G. Garbett, superintendent of the Royal Naval Meteorological Services, in a recent issue of the *Marine Observer* (No. 91), that our very scanty knowledge of upper winds over the oceans is being rapidly increased by systematic observations undertaken on a number of His Majesty's ships, according to a scheme initiated in 1925. During 1931 no fewer than 1500 observations are to be made in various parts of the world, and this year's programme is to be repeated during forthcoming years. The observations are being received at the Meteorological Office, Air Ministry, and are to be shown graphically on a network of 'squares' measuring 10° in latitude and longitude. The soundings frequently extend up to a height of 20,000 feet when clouds do not interfere, and one made in Australian waters reached 49,000 feet, that is to say, nearly the same level as that to which Prof. Piccard ascended recently. In some instances, measurements of temperature are made. The accumulated material will be available at the Air Ministry for consultation by aviators and for meteorological research.

ONE of the great advantages of an electrical supply is the ease with which it can be applied to provide labour-saving devices. The switches for electric fires are now frequently fixed so that without moving the armchair it is possible to turn it on, regulate the heat it gives out, and turn it off. There is no domestic drudgery involved. At first sight some of these labour-saving devices seem almost unnecessary. For example, when measuring the insulation resistance of a network a voltmeter reading has to be divided by an ammeter reading. The arithmetic involved is very simple, but there is a device in much demand which by placing the pointers of the instruments on opposite sides of the same dial tells the resistance by noticing their point of intersection and seeing the curve on which it lies. Similarly, on the dashboard of electric motor-cars the ammeter and voltmeter pointers by their point of intersection indicate the horse power expended on the car. Ingenious experimenters have recently invented devices for shutting and opening windows by pressing buttons, and devices for regulating and controlling their radio-receiving sets from a distance are coming into use in America. Many devices with this end in view are described in the *Wireless World* for June 17. It is well known that most set owners only listen in to a few stations. One device consists of a small metal box on the top of which is a set of six buttons. Two more buttons turn the receiver on or off, and a slight pressure on two other buttons varies the volume of the sound. A tiny lamp lights when the set is

in operation, and indicates by its varying brilliancy whether a station is tuned in to its most sensitive point on the dial. In elaborate installations in large mansions a more complex dialling system is used. In Great Britain the commonest arrangement is a switch which allows the user to turn off his set the last thing at night without getting out of bed.

THE *Transactions* of the Institute of Marine Engineers are issued in monthly parts, and these include many articles from the technical press which are of interest and value to the members, who, owing to the nature of their calling, can seldom visit libraries. The inclusion of these notes has caused the volumes to become rather bulky, and so with the commencement of vol. 43 the size of the pages has been doubled. It is now 11 in. by 8½ in. and corresponds with the size of the *Transactions* of the Institution of Naval Architects. The alteration is a great improvement and will be appreciated by all who read the *Transactions*. Of the two monthly parts issued in the new form and size, that for February contains the paper on the "Electrical Equipment of a Modern Ship" read by Mr. J. E. Allan on Jan. 13, while that for March contains the paper on "Water Tube and/or Scotch Boilers" read by Mr. H. E. Yarrow and S. Hunter, jun., on Feb. 10. Both papers are accompanied by a full report of the discussions. The February issue also contains a portrait of the late Sir Charles Parsons, who was a past president of the Institute. The Institute took a foremost part in arranging the memorial service held on Mar. 22 in St. Botolph's, Aldgate, to commemorate the centenary of the death of William Symington, the father of marine engineering, whose death took place in a house in Burr Street not far from the spot now occupied by the headquarters of the Institute.

THE Engineering Experiment Station of the University of Illinois includes a locomotive laboratory in which tests of service locomotives can be made. Such a laboratory is urgently needed in Great Britain and has, for some time past, been under the consideration of a committee appointed by the Department of Scientific and Industrial Research and presided over by Sir Alfred Ewing. The laboratory at Urbana, Illinois, was described in *Bulletin* No. 82, of the University of Illinois Engineering Experiment Station, while a recently issued *Bulletin*, No. 220, describes the tests of a Mikado-type locomotive equipped with Nicholson thermic syphons, conducted in co-operation with the Illinois Central Railway Company and the Locomotive Firebox Company. A syphon is a supplementary water leg or circulating chamber riveted to the roof of the firebox and the bottom of the tube plate to stimulate the circulation of the boiler water and increase the transfer of heat. The results of the tests showed that the syphon-equipped locomotive possessed a definite and notable superiority over the non-syphon engine as regards both evaporation per pound of coal and boiler efficiency. Under identical conditions of operation, the weight of steam generated per pound of coal would be on the average 8·5 per cent greater with the syphons than without them. There are at the present time about 13,000 syphons in service on American and Canadian locomotives. Copies of *Bulletin* No. 220 can be obtained from the Engineering Experiment Station without charge.

A GREAT collecting expedition to Australia is announced by Science Service, of Washington, D.C. Harvard Museum of Comparative Zoology is determined that its collection of Australia's rare and strange animals shall be one of the largest and best-balanced collections in the world. To that end an expedition, led by Prof. W. M. Wheeler and having the advantage of the presence of Dr. Glover M. Allen, is to leave New York on July 25. The expedition is to be in the field for a year, and is to visit many isolated and little-explored faunal areas in Australia and Tasmania. In addition to mammals, birds, reptiles, insects, and other forms of animal life will be collected. We wonder how long the rare animals of the world will survive the tax of scientific collecting expeditions, and when the museum scientific worker will act on the principle that more is to be learned by studying creatures alive in their native haunts than by measuring their skins in a laboratory. We trust, in any case, that Australia will see to it that the 'bag' of the really rare creatures is strictly limited; for a bird in the bush, in such a case, is worth two in the hand.

IN continuation of its work for the good of mankind, the Institut International de Co-opération intellectuelle, Paris, has published an account of the organisation and activities of "Instituts Nationaux à l'Étranger". The brochure, of 124 pages, includes the names of two categories of institutions: research institutes established by any country in a foreign land, and institutes established in foreign lands to spread there a knowledge of the language and civilisation of the founder country. The objects of the institutes, their personnel, mode of subvention, date of origin, and publications are summarised—a first attempt to give a comprehensive survey of those scientific foundations in foreign lands, which not only make their contributions to scientific knowledge, but also, since they form centres of international scientific collaboration, add to the comity of the nations. Of the 87 research institutes, founded by 16 different countries in 25 other lands, Great Britain claims only 8, a poor figure compared with the 12 representing the United States, 17 representing Germany, and 24 representing France.

AN exhibition of the finds of Mr. Guy Brunton's expedition to middle Egypt during the past season opened in the Nimrud Gallery of the British Museum on July 2. A large number of objects from the earliest pre-dynastic periods, and from the sixth to twelfth, the nineteenth to twenty-sixth dynasties, and the Christian Coptic period of about A.D. 300–500 are shown. The 'Tasian' and 'Badarian' objects include a fine well-preserved black ripple bowl. An 'Amratian' bowl of red-painted ware has a crocodile and a number of small hippopotami moulded on the rim. Other Amratian objects include a number of anthropomorphic amulets of ivory and slate palettes of various

forms, including birds and fishes. There is a large number of beads of various periods. The Coptic objects include a number of shoes, some of which had belonged to children.

THE New International Association for Testing Materials (N.I.A.T.M.), which was formed as a result of meetings in Amsterdam in September 1927, will hold its first congress in Zurich next September. The president is Prof. A. Mesnager. The work of the congress will be divided among four groups, namely, (*a*) metals, chairman, Dr. W. Rosenhain, of the National Physical Laboratory; (*b*) non-metallic inorganic materials, chairman, Prof. M. Roš, of Zurich; (*c*) organic materials, chairman, Prof. J. O. Roos, of Stockholm; and (*d*) questions of general importance, chairman, Prof. W. von Möllendorf, of the Staatliches Materialprüfungsamt, Germany. The proceedings will commence on Sunday evening, Sept. 6, with a reception in the Zurich Polytechnic and addresses by the president and others. The sections will meet each day in the Polytechnic, the plenary session taking place on Friday afternoon, Sept. 11. Visits to works, excursions to places of interest, and various entertainments are being arranged. Particulars of the travelling arrangements and hotel accommodation can be obtained by members affiliated to the British branch of the N.I.A.T.M. from Mr. G. C. Lloyd, 28 Victoria Street, London, S.W.1. The autumn meeting of the Institute of Metals will also take place in Zurich in the week commencing Sunday, Sept. 13—that is, immediately following the Congress of the N.I.A.T.M.

THE tenth annual conference of the Institut International de Bibliographie will be held on Aug. 25–29 at the Hague. In addition to the presidential address, by Prof. A. F. C. Pollard, and the reports of the secretaries, more than a score of papers will be presented. Although the activities of the Institut embrace all branches of knowledge, scientific and technological interests are very well represented, as is shown by the following selection from the papers: "Le rôle et l'Organisation de la Documentation de la *Revue Générale de l'Électricité*", by E. Beinet; "Probleme der bibliographischen Praxis", by Dr. Julius Hanauer, of the A.E.G.; "L'Organisation de la Documentation dentaire par la F.D.I.", by Dr. Émile Huet, delegate of the International Dental Federation; "Rapport sur le 'Repertorium Technicum'", by J. M. C. Muller, Bataafsche Petroleum Company; "International Abstracting and Indexing of Scientific and Technical Literature", by Sir Frederic Nathan; "Aufgaben und Organisation eines Referatenorgans", by Dr. Maximilian Pflücke, of the *Chemisches Zentralblatt*; "The Bibliography of Physiology and the Application thereto of the Decimal Classification", by Dr. J. G. Priestley (Oxford); "La Classification décimale dans le Domaine de la Médecine", by Dr. René Sand, Ligue des Soc. de la Croix Rouge. In addition to the more serious business of the Conference, a very interesting programme of receptions and visits has been arranged. Full particulars may be obtained from the Secretariat, Institut International de Bibliographie, Carel van Bylandtlaan 30, La Haye, Netherlands; or from the honorary secretary, British Society for International Bibliography, Science Library, South Kensington, S.W.7.

THE following have been elected foreign members of the Royal Society: Prof. Charles Fabry, of Paris, distinguished for his work in connexion with the modern interference methods in spectroscopy and the modern system of wave-length standards; Dr. Emmanual de Margerie, of Strasbourg, distinguished for his work on the tectonic geology of parts of France and especially of the Pyrenees; and Prof. Heinrich Wieland, of Munich, distinguished for his work on organic chemistry.

THE Right Hon. Sir Herbert Samuel, M.P., has accepted the presidency of the British Institute of Philosophy in succession to the late Lord Balfour. Distinguished lecturers during the forthcoming session will include: Sir James Jeans, Prof. S. Alexander, the Dean of St. Paul's, the Archbishop of Armagh, Prof. J. S. Haldane, and Dr. C. D. Broad.

WE regret that a misprint has appeared in the letter entitled "Ultra-Violet Absorption and Raman Effect for Hydrazine" by S. Imanishi in NATURE of May 23, p. 782. The line 1120 is attributed to the N-N (single bond) vibration in the hydrazine molecule and not to the N-H vibration as stated in line 34 of the communication.

IT is stated in a *Bulletin* of Science Service that Dr. L. O. Howard, formerly chief entomologist of the United States Department of Agriculture, will receive the Capper award for 1931. This award consists of a gold medal and a cash purse of five thousand dollars. It was founded by Senator Arthur Capper of Kansas, and is given each year to a scientific worker who has made notable contributions to the progress of agriculture.

AN addition must be made to the list of zoological journals, with the appearance in December 1930 of the first part of volume 1 of the *Journal of Science of the Hiroshima University*, Series B, Div. 1 (Zoology). The first portion contains three papers by Yoshio Abe; two of these deal with mammals, and to them further reference will be made in our "Research Items". The journal is beautifully printed, both as regards text and plates, and it is announced that reports are to be published as they are received, and that each volume is to contain about 200 pages. Two of the papers in the first part are in German and one is in English.

THE issue of the *Quarterly Journal of Microscopical Science* for April contains an article of eighteen pages by Prof. E. S. Goodrich on the work of the late Sir Ray Lankester, which gives an excellent review of the chief points in the long series of his published works. Lankester's first papers, on Gregarines and on Tubifex, appeared in 1863, and his subsequent publications ranged over almost all the principal classes of the animal kingdom. The article brings out clearly the great part Lankester played in the progress of zoological science, and incidentally indicates how many of the terms employed in modern zoology and embryology are due to him.

THE first three numbers of a new publication which abstracts the current papers on plant genetics (with the exception of herbage crops) have now appeared. They are published from the Imperial Bureau of Plant Genetics (School of Agriculture, Cambridge) and are issued quarterly at a price of 5*s.* per annum, or 1*s.* 6*d.* for single copies. The three numbers contain respectively 23, 36, and 52 pages, and will be of much service to all workers in plant genetics. In the abstracts, particular attention is given to practical developments in plant breeding and to the genetics of economic plants, but papers of general or theoretic interest are included.

THE Faculty of Medicine of the Egyptian University, Cairo, has published a volume of 506 pages entitled "The Bibliography of Schistosomiasis (Bilharziasis), Zoological, Clinical, and Prophylactic". It has been compiled by Mohamed Bey Khalil, professor of parasitology in the University, and is divided into an alphabetical index of authors (232 pages) and a classified index of subjects. The Schistosomes constitute a family of the Trematoda or flukes, of which three species attack man and others are met with in other animals. The history of schistosomiasis commenced with the discovery of *Distomum hæmatobium* as the cause of endemic hæmaturia (urinary hæmorrhage) in Egypt by Theodor Bilharz in 1851, a half-tone plate of whom forms a frontispiece to the volume. The bibliography is a monumental piece of work, creditable alike to the author, the University authorities, and the printers, Paul Barbey of Cairo.

THE Ministry of Health has issued an eighth memorandum on cancer (*Circular* 1186). It deals with cancer of the lip, tongue, and skin, and an analysis of the recorded deaths by sexes shows that lip and tongue cancers are much more frequent in the male sex, but skin cancers are only slightly more prevalent among males if certain 'occupational' cancers (due to soot, tar, oils, etc.) be excluded. The curability and survival rate for lip and skin cancers are high, but for the tongue the results of treatment are much less favourable. With lip and tongue cancers, some irritative condition is a common antecedent, and syphilitic lesions of the tongue appear to predispose to cancer of this organ. There is nothing to incriminate ordinary tobacco smoking as a predisposing cause of cancer, provided the mouth and tongue are in a healthy condition. In the skin, warts, birthmarks, and scars are liable to develop cancer, but particular sources of irritation over a long period are the predominant cause of cancer, such as X-rays, tar and pitch, soot, certain mineral oils, arsenic, possibly heat rays, etc.

WE have received from Messrs. Baird and Tatlock (London), Ltd., a copy of a book entitled "Analytical Reagents, Standards and Tests", which they have recently issued in conjunction with Messrs. Hopkins and Williams. The book deals with most of the common reagents, in each case a series of tests for possible impurities being given. There is also a list of bench reagents, giving the method of preparation. The use of the book will enable the chemist to check for himself the purity of the materials he purchases, and should prove very useful in analytical laboratories. Several organic compounds are included.

MESSRS. Henry Sotheran, Ltd., 43 Piccadilly, W.1, have sent us part 1 of their "Catalogue of Exact and Applied Science" dealing with periodical publications, general and collected works, and mathematics. Nearly 2000 works are included and (as is usual with Messrs. Sotheran's catalogues) many valuable bibliographic notes are appended. The catalogue is one that should not be missed. Two further parts are promised dealing with astronomy, physics, geology and meteorology, chemistry and chemical technology, and engineering.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A junior laboratory and lecture assistant in the physics department of the University of Manchester—Prof. W. L. Bragg, University, Manchester (July 14). An assistant under the Ministry of Transport (Roads Department) for work in connexion with road traffic—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (July 14). A probationary tutor in economics and allied subjects at University College, Nottingham, for extra-mural classes—The Registrar, University College, Nottingham (July 15). A lecturer in the Department of Chemical Engineering of University College, London—The Secretary, University College, London, Gower Street, W.C.1 (July 17). A chief librarian and clerk to the Library Committee of the County Borough of Ipswich—The Clerk to the Library Committee, Central Public Library, Ipswich (July 18). An assistant lecturer in mathematics in the University of Manchester—The Registrar, University, Manchester (July 20). An assistant superintendent of classes for instruction in the principles of boot and shoe manufacture, under the Northamptonshire County Council Education Committee—The Secretary for Education, County Education Offices, Northampton (July 20). A temporary assistant lecturer and demonstrator in botany at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (July 23). A tutor of psychology and philosophy at Loughborough College—The Registrar, Loughborough College, Leicestershire (July 25). A temporary technical assistant under the Directorate of Ordnance Factories of the War Office—The Permanent Under-Secretary of State for War (C.4), War Office, Whitehall, S.W.1 (Aug. 1). A head of the Department of Chemistry and Rubber Technology of the Northern Polytechnic—The Clerk, Northern Polytechnic, Holloway, N.7. A woman senior assistant for the science library and information bureau of the Research Association of British Flour Millers—The Director of Research, Research Association of British Flour Millers, Old London Road, St. Albans. Two temporary assistants under the Directorate of Ballistic Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Letters to the Editor.

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

Influence of Hydrogen on Chemical Changes in Silica Vessels.

CHEMICAL literature has of late contained several references to the influence of adsorbed hydrogen on silica on chemical changes taking place in silica vessels. At the same time the fact that silica, at moderately high temperatures, takes up very large quantities of hydrogen is stressed, and it is assumed that this hydrogen is adsorbed, that is to say, exists as a film on the gas-glass interface. However, the following experiments seem to indicate that this is only a part of the story.

During the past year we have been studying the condensation of ethane at 600°, by heating the pure gas, generally at concentration of 0·025 gram molecules per litre, in sealed silica tubes for periods up to eight hours. During the first few minutes a part of the ethane is decomposed into ethylene and hydrogen; but when equilibrium conditions are approached this reaction slows down, so that the hydrogen content of the tube varies but little or not at all during the latter periods. Hydrogen plays no direct part in the secondary reaction, or reactions, which lead to the formation of methane and a condensate of aromatic compounds.

Now, though hydrogen plays no direct part in the secondary processes, it plays a very important indirect part; for if hydrogen is added to the ethane to increase the hydrogen content of the reaction mixture by a small amount, the rate of formation of condensate diminishes rapidly, and a relatively small increase in the hydrogen condensate inhibits the formation of condensate altogether. However, we will only refer to this point in passing.

Down to a few weeks ago we had carried out a large number of experiments, using about twenty different silica reaction tubes, and had come only to the conclusion that the hydrogen played some part in the reactions, which we were absolutely unable to understand or to control. We were unable to reproduce experimental results, though in two series of experiments an apparent regularity nearly misled us to the conclusion that the condensation of ethane was primarily a *unimolecular* process.

Reasons which we cannot set forth in detail led us, however, to adopt a method of experiment which gave results which we believe to be both new and interesting. We observed that the results were more erratic when we used thin silica tubing than when moderately thick walled tubing was used, suggesting that, since hydrogen can pass fairly rapidly through silica at 600°, the solubility of the hydrogen in the silica was a factor which must be reckoned with, since the hydrogen in the adsorbed layer must obviously be in equilibrium with the hydrogen in the glassy and gaseous phases. We therefore carried out two series of experiments. In one, we used a very thick-walled reaction tube, and heated it for 15 hours when full of hydrogen to the reaction temperature, before exhausting, cooling, and filling with ethane for an experiment. The other was a thin-walled tube, but it was enclosed in an outer tube, and the space between the tubes was filled with hydrogen during the pre-treatment and during the actual experiment. The results were now absolutely reproducible, and those obtained with the two tubes were sensibly identical.

We suggest that the idea which led us to carry out these experiments is a correct one, and that in dealing with such materials as silica and palladium, through which hydrogen passes readily, the equilibrium system is rather a complex one, and consists of:

Glassy phase	::	Glass-gas interface	::	Gas-glass interface	::	Gas phase

It is possible that in the solid or glassy phase the hydrogen may be more highly dissociated than in the gaseous phase, so that we have to consider the equilibria:

Glassy phase	::	Glass-gas interface	::	Gas-glass interface	::	Gas phase
$H_2 \rightleftharpoons 2H$	$\boxed{H_2 \rightleftharpoons 2H}$	$H_2 \rightleftharpoons 2H$	$\boxed{H_2 \rightleftharpoons H_2}$	H_2	$\boxed{H_2 \rightleftharpoons H_2}$	H_2

The hydrogen atoms in equilibrium in the gas-glass interface and in the gas phase may be so small as to be negligible; however, the life of hydrogen atoms passing out from the glass-gas interface into the gas-glass interface may be long enough to effect those processes which are commonly attributed to atomic hydrogen in the adsorbed layer (gas-glass) on the silica.

Now that we have been able to stabilise the silica-gas system, and to obtain reproducible results, we have been able to study another phenomenon, which is rather striking. The process of condensation of ethane with formation of methane and condensate appears to be catalysed and accelerated, so that, representing the amounts of product obtained as ordinates and time as abscissæ, the curve representing the change, in either case, has an upward tendency. Now over a range between 570° and 610° C., and at concentrations between 0·025 and 0·0125, and whether in the thick-walled tube or in the double-walled tube, the rate of formation of condensate or of methane undergoes so sudden a change after a period which is always almost exactly $2\frac{1}{2}$ hours from the commencement of the experiment, that one is inclined to connect the phenomenon with some change of an *explosive* character such as all forms of silica undergo when changing from the α to the β form, or vice versa. What the nature of the change is we do not know, but we suggest that it may be a chemical change, facilitated by the fact that the silica surface, like the interior surface of all tubes, is in tension, when, as we now know, reactions can take place which general thermodynamic data would indicate to be impossible.

These matters are the subject of further investigations.

MORRIS W. TRAVERS.
LESLIE E. HOCKIN.
THOMAS J. P. PEARCE.

Department of Chemistry,
University of Bristol,
June 24.

The Composition of the Blood of Aquatic Animals and its Bearings upon the Possible Conditions of Origin of the Vertebrates.

FORTY years ago a suggestion was made (Bunge)[1] that the sodium chloride in the human tissues might be a relic, an inherited feature of some aquatic marine ancestor. The same idea was expressed in certain papers by Quinton,[2] who stated that so far as salinity is concerned the blood of most animals is an altered sea water. In 1903,[3] Macallum, then unaware of the suggestions of Bunge and Quinton, advanced the theory "that the blood plasma of vertebrates and invertebrates with a closed circulatory system is, in its inorganic salts, but a reproduction of the sea water of the remote geological period in which the prototypic representative of such animal forms first made their appearance". He regarded the differences between the blood salinity of the higher vertebrates and the

present-day ocean as due to changes in the composition of the sea water since palæozoic or mesozoic times. Macallum followed up his first statement by more detailed papers, and made some valuable analyses of blood to support his thesis. He is now generally credited with being the originator of this interesting conception. In 1912 I discussed the matter [4] from the point of view of certain experiments and observations on marine and fresh-water invertebrates, and came to the conclusion that whilst one might accept the well-regulated saline composition of the blood of teleost fishes, amphibia, and the higher groups as being to a certain extent an heirloom of an ocean environment, there was no reason whatever to believe that the favoured salinity associated with independence represented the composition of any particular primeval ocean. At that time I stated that the investigations of osmotic regulation did not preclude the idea that the early vertebrates with an independence in blood salinity had evolved in fresh water.

Recent researches have gone far to confirm this view. It is now fairly well known that the blood of marine invertebrates resembles very closely in saline contents the sea water in which they live, and the concentration and composition is very dependent upon this medium. It is, however, becoming clear that these conditions only hold good in the sea. Marine invertebrates which have invaded brackish and fresh waters often present an independence of the blood which is not at all unlike that of the vertebrates. For example, in both the fresh-water crayfish and a frog immersed in water, there is a constant and controlled diffusion inwards of water and a regulated output from the excretory organs. A new fresh-water crab (from a river of New South Wales) with which we have been experimenting retains a constancy of blood salinity which is less than half that of the ocean from which it has undoubtedly wandered, yet its sojourn in fresh water cannot have been of long duration. During recent years, oceanographers and geologists have been more inclined to be conservative with their conceptions of increase in the salinity of the ocean since mesozoic or palæozoic times, and palæontologists are well disposed to the origin of the early vertebrates in fresh or brackish water. It does not really matter, however, from the present point of view, whether the ocean has become more saline or not. Comparative and experimental physiology gives little support to the view that the regulated blood salinities of the vertebrates represent the salinity of the media in which their ancestors evolved that constancy.

We can only accept the universal saline composition of the blood of *metazoa*—with its variations—as a possible reflection of a long-continued existence and probable origin in a saline medium.

W. J. DAKIN.

University of Sydney, May 16.

[1] Bunge, "Lehrbuch der physiologischen und pathologischen Chemie". Leipzig, 1889.
[2] Quinton, "L'eau de mer, milieu organique". XIIIe Congrès intern. de Méd. de Paris. Paris: Masson, 1900.
[3] Macallum, "Palæochemistry of the Ocean", *Trans. Canad. Inst.*, 1904.
[4] Dakin, William J., "Aquatic Animals and the Constitution of the External Medium", *Internat. Revue d. ges. Hydrobiologie.* Leipzig, 1912.

Effect of Light on Urediniospores of Black Stem Rust of Wheat, *Puccinia graminis tritici*.

AT the Dominion Rust Research Laboratory, Winnipeg, the effect of ultra-violet light on the development of the rust organism has been studied by me. As a result of certain experiments, evidence was obtained that the pigment in the epispore of a normal urediniospore protected it from injury by ultra-violet light. The experiments in which this evidence was obtained were carried out in the laboratory, and the source of light was a mercury vapour sun lamp. These experiments were concluded and others were commenced out of doors, the source of light then being the sun.

As these experiments progressed, an interesting phenomenon was observed. Urediniospores of black stem rust, when dusted lightly on the surface of distilled water and exposed either to direct sunlight or very strong diffuse light, did not germinate, whereas similar spores kept under the same conditions in the dark germinated very readily.

On bright days during April and May experiments of this nature have been carried out and spores have been exposed for varying periods, generally from 9 A.M. until 4 or 5 P.M. The results have always been the same—the spores have not germinated until the light intensity was low.

At first it was thought that the spores had been killed by the ultra-violet light emanating from the sun. When, however, the dishes containing the spores were covered by ordinary glass, and also by a glass transmitting the ultra-violet rays, the same phenomenon was observed.

Other experiments were carried out to see if this inability to germinate was due to existing temperature or humidity conditions. When, however, the spores in the dark and the spores in the sunlight were under approximately similar conditions with respect to temperature and humidity, those in the sunlight did not germinate.

In no case when urediniospores have been dusted on the surface of distilled water has germination been observed to take place in strong sunlight. In the dark these spores germinated readily, and germination was well advanced within two hours. Moreover, when spores exposed out of doors were taken into the laboratory they germinated in a normal manner. In controlled experiments in the laboratory dark room, using ten hundred-watt lamps, it was noted that germination was higher the farther the spores were placed from the source of light.

It seemed clear, therefore, that the reason these spores did not germinate was due in some way to visible white light and the intensity of it.

Standard Wratten light filters were then used, and the spores were covered by these and exposed to sunlight. It was observed that the spores germinated abundantly under the green and blue filters, but that only occasionally did any spores germinate under the red, scarlet, orange, yellow, or purple filters. When the light intensities were low, however, germination took place.

To confirm this observation a prism was used to split the sunlight into its component parts, which were allowed to fall on spores contained in ring chambers. No germination took place at the red end of the spectrum. To confirm this, spores were dusted lightly on to the surface of different dyes, and it was observed that they failed to germinate on Congo Red when exposed to sunlight; but on Light Green germination took place. In both cases, in darkness, on solutions of the same concentrations they germinated normally.

Pursuing these observations, other filters were tried, chiefly of different greens and blues. It was noted then that germination decreased when certain green and certain blue filters were used. The more yellow in the green and the more light blue in the green the more pronounced was the inhibition.

In addition to spores of different physiologic forms of *P. graminis tritici* this same phenomenon—that is, the inability to germinate in sunlight or under red, orange, yellow, and purple filters when exposed to strong sunlight—has been observed with different

physiologic forms of *P. graminis avenæ* and, at the present time, other fungal spores are being investigated. If it may be assumed that the mycelia react in the same way as the spore and its germ tube to light of different wave-lengths, then these observations suggest some very interesting possibilities.

In a letter such as this it is not possible fully to outline the complete observations of these preliminary investigations; in consequence the results so far obtained with certain of these physiologic forms of rust and with other fungi, will be communicated elsewhere, and the work will be continued.

W. A. R. DILLON WESTON.
Dominion Rust Research Laboratory,
Winnipeg, Man., June 1.

Ultra-Violet Rays and Mosquito Larvæ.

RECENT work which I have been conducting at this laboratory on the possible effect ultra-violet rays may have on the activation of ovarian function in female mosquitoes, has disclosed the fact that mosquito larvæ are highly susceptible to a remarkable form of injury by radiations from the unshielded mercury-arc generated by the ordinary Cooper-Hewitt vacuum type of quartz lamp.

Larvæ in water contained in open watch-glasses when exposed to the rays at 12 inches from the lamp immediately exhibit an intense irritation. After an irradiation of 3 minutes' duration there is evidence of partial paralysis, in that the larvæ show signs of slight ventral curvature while resting at the water surface; otherwise, they are apparently normal in their responses and swimming movements. However, if such larvæ are kept under close observation, the rapid development of a progressive type of injury is made evident within a few hours. The paralysis increases, the ventral curvature becomes more and more pronounced, and usually by 6 hours after irradiation severe injury to the internal tissues is distinct. The injury takes the form of a progressive histolysis of the connective tissue, muscles, fat-body, etc., first along the dorsal region of the thorax and abdomen, then gradually extending to the underlying tissues, until ultimately the larvæ, bereft of a large mass of tissues, present an astonishing appearance. The chitinous integument is itself unaltered, and consequently extensive internal spaces are formed where tissue histolysis has taken place. These spaces, filled with the fluid product of histolysis, are perfectly transparent except for the ramifications of the tracheæ, and finally, the still living larvæ are reduced to a condition where only a comparatively narrow band of tissues remain along the ventral region of the body. The larvæ are then practically immobile, lying at the bottom of the water-container, but the action of the heart continues feebly for some length of time, even after the respiratory system has completely collapsed by paralysis of the constrictor-dilator nerve-muscle mechanism.

Under the rays of a lamp which has not operated for more than a total of 150 hours, the minimum duration of exposure necessary to produce fatal injury of this nature in the larvæ of both *Aëdes* (*Stegomyia*) *ægypti* L. and *Culex* (*Culex*) *pipiens* L. has been found to be a period of 45 seconds. The rate of the induction of these tissue changes is directly proportional to the duration of irradiation over fairly wide intervals, while the period occupied by the progress of the process, and before the ultimate death of the larvæ occurs, is inversely proportional to the duration of the irradiation.

Two distinct types of injury have been revealed. (1) A direct injury to the motor nervous system indicated by immediate partial paralysis of certain muscles, and the inhibition of the pulse-rate and tone of the heart. The heart is one of the first organs to suffer injury, but, strangely enough, is the last to be put entirely out of action. (2) An indirect injury leading to the progressive dissolution of many tissues, though principally affecting the fat-body.

The radiations responsible for these remarkable effects have been traced by the use of filters and subsequent spectrographic analysis to the band 2150-2850 A., the most effective radiations being apparently below 2500 A. A possible cause of the tissue histolysis and other injury would seem to be the disturbance of the normal electrostatic conditions within the living cell by absorption of the quanta of the lethal rays.

A full account of my investigations and the results of various experiments to determine the histological nature of the injury will be published in due course.

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

The Form of Fæcal Pellets and Specific Identification.

WHILE at Oslo, Norway, in 1927, I devised a bottom sampler capable of withdrawing a core of mud from the sea bottom, and at the same time preserving, as *in situ*, the surface layer. My object was to examine this upper layer of flocculent detritus with reference to its possibilities in providing potential food for bottom-living organisms. A description of this instrument with slight modifications was published by Moore in the *Jour. Marine Biol. Assoc.* (vol. 16, No. 2, pp. 589-594). When examining samples which I collected in the Clyde Estuary, I was struck by the characteristic form and sculpturing of fæcal pellets found in them, and, by keeping various members of the bottom fauna in captivity, was able to determine from which particular organism these fæcal pellets were derived.

Doubtless Mr. Moore [1] will remember my discussing the matter with him at Millport Marine Laboratory in 1929 before he commenced his investigations on marine muds.

I may mention here that a distinct stratification in the core extracted from the bottom was noticeable, and my examination showed that successive layers were characterised by fæcal pellets derived from different species, and in some cases different groups, of organisms. A history of the nature of the population in a specific area over a period was thus possible.

Not only were these layers characterised by the fæcal pellets of different organisms, but also they registered more or less faithfully the amount of land drainage in the particular neighbourhood.

I was therefore interested to read in Mr. Moore's letter that he has been so successful in his investigations, which in part confirm my observations. The detailed published results of his work should be valuable.

RODERICK MACDONALD.
Marine Laboratory, Egypt,
June 18.

[1] NATURE, May 30, p. 818.

The Theoretical Magneton Numbers in Weiss Units.

As in several cases the experimental ionic magneton numbers may be regarded as established to within a few hundredths of a Weiss magneton, and as, on the other hand, the theoretical values given by Hund,[1] Laporte-Sommerfeld,[2] and Bose-Stoner [3] are accurate only to a few tenths of a magneton, it may be useful

to tabulate the more exactly calculated magneton numbers expected from the different theories.

For the magnitude of the Bohr magneton $\left(N\frac{he}{4\pi m}\right)$, 5564 erg gauss^{-1} mol^{-1} has been accepted,[4] where the spectroscopic value of e/m has been used.[5]

The experimental Weiss magneton, in terms of which the measurements are usually described, has the value 1123·5 erg gauss^{-1} mol^{-1}. The ratio of the two units is 4·952.

Hund's theory leads to the formula $p = 4{\cdot}952\, g\sqrt{j(j+1)}$; the theory of Bose and Stoner to $p = 4{\cdot}952\,\sqrt{4s(s+1)}$.

The values of p for the group of rare earths (following Hund), and for the iron group, are tabulated next to the numbers, as given by the authors themselves.

RARE EARTHS.

Number Electrons.	Ion.	Basic Level.	p_H.	p_H foll. Hund.
55	Ce'''	$^2F_{5/2}$	12·56	12·5
56	Pr'''	$^3H_4$	17·72	17·8
57	Nd'''	$^4J_{9/2}$	17·92	17·8
58	Il'''	$^5J_4$	13·29	13·4
59	Sa'''	$^6H_{5/2}$	4·19	4·2
60	Eu'''	$^7F_0$	0	0
61	Gd'''	$^8S_{7/2}$	39·31	39·4
62	Tb'''	$^7F_6$	48·14	48·3
63	Dy'''	$^6H_{15/2}$	52·72	52·8
64	Ho'''	$^5J_8$	52·53	52·8
65	Er'''	$^4J_{15/2}$	47·45	47·7
66	Tu'''	$^3H_6$	37·44	37·6
67	Yb'''	$^2F_{7/2}$	22·46	22·5

IRON GROUP.

Number Electrons.	Ions.	Basic Level.	p_H.	p_H foll. L.-S.	$p_{B.-St.}$	$p_{B.-St.}$ foll. St.
19	V'''', Ti'''	$^2D_{3/2}$	7·67	7·7	8·58	8·6
20	V''', Ti''	$^3F_2$	8·09	8·1	14·01	14·1
21	Cr''', V''	$^4F_{3/2}$	3·84	3·9	19·18	19·3
22	Mn''', Cr''	$^5D_0$	0	0	24·26	24·4
23	Fe''', Mn''	$^6S_{5/2}$	29·30	29·6	29·30	29·4
24	Fe''	$^5D_4$	33·22	33·6	24·26	24·4
25	Co''	$^4F_{9/2}$	32·85	33·2	19·18	19·3
26	Ni''	$^3F_4$	27·68	28·0	14·01	14·1
27	Cu''	$^2D_{5/2}$	17·58	17·7	8·58	8·6

C. J. GORTER.

Natuurk. Laborat. der Rijks-universiteit,
Leyden, June 4.

[1] F. Hund, *Zeit. f. Phys.*, **33**, 855; 1925.
[2] O. Laporte und A. Sommerfeld, *Zeit. f. Phys.*, **40**, 333; 1926.
[3] D. M. Bose, *Zeit. f. Phys.*, **43**, 864; 1927. E. C. Stoner, *Phil. Mag.*, **8**, 250; 1929.
[4] R. T. Birge, *Phys. Rev.* Suppl., vol. i.; 1929.
[5] Even the last deflection measurements point to the 'spectroscopic' value. C. T. Perry and E. L. Chaffée, *Phys. Rev.*, **36**, 904; 1930.

Measurement of the Electricity Liberated during the Downgrade Reactions of Organic Compounds.

THE possibility of deriving electrical energy from an organic reaction proceeding irreversibly in one half-element of a cell seems so unlikely on general grounds that an attempt has been made to repeat the observations recorded by Prof. Potter under the above title in NATURE of April 11. Briefly, Prof. Potter found that if the cell

carbon (or stainless steel)	dilute HCl	porous pot	CuSO4 solution	copper

is short-circuited, no current passes; if, however, zinc is placed in the acid out of contact with the electrode, copper is deposited on the right-hand electrode so long as the zinc continues to dissolve. He further found that, if the acid is replaced by 15 per cent sugar solution and the cell is short-circuited, copper is deposited on the electrode as soon as yeast is added to the sugar solution, but not before. Prof. Potter also found that a primary cell (capable of electrolysing copper sulphate solution) is obtained from the combination

carbon	15 per cent sugar solution	porous pot	15 per cent sugar solution and yeast	carbon

the electrode in the fermenting half of the cell being negative. Observations were further recorded in which the decay of lawn mowings and other organic matter was made to produce electrolysis.

When I repeated Prof. Potter's experiments with the first type of cell, I found small random changes in weight of the copper electrodes which, however, were affected neither by the addition of zinc to the acid nor by the addition of yeast to the sugar solution. Furthermore, control copper electrodes, immersed in the copper sulphate solution but unconnected to the other electrode of the combination, showed exactly similar changes in weight.

To explore the matter further, the cell

carbon	$\frac{N}{5}$ HCl	saturated KCl	$\frac{N}{5}$ CuSO4	Cu

was set up and its E.M.F. was measured on a potentiometer. The cell was found to give a substantial but variable E.M.F. ranging from 0·1 to 0·3 volt; the carbon electrode was usually positive, so that if the cell had been short-circuited, copper would not have deposited but would have dissolved. When zinc was placed in the acid, its solution caused no substantial change in the sign or magnitude of the E.M.F.

The replacement of the acid by 15 per cent sugar solution yielded a cell in which the carbon was positive to about the same extent. The addition of yeast and subsequent fermentation produced none but random variations in the E.M.F. of the combination.

The cell

carbon	15 per cent sugar solution	porous pot	15 per cent sugar solution and yeast	carbon

was set up several times. It yielded an initial E.M.F. entirely fortuitous in sign and upon which the subsequent fermentation produced no systematic effect. Like all the other combinations measured, this cell polarised with great readiness.

In none of my observations is there any evidence, therefore, of a continuous supply of electrical energy from a chemical reaction proceeding irreversibly. Neither the solution of the zinc nor the fermentation of the sugar had any effect on the E.M.F. of the cell beyond the random effects to be anticipated during the liberation of gases in the neighbourhood of an indeterminate and readily polarisable electrode such as carbon.

Since making these observations I have been in correspondence with Prof. Potter. We have not succeeded in discovering any significant discrepancy in the two sets of experimental conditions beyond the fact that I used pure sucrose while Prof. Potter used unrefined sugar. Apart from their effect on the internal resistance of the cell, it seems unlikely that the impurities could play a decisive part.

J. H. WOLFENDEN.

Balliol College and Trinity College Laboratory,
Oxford, June 18.

X-Ray Fibre Photography.

WE have recently brought to a successful termination an investigation which was carried out to determine a combination of an X-ray generating plant and tube which would enable fibre photographs to be taken with exposures so low as to enhance the value of X-rays as a testing medium in the silk, wool, and allied industries. Fig. 1 is an X-ray photograph of ramie fibre of fifteen minutes' exposure. This exposure, however, greatly under-estimates the efficiency of the plant, since later photographs were produced with exposures of only thirty seconds' duration. This was repeated for wool and artificial silk.

A Laue spectrographic arrangement was used, and the fibres were subjected to copper radiation emanating from a Muller type water-cooled hot filament tube working at 10 m.amp. at 40 k.v. peak. The tube was fed by a D.C. generating plant consisting of a valve rectifier plant with smoothing condensers, arranged for an output of 30 m.amp. at 60,000 volts D.C. maximum.

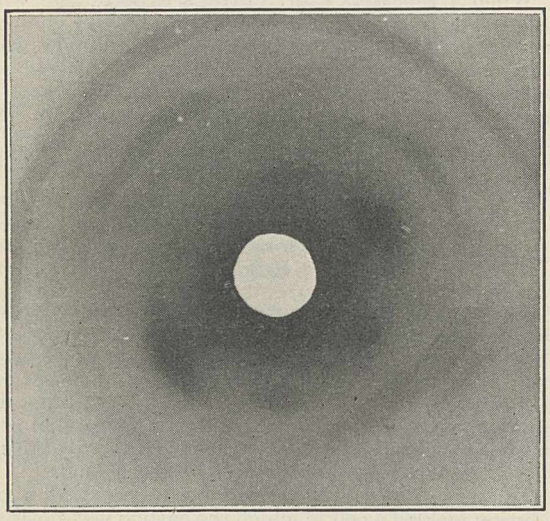

FIG. 1.—X-ray photograph of ramie fibre. The outer ring is due to brass of collimating tube.

We intend in the future to use a helium-filled Muller chrome iron tube with flat copper anode and fitted with four Lindemann windows. This tube will carry continuously, on rectified current, loads of 25 m.A. at 60 k.v. peak or 30 m.A. at 40 k.v. peak. This results in a treble output of that initially used, and in addition the tube is so designed that the anode to fibre distance is reduced by half. Thus we confidently expect to obtain X-ray fibre photographs with exposures of five seconds and even less.

S. ZEIDENFELD.
Adam Hilger, Ltd. (Research Laboratories),
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"The World List of Scientific Periodicals."

"THE World List", of which the first edition was published a few years ago, was an attempt to issue a complete alphabetical list of all the periodicals in all countries publishing the results of scientific research, in existence between 1900 and 1920, with standard abbreviations for the titles of each. The List contained the titles of approximately 24,000 periodicals. It was impossible that a work so costly to compile and to print could be self-supporting, and the publication of the first edition was made possible only by grants from the Carnegie United Kingdom Trust and from private individuals.

The Royal Society of London, recognising the value to science of "The World List", has made a grant sufficient to enable us to undertake the preparation of a new edition. This is to be complete, so far as we can make it, up to the end of 1931. I shall be very grateful if librarians and others who have the first edition will send to the editor, Mr. W. A. Smith, Department of Printed Books, British Museum, Bloomsbury, London, W.C., a note of any errors they may have observed in the first edition, any omissions from it, and the titles of any existing periodicals containing the results of scientific research, in actual existence from 1900 up to the present, and omitted from the original edition.

P. CHALMERS MITCHELL
(Chairman, "The World List").

July 2.

'All or None': a Question of Nomenclature.

THE 'all or nothing' hypothesis represents such a clear-cut principle in elementary physiology that it seems a pity that the ambiguous phrase, 'all or none', should so often be used instead. We have been accustomed to suppose that a given physiological unit, or set of units, shows either 'all or nothing' of the response it can make under given conditions; also that additions to this response, under the same conditions but with greater stimulus, can be made only by co-operation (or, in a special context, 'recruitment') of additional units. This meaning is actually excluded by the nickname 'all or none', because we have supposed that 'some' units, few or many, fill in intervening stages of intensity of the response.

Moreover, recent and well-known work (such as the experiments at Oxford and at Cambridge on the spinal flexion reflex and on variation of electrical rhythm in sensory and motor units) demonstrates that 'all or none' of the active units can together modify their response. The alternative phrases now suggest two different principles, separately demonstrable in certain experiments—variability in number of units, each contributing its own 'all or nothing', and secondly, variability of contribution from 'all or none' of them.

W. W. WALLER.
Physiological Laboratory,
University of Liverpool.

Polarisation of Raman Scattering by Hydrogen Gas.

THE theoretical work of Hill and Kemble, Manneback, and others, indicates that in the spectrum of the light scattered transversely by diatomic molecules, the rotational lines should be very imperfectly polarised. The Raman spectrum of hydrogen offers a particularly favourable case for an experimental test of this point, as the individual rotational lines are well separated from the exciting line. Working at a pressure of 50 atm. I have observed that the Raman lines representing the rotational transitions $0 \rightarrow 2$ and $1 \rightarrow 3$ in hydrogen gas are only weakly polarised, that is, to the extent of about 25 per cent; and that, on the other hand, the polarisation of the vibration lines appears to be sensibly complete.

By improving the experimental arrangements it has been found possible to eliminate stray light, and thus ensure that the light entering the spectrograph is exclusively that scattered by the molecules of the gas. Experiments are in progress to determine directly from the spectrograms the relative intensities of the Rayleigh and Raman scattering by various gases.

S. BHAGAVANTAM.
210 Bow Bazar Street, Calcutta, June 1.

Research Items.

Yaksas.—In '*Yaksas*', pt. 2, published by the Smithsonian Institution, Freer Gallery of Art, Dr. Ananda Coomaraswamy continues his study of the Yaksas cults of India. All Yaksas, great or small, are vegetation spirits directly controlling, or bestowing on their *bhaktas*, fertility and wealth. All Yaksas are intimately connected with the waters; for example, Kubera's inexhaustible treasuries are a lotus and a conch; innumerable Yaksas have a makara or other fish-tailed animal as their vehicle; Kamadeva has the makara as his cognisance; the greater tutelary Yaksas control the rains essential to prosperity. In the decorative art, vegetation is shown either springing from the mouth or navel of a Yaksa, from the open jaws of a makara, or other fish-tailed animal, or from a conch, but never directly from a symbol representing the earth. But the Yaksas do not so much control the waters as water, as the essence in the water, which is at one with the sap in trees, the elixir of the Devas, especially Agni, with the soma, and the seed in the living being. They are a far greater and mysterious power, and far more significant than the Nagas or dragons, who are also water deities. The importance of the Yaksas in what has been called the Life cult is to suggest that this cult, which is connected with the worship of the Great Mother, may have been the primitive religion of India. A belief in the origin of life in the water was common to many ancient cultures, and must have arisen very naturally in the case of peoples, like those of the valleys of the Euphrates, Tigris, or the Indus, among whom water, whether of the seasonal rains or the overflowing river, was the most serious prerequisite for vegetal increase.

Hand-Spinning in Egypt and the Sudan.—The Bankfield Museum, Halifax, has published as No. 12 of the second series of its *Museum Notes*, a study of hand-spinning in Egypt and the Sudan, by Mrs. Grace M. Crowfoot. In this area a number of different types is found, from the most primitive and simple by hand alone to the highest type of suspended spindle-spinning reached before the invention of the wheel. Six types are recognised: (1) Hand-spinning alone, the simplest method known, in which the hand alone is used or with the assistance of the thigh. There is no example in modern Egypt, but it is represented in ancient Egypt. In the Sudan it occurs far to the south among the primitive Nuer. (2) Spinning by twisting a hooked stick, a simple and primitive method found among the conservative nomads, such as the 'Beit Awad' of the Beni Amer. (3) Spinning by rotation of the spindle in the hand, a surprising and beautiful method found among the Sudanese Arab tribes and the Hadendoa of the Red Sea coast. The stick is sometimes plain, and sometimes has a whorl at the tip. Its special value lies in its command over short-stapled wool. (4) Grasped spindle, in which a prepared rove is passed through a ring over a forked stick or other support and is spun on a large spindle suspended in both hands, known only from ancient Egypt. (5) Supported spindle: (*a*) spindle rests lengthwise on the right thigh and is spun on a large spindle grasped in both hands; (*b*) spindle spun while standing erect on the ground or in a shell or bowl; 5 (*a*) is used chiefly for cotton—the only modern example is in Dongola Province; 5 (*b*), the chief way of spinning cotton in many parts of the world, is used in the Sudan only by immigrants from Sokoto and Bornu. The flax-spinning of modern Egypt shows the influence of ancient Egypt and Europe, cotton-spinning in the Sudan shows strong resemblances to the flax-spinning of ancient Egypt.

The Wolf of Corea. — In Corea a considerable amount of damage is still caused by wolves, and the Tyosen (Corean) Government reports show that rewards are paid annually for the slaughter of more than a hundred individuals. On three occasions, Yoshio Abe visited Corea for material to study the wolves of the region, and these he now describes as belonging to a geographical race of the common wolf, *Canis lupus coreanus*. From the races of the common wolf which inhabit various areas of Asia, the Corean form is distinguishable by the relative slenderness of the muzzle, a character in which it approaches the North American *Canis occidentalis*. In colour, the Corean wolf, which, like other wolves, shows distinct variation in individuals, falls between the common wolf and the pale *Canis laniger* (*Jour. Sci., Hiroshima Univ.*, Ser. B, Zoo.; Dec. 1930.)

New North and South American Ascidians.—Dr. Willard G. Van Name in the *Bulletin* of the American Museum of Natural History, vol. 61, art. vi. pp. 207-225, describes four species of ascidians new to science, and a fifth from Tortugas, Florida, appears to be identical with a Japanese form, *Botryllus primigenus* (Oka), described by Prof. Oka in 1928. This species is noteworthy in that the branchial sac has but 4 rows of stigmata, unlike all other known American and European forms, which have 8 or more such rows—8 or 9 in the common *B. schlosseri*, typical of British waters. In addition the atrial orifices of some of the zooids of *B. primigenus* open directly on to the surface of the colony without the intervention of common cloacal cavities. Of the four species new to science, all are members of well-known families and genera: *Clavelina huntsmani* from the west coast of N. America; *Stolonica zorritensis* from Zorritos, Peru, peculiar in having a small number of gonads all apparently hermaphroditic; *Pyura bradleyi*, also from Zorritos; and *Polyandrocarpa gravei*, a compound styelid of flat encrusting form from Tortugas. As is usual with Dr. Van Name's publications, the descriptions of the species are accompanied by numerous helpful illustrations.

Antarctic Alcyonaria, Madreporaria, and Antipatharia.—Sir J. Arthur Thomson and Miss Nita Rennet describe these cœlenterates of the Australasian Antarctic Expedition, 1911–14, under the leadership of Sir Douglas Mawson (*Scientific Reports*. Series C, Zoology and Botany. Vol. 9, part 3, January 1931). The collection includes 31 species of Alcyonaria, of which 7 are new, 5 species of Madreporaria, and 2 species of Antipatharia. The most important find is that unique type of alcyonarian *Ainigmaptilon haswelli* Dean, placed provisionally in the Pennatulacea and already described in the *Proceedings* of the Linnean Society (Zoology, vol. 36; 1926) by Miss Isobel Dean. From a narrow main stem, without an axis, numerous short side-branches are given off which subdivide irregularly into twigs bearing many small autozooids. There are four longitudinal septa in the main stem—the most striking pennatulid feature—and the side branches are most nearly comparable, though not identical in structure, with the pinnæ of the pennatulids *Virgularia gustaviana* and *V. halisceptrum*. However, there is no satisfactory evidence of siphonozooids; also a definite axial canal and an axis are missing. It is, however, possible, although not probable, that the axis was separated from the colony in the dredging, as the septa are torn. *Ascolepsis splendens*, a new genus, is a beautiful alcyonarian belonging to the Primnoidæ in the order Axifera. This has a new type of sclerite, chalice-like

in shape. Another species belonging to this genus, *A. spinosa*, is also described, and a form intermediate between these two. The plates are excellent, especially those which are delicately coloured.

Chromosome Multiples in *Chrysanthemum* and *Potentilla*.—In a paper just received, N. Shimotomai (*Jour. Sci., Hiroshima Univ.*, Botany, vol. 1, p. 37) describes three species-hybrids of *Chrysanthemum* and the behaviour of their chromosomes. In *Ch. Decaisneanum* ($n=36$) × *Ch. indicum* ($n=18$) the F_1 hybrid has 54 chromosomes, which form 27 pairs in meiosis, and the pollen grains receive 27 chromosomes. This is presumably because 18 of the chromosomes from the octoploid *Ch. Decaisneanum* pair with each other. Similarly, in *Ch. marginatum* ($n=45$) × *Ch. morifolium* ($n=27$) the hybrid has 72 chromosomes which form 36 pairs. Again, 18 chromosomes of the higher polyploid parent mate with each other. In *Ch. marginatum* × *Ch. indicum*, however, the 63 chromosomes of the hybrid form 18 bivalents and 27 univalents. These hybrids are all intermediate between the parents, but nearer that one with the higher chromosome number. Another paper in the same journal (p. 1) gives chromosome counts in a number of further species of *Potentilla*, and discusses the phylogeny of the genus in the light of the chromosome numbers. It appears that primitive species and subsections have the basal number ($2n=14$) or low multiples, while in the Hæmatochroæ, regarded as recent in origin and arising in part through hybridisation, the numbers range from 42 in *P. nepalensis* to 112 ($16n$) in *P. hæmatochrus*. It is believed that the originals of *Potentilla* were diploid species with a circumpolar distribution in the Tertiary, whence they afterwards moved southwards, intercrossed, and gave rise to various polyploid species and groups.

The Classification of Carbonaceous Minerals.—In 1927 Prof. G. Hickling plotted the percentages of carbon and oxygen recorded in more than a thousand analyses of American and British coals, and found that the points lay on a well-defined and continuous belt covering the whole range from lignite to anthracite, thus demonstrating that these coals are members of a natural, unbroken series. Prof. H. Briggs has now plotted the corresponding data for other carbonaceous materials and recorded the results in the *Proc. Roy. Soc. Edinburgh*, **51**, 1931, pp. 54-63. It appears that there are two kinds of cannel coals, the analyses of which fall on distinct 'development' lines. In order of increasing hydrogen, the series recognised are (*a*) sub-cannels, (*b*) cannels, (*c*) paraffin shales, and (*d*) torbanites. These give lines nearly parallel to the coal belt, and beyond them fall two groups of crude petroleums, heavy and light oils respectively, on lines having a very different slope. It is noteworthy that the further from the coal belt an analysis is situated (in the direction of increasing hydrogen) the more suitable is the mineral as a source of oil. The graphs therefore serve a useful purpose as a standard of reference for distinguishing suitable materials for distillation.

High Vacua.—In the June issue of the *Journal of the Franklin Institute*, Dr. S. Dushman, of the research laboratory of the General Electric Company, reviews the advances in the production and measurement of high vacua which have taken place since the issue of his own and of other books on the subject, published five or six years ago. The chief advances are in the introduction of vapour pumps of much higher speeds, the use of what are known as 'getters' to improve the vacuum, and in the more careful investigation of the behaviour of the metal parts of the apparatus towards the vacuum. The usual method of measuring the speed of exhaust depends on Knudsen's expression for the resistance a tube offers to the flow of gas through it. Condensation pumps are the rule, and the Payne two-stage pump used by the Company is described. It requires a force pump giving a pressure of 2 mm. of mercury, and its speed is given as 60,000 c.c. per second. Pumps using organic liquids instead of mercury, as used in the Eastman Kodak Laboratories, are also described. Magnesium and calcium are the usual 'getters' for oxygen, but for hydrogen and nitrogen, cæsium and sodium are more active. Pressure gauges are generally either of the ionisation type, depending on the ionisation produced in the residual gas by accelerated electrons from an oxide-coated filament, or they utilise the temperature or resistance of a thin wire electrically heated in the residual gas. The author collects a considerable amount of information recently obtained on the constitution and amount of the gases in metals and in glass.

Reflection of Water Molecules at the Liquid Surface.—Whilst it is relatively easy to investigate experimentally problems connected with the emission and reception of charged particles, the study of the corresponding processes for neutral atoms and molecules often presents considerable difficulty and has received less attention. Prof. T. Alty has contributed a paper to the June issue of the *Proceedings of the Royal Society* in which he describes a determination of the reflection coefficient of water molecules when they are incident on a liquid water surface. The method employed was to measure the rate of evaporation from a water surface of known area as a function of the vapour pressure over the evaporating surface, whence by extrapolation to zero pressure the rate of evaporation into a vacuum could be deduced. The last quantity was then compared with the rate at which molecules struck the surface from the saturated vapour, calculated by the usual kinetic theory relations. The two quantities were of a different order of magnitude, and to reconcile them it is necessary to assume that the large majority of the molecules are reflected from the surface when they strike it, and pass back into the vapour phase. Under the conditions used by Prof. Alty, it appears that only about one per cent of the incident molecules are able to enter the liquid. The average time which a molecule spends in the surface is not greater than about 10^{-5} sec.

Photochemical Decomposition of Hydrogen Iodide.—The decomposition of hydrogen iodide gas on exposure to light, first studied by Lemoine in 1877, has been investigated several times, and it has been considered that the gas exhibited continuous absorption to a wave-length of 3600 A. In the May number of the *Journal of the American Chemical Society*, Rollefson and Booher show that the absorption extends as far as 4000 A. The absorption on the long wave-length tide of 3120 A. is interpreted as due to dissociation of the molecule into normal atoms (a type of reaction not very common), that on the shorter wave-length side giving an excited iodine atom. Salant and Sandow have reported decomposition with the 4047 A. line of the mercury arc. The conclusions are based on the value 69,000 gm.cal., or 3 volts, for the heat of dissociation into normal atoms, and the energy 0·95 volt to raise the iodine atom to the first stage of excitation. This gives the corresponding wave-lengths 4120 A. and 3120 A. The results are interpreted in terms of potential energy curves. It is concluded that in the zero and first vibrational levels the molecule may be considered as an example of ionic binding.

Estimation of Bromine in Organic Compounds.—By substituting butyl alcohol for ethyl alcohol in Stepan-

off's method for the determination of halogens in organic compounds, Dr. F. Schultz claims to have made the method more accurate and even applicable to the determination of bromine in highly brominated hydrocarbons. Stepanoff's method (*Ber.*, 1906, 39, 49) of estimating halogens by treating the substance in alcoholic solution with sodium, thereby converting the chlorine, bromine, or iodine present into the sodium salt, possesses obvious advantages over the Carius tube method. Various modifications have been suggested from time to time, but the method has not hitherto been considered accurate for highly brominated hydrocarbons. In his paper in the May number of the *Collection of Czechoslovak Chemical Communications*, Dr. Schultz describes how he carried out the reaction by gradually adding sodium to the boiling butyl alcohol solution of the bromine compound. Hexabromobenzene, pentabromotoluene and hexabromonaphthalene were examined. After the sodium had all been introduced, boiling under a reflux condenser was continued for an hour. Water was then added before filtration and the acidified solution was precipitated with silver nitrate and 'back-titrated' with ammonium sulphocyanide. The results were in very good agreement with the theoretical values.

Oxidation-Reduction Potentials in Bacteriology.—It is now well known that living cells require a constant hydrogen ion concentration in their environment if they are to live and function normally, and in higher animals mechanisms have been developed to maintain this concentration in the tissue fluids constant at a point close to neutrality. The reducing power of the environment is probably similarly regulated, a balance being struck between the reducing and oxidising tendencies just as there is a balance between the hydrogen and hydroxyl ions. The oxidation-reduction potential can be measured by suitable indicators or potentiometrically. L. F. Hewitt, in a publication, "Oxidation-Reduction Potentials in Bacteriology and Biochemistry", recently issued by the London County Council (pp. 70. Price 2*s.*), describes a series of investigations on the oxidation-reduction conditions produced by bacteria in the medium by which they are surrounded, and has found striking differences of behaviour between different micro-organisms. Thus aerobes are in general able to reduce ordinary aerobic culture media until a moderately intense reducing level is reached; anaerobes, on the other hand, cannot effect any reduction in ordinary aerobic cultures, but if the medium is partially reduced to begin with, for example, by exclusion of the oxidising effect of air, they are able to establish very much more intense reducing conditions than the majority of aerobes. Pneumococci, again, do not maintain the level of reducing intensity after the logarithmic phase of growth, highly oxidising conditions being gradually established owing to the formation of peroxide. The virulence of hæmolytic streptococci is maintained in culture by opposing the reducing effects of the organisms, through increasing their oxygen supply. It seems possible that a systematic classification of organisms will result from studies of the oxidation-reduction potentials in bacterial cultures.

Astronomical Topics.

Distance of the Great Nebula in Orion.—A *Bulletin* dated June 11, from Science Service, Washington, D.C., gives a summary of a new determination of the distance of this nebula, made by Dr. R. J. Trumpler at the Lick Observatory, and reported by him to the Astronomical Society of the Pacific at Pasadena. He states that three different methods give the distance as 1800 light-years, which is about three times as great as the value generally given; thus Kapteyn gave the parallax of the nebula as 0·0055″, implying a distance of 590 light-years. As there is evidence of association between the nebula and many of the bright stars in Orion, their distance is generally taken to be about the same; if the new distance applies to Rigel, it must be of extraordinary brilliance. The table in Russell, Dugan, and Stewart's standard work gives its absolute magnitude as −5·8 with a parallax of 0·006″; at three times the distance it would have absolute magnitude about −8·2. The new value gives the diameter of the nebula, neglecting its faint extensions, as 26 light-years. Dr. Trumpler has also investigated the colour of the stars in the nebula; he finds that they are slightly redder than stars of the same type elsewhere, which he ascribes to the absorptive effect of the nebula on their light.

The Cape Observatory.—The report of the Cape Observatory for 1930, which has just come to hand, states that the transit circle observations include the sun, Mercury, Venus, and Vesta (which is used to check the equator point), zodiacal stars, and stars south of −30° Decl. down to mag. 7·5. There is the welcome news that the heliometer observations of the outer planets since 1897 will shortly be published. They are likely to help in the determination of Pluto's mass.

Proper motions of stars in the Cape astrographic zone are being deduced by comparing recent photographs, taken through the glass, with those taken several years ago.

The relative trigonometrical parallax of Nova Pictoris came out as −0·013″. Another determination was made by co-ordinating the increase of brightness with the expansion indicated by the spectroscope. The value 0·0015″ was obtained, which makes the absolute magnitude at maximum −7·9.

The report shows that even before the end of 1930 the Eros programme was in full swing; the most important southern observations would be those made in January and February.

1930 was the driest year at the Cape since 1841, the rainfall being 16·46 in. The extremes of temperature were 104·0° and 35·8°, the annual mean being 63·7°.

New List of Astronomers and Observatories.—Prof. P. Stroobant and the other members of the staff of Uccle Observatory have just published a new edition of their useful list. The first edition appeared in 1907 and is now out of date; the new one is brought out under the auspices of the International Astronomical Union, which has assisted in the cost of publication. Very full particulars are given of the observatories; the names of all members of the staff, the department that they are attached to; details about the instruments, and the work for which they are used. The list of astronomers has references to all the pages on which they are mentioned. Full details are also given of the astronomical societies, with a description of their special objects, their dates of meeting, their publications, etc. They are arranged in order of their dates of foundation, the Royal Astronomical Society coming first. Finally, there is a list of astronomical periodicals, with particulars about their special fields of work, dates of publication, and subscription prices. Altogether the volume is one which all astronomers will find most useful; it is printed and edited by Messrs. Casterman, Tournai; the price is not stated.

National Physical Laboratory, Teddington.

INSPECTION BY THE GENERAL BOARD.

ON Tuesday, June 23, the General Board of the National Physical Laboratory made its annual inspection of the laboratory. As is customary, a large number of visitors, including members of scientific and technical institutions, government departments and industrial organisations, were present and were received by Sir Gowland Hopkins, president of the Royal Society, chairman of the General Board, Sir Richard Glazebrook, chairman of the Executive Committee, and Sir Joseph Petavel, director of the Laboratory.

A comprehensive range of experiments and apparatus, illustrating the various activities of the Laboratory, was shown.

In the Aerodynamics Department, the compressed air wind tunnel, a model of which was shown in 1928, has nearly reached completion and was thrown open for inspection. This tunnel, which consists of a main steel shell 50 ft. in length and 17 ft. in diameter, enclosing the working tunnel of 6 ft. diameter, is constructed of rolled steel rings closed by hemispherical end castings, both made at the works of Messrs. John Brown, Ltd., Sheffield. The tunnel is of the open jet, return flow type and is capable of withstanding pressures up to 25 atmospheres. Three 400 h.p. compressors are housed in an adjoining room and can raise the pressure to its full value in about 80 minutes. The propeller for circulating the air is driven by an external 400 h.p. motor, the shaft passing through a stuffing box. It is anticipated that an air speed of about 90 ft. per sec. will be possible at the highest working pressure, corresponding to a speed of about 150 miles per hour in the case of an average aeroplane under normal atmospheric conditions.

In one of the four-foot wind tunnels demonstrations were given of the buffeting of aeroplane tails, a phenomenon revealed by tests subsequent to the Meopham accident. This phenomenon is due to the character of the airflow behind an aerofoil, when the latter approaches stalling incidence, particularly at high speeds. Under these conditions the airflow becomes periodic, and the eddies so formed may impinge on the tail, and in special circumstances may set up serious vibration. To demonstrate the phenomenon, an aerofoil was mounted in the tunnel at stalling incidence and means were provided of setting the tail in any desired position relative to it. The tail was provided with suitable flat springs to allow vibration to take place, the oscillations being projected by appropriate mirrors on to photographic paper. The investigation is directed to the study of the limits of the eddying wake produced by different wing sections at various angles of incidence, and to the buffeting effects on a tail placed at various positions inside and outside the wake.

Apparatus for the precise reproduction of the spinning motion of an aeroplane has been constructed in the Department. Hitherto, in wind tunnel tests relating to spinning problems, the model has been rotated about an axis through the centre of gravity. This does not take account of the fact that the latter moves in a helix. The new apparatus allows for this factor. The model is offset at any desired distance from the rotating axle by means of a radius arm, the rotation being effected by means of a motor and epicyclic gearing. The rolling moment is determined by measurement of the mechanical reaction on the gear system due to the model.

Of interest also was a method of rendering visible the airflow round a body placed in an airstream. Fine platinum wires, half an inch apart, are mounted on two vertical supports situated in front of the body and heated to redness by means of an electric current. Each wire gives rise to a band of heated air which persists for some distance downstream. These bands, owing to their decreased refractivity, cast a shadow on a screen when suitably illuminated and thus give a direct picture of the streamlines. These can be examined by means of a stroboscope if necessary. Such phenomena as the behaviour of an aerofoil at stalling incidence and of the Handley Page slot are clearly brought out.

In the Engineering Department an investigation was in progress for the Roads Department of the Ministry of Transport on the forces due to wheel impacts on a road. To determine such forces it is necessary to know the corresponding spring load and the linear accelerations of two points on the axle. To measure the latter, special accelerometers have been designed and constructed in the Department. These instruments depend on the variation of a mutual inductance by the impact. Alternating current of definite frequency is supplied to the primary coil and the secondary current, after rectification, is recorded by an oscillograph. The load on the springs is determined by mounting the normal suspension springs on stiff springs, the deflection of one end of which is determined by a method similar to that utilised in the accelerometers. The whole equipment is mounted on a special trailer, which is provided with a dark room for development of the records on the road. The effects of different types of tyre and sizes of wheel are being investigated.

In connexion with the investigation of the mechanical properties of materials at high temperatures, creep tests have been made on a variety of materials—cast and forged steels, alloy steels, and non-ferrous alloys—and the effects of an atmosphere of steam and of a hot air blast have been investigated. To obtain greater refinement in such tests, very accurate control of the temperature of the specimens has been found necessary. For this purpose a further batch of creep units has been constructed. These are controlled by a thermionic valve bridge and suitable relays, and the temperature can be maintained constant within $\pm 0{\cdot}5^\circ$ C. The extension of the specimen is measured by means of Marten's mirror extensometers, capable of measuring to one millionth of an inch on a five-inch length. A new 25-ton testing machine to accommodate the new creep units has been installed. With this machine low rates of creep can be obtained.

Attention has been given to a method of testing the hardness of thin coatings of electrolytically desposited metals such as chromium. Some success has been obtained with a diamond scratch method, using suitable loads.

Experiments have also been made to determine the minimum dimensions for correct results of a test piece suitable for use in ball indentation tests. Sample test pieces of various shapes and thicknesses which have been used in the investigation were on view.

Of interest also was apparatus for determining the hardness of white metal bearings at temperatures up to 350° F. The tests are made on the metal in actual half bearings ready for service. A Vickers loading machine is used, the bearing being immersed in an oil bath mounted on the machine and maintained at the required temperature. The apparatus was shown in use for tests on a big-end bearing.

Attention has also been given to the problem of

corrosion fatigue, which is being dealt with under two aspects. In one case experiments have been made on a single crystal of aluminium stressed while immersed in a slow stream of tap water. Corrosion was found to occur preferentially on the site of previously formed slip bands, and to this corrosion the ultimate failure of the crystal was mainly due. Specimen test pieces showing the corrosion product (aluminium hydroxide) were on view. In the second case the relative strengths of aircraft steels and alloys have been determined when tested *in vacuo*, in various gases, in a salt spray, and with and without protective coatings. The specimens are subjected to reversed bending and to reversed direct stresses under these conditions.

Research work has been carried out to determine the causes of failure of wrought iron chains. The investigation has shown that failure may be caused by the occurrence of burnt iron, which is due to an excess of phosphorus and silicon, and dates back to the puddling stage of manufacture. A test has been devised to reveal the presence of such defective material. Work is also in hand to determine the effects of service conditions and of subsequent heat treatment, such as annealing, upon the threaded parts of shackles and upon the pitch of chains. Special machines have been devised in which service conditions are reproduced.

The Department has been responsible for the design of standard forms of crane hooks. Sample hooks have been prepared and tested for strength and have been found extremely satisfactory. The designs have been adopted by the British Engineering Standards Association. Specimen hooks both before and after test were on view.

An investigation was in progress to study the velocity of travel and the wave-length of waves set up on the surface of water by the action of wind. The waves are produced in a 12 in. by 12 in. rectangular tunnel 50 ft. in length. By observation with a stroboscope it is possible to determine the frequency and wave-length at the same time. From photographs of the wave motion, scale models of the actual waves can be constructed and the distribution of wind pressure over them determined in a wind tunnel. The relation between the wave-length and the velocity approximates very closely to that calculated on the basis of the irrotational motion of a frictionless wind.

Of interest also was a liquid gauge used for simultaneous measurements of the wind pressure at a number of points on a building. The tubes contain benzyl alcohol and a solution of calcium chloride; these liquids give a clear surface of separation and the difference of their densities is small. A sensitivity five times that of the ordinary water gauge is attained. A flashlight photograph is taken of the gauge, and the pressures corresponding to different points of the building are read off from the print.

In the Metallurgy Department, research work was in progress in connexion with the effect of various aqueous solutions of salts, such as may be present in boilers, on the behaviour of boiler steels when stressed. Steel specimens which have been subjected to the action of various solutions are bent in alternate directions at intervals of 24 hours. It has been shown that the effect of continuous immersion in tap water is to reduce the survival of the specimens (expressed as the number of bends before fracture) by 30 per cent as compared with the endurance in air. Concentrated solutions of sodium chloride have a similar but less severe effect.

The investigation of the effect of flue gases, mentioned last year, has been continued, and has now reached the stage when a batch of a dozen wires can be tested simultaneously for the corrosive action of flue gases. Improved apparatus has been installed, permitting the tests to be carried out at 400° C., 500° C., and 600° C.

An investigation has been undertaken on behalf of the Aeronautical Research Committee in connexion with the constitution and structure of magnesium alloys. The work is directed towards improvements of mechanical properties by the discovery of new alloys in which there is a considerable solubility of the added element, or a change of solubility with temperature sufficient to permit age hardening. Samples of such alloys were on view.

Beryllium is usually prepared by electrolysis of its fused chloride at white heat. A method has, however, been developed in the Department for the electrodeposition of the metal from its fused salts at a much lower temperature. Coherent deposits on copper have been obtained in this way and specimens were exhibited.

Research work has been undertaken for the British Non-Ferrous Metals Association to determine the effects on the strength of copper of such impurities as bismuth, arsenic, antimony, and oxygen. Prepared specimens in the form of strips are subjected to bending in alternate directions in a special machine.

One of the difficulties encountered in the determination of the melting points of some alloys is the presence of vapour, which prevents the use of an optical pyrometer and may contaminate thermocouples. To avoid this difficulty, work is in progress to produce special refractories which are impervious to such vapour. It has been possible to make small tubes of glazed alumina which are satisfactory in this respect, and work is in progress to apply the technique to the production of larger tubes. To avoid glow discharge, and hence error in the thermocouples due to local heating when these are used in the induction furnace, a special furnace of this type has been evolved. This is coreless and is fitted with a water cooled electrostatic screen round the melting chamber.

A demonstration was given in the rolling mill of a special type of failure which can occur in the rolling of ingots of aluminium alloys if the conditions of cooling are not correct. These alloys are rolled while hot. Accurate control of the temperature and the conditions of working previous to rolling—such as casting and forging—are essential.

In the Metrology Department a new clock has been installed depending for its action on the mechanical vibrations of a metal bar held at its centre. The primary vibrating element is a rod of elinvar, an alloy with a low temperature coefficient of elasticity. This is maintained in a state of self-vibration by the application to one end of electrostatic forces obtained after amplification by a valve amplifier from similar feeble forces taken from the other end. A phonic motor operated by the amplifier drives a clock train, one spindle of which rotates once per second. Suitable means are provided for the recording of these seconds on a chronograph. To ensure constancy of frequency, the bar is enclosed in a special housing, the temperature and pressure in which can be controlled by immersion in a vessel of circulating water, the temperature of which is regulated by a toluene thermostat.

Of interest also was a new method of testing surface plates. The plate to be tested is supported on a somewhat larger one provided with levelling screws, and resting on a large flat plate forming the base of the apparatus and carrying a 'Hirth' minimeter as an indicator. The specimen is first set approximately parallel to the base plate by means of the minimeter and then explored by the same instrument. If a standard plate, of which the departures from flatness are known, is substituted for the test plate and the same procedure is adopted, the errors in the latter can be readily determined.

In the Physics Department the investigation on the heat transfer from moving air to cold pipes has been continued, and extended to include banks of pipes such as are used industrially for air cooling in refrigerators.

Experiments were in progress to determine the heat transmission through wall materials. A specimen plate of the material is laid on an electrically heated plate, backed with cork, and is surmounted by a water plate. The electrical input, after correction for the heat conducted through the cork, together with the temperatures of the two faces, gives the necessary data for calculating the conductivity of the material.

The thermal conductivities of heat-insulating materials at high and low temperatures were also under investigation. In the case of the low temperature measurements, the method adopted is similar to that used for the wall materials, a refrigerating plant being utilised for the maintenance of the low temperature. For the measurements at high temperature a water-flow calorimeter is used. The rate of flow, and the rise of temperature of the water when steady conditions have been attained, give the data for the calculation of the thermal conductivity.

An investigation is being carried out, for the Atmospheric Pollution Research Committee, in connexion with the determination of the water in fogs, and a dew point method has been developed for the purpose. A stream of fog-laden air is drawn through a heated tube to vaporise suspended water droplets, and the dew point of the resultant fog-free air is then determined. For the production of artificial fogs a special equipment has been devised consisting of a small chamber provided with air-circulating apparatus which is supplied with steam from an external generator.

A study has also been made of the basic laws of the wet and dry bulb hygrometer over the temperature range 40° C.–100° C. As standards of reference the dew point and gravimetric methods of determining humidity have been used. Apparatus has been designed to give a stream of air at any desired temperature and humidity flowing past the wet bulb thermometer, with velocities exceeding three metres per second. A number of novel features have been incorporated in the apparatus.

In the Sound Division attention is being devoted to the increasingly important subject of noise measurement. The laboratory has co-operated with the Royal Aircraft Establishment in connexion with measurements of the noise of airscrews and exhausts. In the case of the former, the effects of tip speed of rotation, blade diameter and blade shape have been studied and have yielded interesting results. An investigation has also been undertaken for the Ministry of Transport on the noisiness and stridency of motor horns. The loudness was measured by means of an audiometer of the Barkhausen type. By means of a portable microphone amplifier arrangement and cathode ray oscillograph, measurements were also made of the spectral distribution of the sound intensities emitted by the horns. The results indicated that some of the factors affecting the stridency might be the occurrence of strong high frequency components and the presence of inharmonic series of frequencies.

In the Radiology Division the depth below the surface of the cathode at which X-rays originate is being explored. A special hot-cathode X-ray tube is used, the target consisting of thin foil of the material to be investigated. The nature of the X-ray output is analysed by comparative measurements of the absorption in an ionisation chamber.

A number of investigations are being undertaken in connexion with the application of X-rays to industrial problems. These include a study of tungsten steels and tungsten steel residues, the effect of rolling on the crystal orientation in aluminium, and of drawing on that in constantan wire, problems of electrodeposition, paints, and artificial teeth. In the case of constantan wire, the temperature coefficient was found to change as the wire was drawn, and the effect on this phenomenon of changes in crystal orientation is being studied.

In the Electrical Standards Division considerable attention has been devoted to the development of a standard of radio-frequency of high accuracy. The requisite precision has been attained by the use of a valve-maintained tuning fork operating in an airtight enclosure in which the pressure and temperature can be maintained constant. The six walls of the enclosure are provided with heating mats, temperature control being effected by means of a toluene thermoregulator. The tuning fork controls a phonic motor and chronograph, on which are recorded hourly the differences of the fork and the standard Shortt clock. The electrical and mechanical arrangements are such as to permit the determination of the frequency of the fork at any time to an accuracy of two parts in ten millions.

A method has been evolved for the measurement of the small anode-grid capacity of screen grid valves. Use has been made of the amplification of the valve itself. A tuned circuit, the coil of which is loosely coupled to a radio frequency generator, is inserted between the grid and the filament, resonance being indicated by a valve voltmeter. Readings of the condenser in the tuned circuit with no impedance, and with high impedance in the plate circuit, enable the anode-grid capacity to be determined.

An investigation has been commenced in connexion with the magnetic susceptibility of various rocks on behalf of the Geological Survey of Great Britain. An instrument of the type used by Prof. E. B. Wilson has been designed for the purpose. The specimen, in the form of a cylinder, is suspended at the end of a torsion arm in the gap of a large ring electromagnet. The instrument is capable of measuring susceptibilities one hundred million times less than that of iron.

For the precision measurement of the resistance and inductance of four-terminal resistances at power frequencies, a substitution method which avoids the necessity of taking current from the voltage terminals has been evolved in the Electrotechnics Division. The resistance under test is connected in series with a known standard resistance of nearly the same value and with the primary of a nickel-iron transformer. In series with the secondary is a resistance the value of which is so adjusted with reference to the transformer ratio that the voltage drop across it is approximately equal to, and may be opposed in turn to, that across each of the standard and test resistances. A vibration galvanometer is included in the apparatus and its deflection can be reduced to zero by suitable shunts incorporated in the secondary circuit. The resistance and inductance of the unknown resistance can then be determined.

Another exhibit showed arrangements for the measurement of the current rating of power cables. The modern trend in building construction has led to a more extensive use of electric power, and it is becoming standard practice to employ single core lead or rubber covered conductors to carry the current. Owing to sheath losses and skin effect, the current carrying capacity of a cable for a given temperature rise is less with alternating current than with direct current, and is determined by the maximum temperature rise that can be allowed in any given set of circumstances, having regard to the deleterious effect of

high temperature on the properties of the insulating material. The object of the investigation is to determine the current carrying capacity of standard cables of various types and sizes under different conditions of laying, both for alternating and direct current.

For work in connexion with the testing of fuses, the laboratory facilities have been extended to cover the latest specification of the British Engineering Standards Association for domestic fuses up to 250 volts and 100 amperes. The specification requires that the tests be made at 260 volts and at suitable short circuit currents up to a maximum of 6500 amperes. With the new equipment, the short circuit is made from a distance by means of a solenoid controlled switch, the cut-out being observed through a wired glass panel in the door of the test enclosure. An auxiliary circuit incorporating a neon lamp indicates whether iron-clad cut-outs show any tendency to arc to their cases.

In the Wireless Division a new type of dynatron oscillator has been developed by the use of the negative resistance characteristic of the screen grid valve. By coupling the anode to the control grid through a small capacity and including a resistance of the order of a megohm in the filament-control grid circuit, higher frequencies than are possible with normal dynatron circuits have been obtained. The exhibit shown can be used for the generation of oscillations of wave-length as small as 6 metres.

The same principle can be applied to the problem of selective amplification. With the usual triode valve the presence of the positive shunt resistance of the valve decreases the selectivity of the tuning circuit through damping. If the negative resistance characteristic of the screen grid valve be utilised, the selectivity of the amplifying stage can be made greater than that of the tuned circuit alone. A demonstration of this was given by means of a circuit incorporating a valve of this type.

The investigation on behalf of the Radio Research Board in connexion with the development of transmitting and receiving apparatus for very short wave-lengths has been continued, and equipment capable of transmitting and receiving oscillations of wave-length as small as 1·5 metres was shown. The apparatus has been used for the study of the propagation characteristics of very short waves.

The apparatus for testing the performance characteristics of wireless receivers has now been extended to cover the shortest wave-lengths in commercial use. Improved apparatus has been installed capable of carrying out comprehensive tests at wave-lengths from 7 metres to 2000 metres. The tests comprise over-all sensitivity, radio-frequency, selectivity, and fidelity in the reproduction of radio-frequencies. The last-named test is carried out by the use of an input modulation free from harmonics. Any harmonics present in the output constitute a measure of the distortion produced.

In the High Voltage Building, equipment for the measurement of the dielectric loss of high voltage porcelain insulators was exhibited. Demonstrations were given of flashover tests to determine the maximum voltage withstood by a 132-kilovolt porcelain insulator string.

In the Photometry Division an investigation was in progress in connexion with the light-diffusing properties of diffusing glassware. These properties are governed by the size and concentration of the particles, and apparatus has been developed in the division for the measurement of these two quantities by the use of a powerful microscope. Half-silvered interferometer plates are fitted to the fixed and movable stages of this instrument, enabling the movement of the latter to be obtained directly in terms of light wave-lengths. The diameter of a particle can be determined by observation of the interference fringe system, as the particle is made to traverse a fixed cross wire, or alternatively by attaching the cross wire to a travelling microscope, the scale of which can be calibrated by means of the interferometer. To determine the concentration, the field is limited by an aperture of known diameter. The microscope is focused through the particles by a slow-motion device, the distance traversed being measured by a second interferometer.

The fundamental work on glare has been extended to cover the glare effect of coloured light sources with white and coloured backgrounds. Practical application has also been made of the results already obtained with normal light sources by the design of an instrument for the determination of the glare effect due to an actual lighting system. Two measurements of the brightness difference threshold, one with the glare sources exposed to the observer's eyes, and the other with the glare sources screened, give a ratio which is a measure of the glare effect.

In the William Froude Laboratory a model of a single-screw vessel was being tested to compare its behaviour in shoal and deep water. There are reasons for supposing that there is a scale effect leading to differences between the model and the full-sized ship. The model under test was equipped with its own inboard motor and propeller and apparatus for determining its resistance through the water. A model twin-screw vessel fitted with its own propelling and recording gear and utilised for research work on the backing qualities of propellers was exhibited. The tests are designed to show the thrust capacities of propellers of various shapes and diameters to destroy and reverse the motion of the model.

The International Congress of the History of Science and Technology.

THE Second International Congress of the History of Science and Technology, which assembled in London on June 29–July 4, has achieved a notable success, thanks to the untiring efforts of its distinguished president, Dr. Charles Singer, and the executive committee, and thanks also to the active interest it has aroused among scientific workers and historians throughout the world. The Congress, which was really the first of its kind, originated with the Comité International d'Histoire des Sciences, which was founded at Oslo on Aug. 17, 1928. It has, however, been fortunate in enlisting the co-operation of the Comité International des Sciences Historiques, of the American History of Science Society, and the Newcomen Society for the Study of the History of Engineering and Technology, of London. It has thus been possible to show, in its widest extent, the important part played by the sciences in historical and technical research. The papers and discussions of the Congress, and the large attendance of official representatives, who came not only from most of the universities of Great Britain and the Empire, but also from the Continent, North and South America, Asia, and Africa, bear witness to this fact.

At the inaugural session of the Congress, which was opened by the President of the Board of Education, the Right Hon. H. B. Lees-Smith, M.P., in the Great Hall of the Royal Geographical Society, Dr. C. Singer

read some paragraphs of his inspiring presidential address on "The Beginnings of Science", which was published in full in NATURE of July 4. He emphasised the dynamic rôle of science, which is best illustrated by its history, and pleaded for the introduction into school-teaching of the broad lines of scientific history.

The work of the Congress itself was divided into four main sections, which met most fittingly in the lecture hall of the Science Museum. The first section, with Prof. G. Loria (Genoa) as chairman, dealt with "The Sciences as an Integral Part of General Historical Study". In his opening paper, Prof. G. N. Clark (Oxford) showed the complexity of the relations between the history of science and general history, and claimed that science has more truly a history than have other human activities, owing to the fact that the history of science is distinguished by more definite achievements and a more orderly development. This point was further emphasised by Sir William Dampier-Whetham (Cambridge), who proposed that the teaching of history should follow the natural order of its development, moving onward from primitive emotions to law, economics, and science. In support of these views, Dr. T. Greenwood (London) maintained in his paper that even the development of mathematics is a necessary constituent of both philosophy and technology, and illustrated the point that a critical history of mathematics should help in getting a deeper knowledge of the various philosophical systems which, in turn, provide the fundamental causes of the periodical and progressive changes in the mental and material outlook of the human race. Some stimulating remarks were made in this connexion by Prof. A. V. Hill (London), who submitted that if history is to deal with human greatness, with things which have given man control of himself and his surroundings, that have relieved him of superstition, ignorance, ill-health, and incompetence in the face of natural forces, then the great figures of science and their discoveries deserve a more worthy place even in children's history-books. For after all, the forces that move us are forces of our own making, which cannot be of less importance than the results they produce.

To this individualistic interpretation of history and to the paramountcy of the history of science, the representatives of the U.S.S.R. took exception, and proposed instead a communistic explanation of scientific development, in which the integrative work of the masses is exalted at the expense of the glorification of genius. Prof. B. Zawadovsky (Moscow), for example, does not conceive history as the history of personality, but rather as the process of development of mankind conforming to certain laws, as a social whole in all the multiformity of its class structure. From this angle, the history of science begins only from the moment when we discern the particular conditions of material culture and the economic requirements of production which determine the direction of the interests of the scientific workers concerned, and the readiness of society to utilise their discoveries. In seconding this opinion, Prof. E. Colman (Moscow) was able to illustrate the influence of the spiritual atmosphere of his time on Darwin himself by means of a letter written by the great naturalist to Karl Marx, in which Darwin admits having refrained from writing on religion in order to avoid surprising his contemporaries and his relatives, although he was all the same an advocate of free thought on all subjects. Prof. M. Rubenstein (Moscow) shared the views of his colleagues, suggesting that history has not been made by great men, but by the economic and social forces of which they have been the expression. It might be said here that the attitude of the Soviet delegates can scarcely explain any history, however stimulating their message and their endeavours to put it into practice in their own educational institutions.

The second section of the Congress, with Prof. W. H. Welch (United States) in the chair, discussed the important problem of "The Teaching of the History of Science". M. Aldo Mieli, the active permanent secretary of the Comité International d'Histoire des Sciences and editor of *Archeion*, told the Congress how this body is directing an inquiry into the teaching of scientific history, which will be completed in time for the Congress of History to be held at Warsaw in 1933. Going into the heart of the debate, Prof. A. E. Heath (Swansea) tried to show that our social and cultural disharmonies are largely due to our failure to acclimatise ourselves to modern cosmologies; and proposed, as a solution of this difficulty, the creation of a scientific history more in accord with the facts of the modern world. On the other hand, in advocating the development of special courses in the history of science in secondary schools and colleges, Prof. F. S. Marvin (University of Cairo) outlined, in his paper, the advantages to be gained by introducing the historical side into scientific work: such a method would present science as a growing thing; it would show the link with the other aspects of our knowledge; it would present the mass of scientific facts in a more human form; and finally it would illustrate the collective work of the human mind, building up an increasingly coherent framework of the universe. One may add, too, that the history of science can suggest new lines of research, and thus lead to unexpected discoveries.

Prof. A. Wolf (London) outlined the teaching of the history of science in the University of London, which owes so much to his own efforts, pointing out as one of the difficulties of the organisation of such courses the existing hostility towards new subjects, which are wrongly imagined by many to be side lines to something else. Prof. P. Diepgen (Berlin), Prof. H. Dannemann (Bonn), Prof. Q. Vetter (Prague), Prof. M. Stephanides (Athens), and Prof. D. E. Smith (United States) gave some interesting details about the teaching of the history of science in their respective countries; while Prof. Laignel-Lavastine, the new holder of the chair of the History of Medicine in the University of Paris, expressed the feeling of the whole Congress when he urged the necessity of university chairs of the history of science in the principal universities of the world.

The third section of the Congress was devoted to the "Historical and Contemporary Inter-relationship of the Physical and Biological Sciences", and was presided over by Prof. W. Ritter (United States). It developed into a lively debate between 'organicists', represented by Prof. J. S. Haldane, Prof. D'Arcy Thompson, Dr. E. S. Russell, and Mr. L. L. Whyte, and the 'mechanists', represented by Dr. J. Needham, Dr. J. H. Woodger, Prof. L. Hogben, and Prof. Baas-Becking (Holland). The case for organicism was put forward forcibly by Prof. J. S. Haldane (Oxford), who claimed the independence of biology from physics, while admitting that the advances of physics during the present century have made it much easier to realise the true relations between these sciences. The discovery that atoms are not mere inert elastic bodies, but centres of intense specific and persistent internal activity, and that on this internal activity their physical and chemical properties depend, has upset the physical conceptions which we inherited from Galileo and Newton. Atoms seem now as if they had properties similar to those which the vitalists attributed to living organisms. Yet, on the other hand,

biology deals with parts and events which are manifestations of the co-ordinated whole which we call the life of the organism. Hence, it looks as if, while we shall retain the old physical and mathematical conceptions for practical purposes, the more fundamental physical and mathematical conceptions are assuming characters similar to those of biology. This fundamental attitude was further explained by Mr. L. L. Whyte, who showed how the study of the structure of material bodies and of radiation is beginning to influence biology. The adequate description of ordered structures, which was impossible by classical methods, is now expressed by 'quantum conditions' which refer to systems as a whole, each part having in it definite positions and motions. Thus the conflict between the analytical methods of classical physics and the organic concepts of biology is thinned down to such a point that it may be hoped to see the study of biology leading ultimately to the discovery of exact biological laws defining the structural characteristics of living systems.

Dr. Needham's cry for an increase in the use of the style of physics in biology, and Dr. Russell's slogan, 'Back to Aristotle', alike strengthened the resistance of the mechanists, who, like Prof. L. Hogben (London), emphasise that there was never a time when biologists entertained more confidence in the usefulness of classical physico-chemical methods as instruments for arriving at predictable conclusions about how organisms behave. The ecclesiastical origins of modern culture and the contemporary social unrest were quoted as causes for the public distrust of the mechanist conception of life, at a time when the materialistic tradition appears to be entrenched in the laboratory more strongly than ever before. Dr. J. H. Woodger (London) went a step further by proposing to apply to the study of biological questions, not only physical methods, but also an appropriate notation of mathematical logic derived from the method of Russell and Whitehead. He was thus led to predict a gradual displacement of the notion of 'stuff' by that of 'system'; so that the notion of 'protoplasm' or 'living matter' would have to go the way of 'hereditary substance', when the scientific worker will learn to think of cells more in term of systems, and less in terms of stuff. A mechanist conception of biology seemed to linger also in the mind of Prof. A. Joffe (Moscow), though he admitted that physicists have to use biological methods for the finest measurements. He quoted the experiments of Prof. Gurtwitsch, who claims to have discovered 'biological rays', in support of the closer relationship between physics and biology, which will lead in time, he hoped, to the disappearance of the 'mysterious' vitalistic conceptions.

The fourth section of the Congress, presided over by Sir Henry Lyons, Director of the Science Museum, dealt with "The Interdependence of Pure and Applied Science". Sir Napier Shaw, Prof. C. H. Desch, Prof. F. G. Donnan, Dr. G. Windred, Mr. R. V. Vernon, Dr. Marie Stopes, and Prof. W. Mitkewich illustrated the various aspects of the problem, and seemed to agree that a study of scientific history makes it evident that there can be no independence between pure research and experiment on one hand, and the practical application of scientific principles on the other hand. Further, it appears that the present tendency of intense specialisation makes the progress of science more than ever dependent upon the co-ordination of pure and applied science.

At a meeting of the Committee on July 5, the following were elected members of the International Council for the period 1931–34: Prof. Karl Sudhoff, of Leipzig (*President*); Prof. Gino Loria (Genoa), Dr. Charles Singer (London), Prof. Paul Diepgen (Berlin), Prof. Julian Ribera (Madrid), Prof. George Sarton (Harvard); Mme. Hélène Metzger, of Paris (*Treasurer*), and M. Aldo Mieli, of Paris (*Secretary*). The next Congress will be held in Berlin in 1934.

Such was the general trend of the labours of the Second International Congress of the History of Science and Technology. As Dr. Singer has long been claiming, the history of science can take its place not only among the departments of high scholarship, but also as an integral part of training and discipline in the general study of history. Science cannot assume her just position in education until the educator himself recognises the part that science has taken in shaping the social and intellectual environment in which we live. If the scientific process come to be recognised as a great part of our great inheritance, the Congress will have gone a good way towards achieving its objective. THOMAS GREENWOOD.

The British Australian New Zealand Antarctic Research Expedition.

THE second cruise of the *Discovery*, under the title of the British Australian New Zealand Antarctic Research Expedition, ended on March 27 with the arrival of the ship and party at Melbourne. The health of Sir Douglas Mawson and his men has been excellent, and they have added greatly to our scientific knowledge of the Antarctic continent.

It has been definitely established that the coast-line is continuous through a great arc from Cape Adare to Enderby Land, which is nowhere far removed from the Antarctic Circle. New land totalling 16° of longitude has been discovered, and further detailed charting has been carried out of the 13° discovered on the first cruise last year. The field work extended through one-third of the circuit of the Antarctic region, beginning at the new 180th meridian and ranging west to long. 60° E. Additional features have been added to the coast lines of Adelie Land and Wilkes Land. It has been shown that there is no land in the latitudes assigned for North's Highland, Totten's Highland, or Budd's Land. The name Banzare Land (from the initials of the Expedition's title) has been given to a stretch of territory running from a well-defined cape near the juncture of the 66th parallel and the 127th meridian. It is proposed to maintain the title Sabrina Land for an area observed from the aeroplane between the 115th and 116th meridians at about the 66th parallel. At the end of Wilkes Land is an ice land about 1300 ft. high, which has been charted as Bowman Iceland, in honour of the Director of the American Geological Society. Princess Elizabeth Land is a newly discovered region commencing at the 80th meridian on the 76th parallel and extending south and west in a great sweep to Cape Amery. All the salient features of the MacRobertson Land coast have been charted and named. It is a most interesting region, diversified with mountains, peaks, and islands.

Apart from the geographical work, an immense mass of scientific data has been accumulated by the Expedition. Considerable delineation of the sea floor has been possible with an echo sounder, and many examinations of vertical marine stations were carried out. Daily nettings for marine life and

chemical examination of waters have been made, as well as investigations on bacteria in sea water and their rôle as denitrifiers. A two-hourly meteorological record was maintained, and the pilot balloon work was very successful. An interesting fact established is that the violent winds of certain parts of the Antarctic are mainly confined to the surface, seldom extending more than 500 ft. or 1000 ft. above ground-level. Useful observations in magnetics, solar radiation, and cosmic penetration have been made, while, of course, a rich harvest has been reaped in glaciology, geology, and ornithology.

The *Discovery* sailed from Melbourne about the middle of April and, if not delayed, may be expected in London shortly.

A New Heat Engine.

AT the Royal Society of Arts on June 4, Mr. J. F. J. Malone, in a paper entitled "A New Prime Mover", gave a description of a form of heat engine, invented by himself, in which the working medium is a liquid instead of a gas. In the course of his paper he stated that though mercury and oil have been tried, water has been found to be the most suitable medium, and in the engines to which reference was made only water has been used.

The main parts of the new form of engine consist of one or more working cylinders, a large number of long thick steel tubes in each of which is a movable displacer or regenerator, and a furnace. The tubes the author calls the thermodynamic tubes or 'T.D. tubes', and the regenerators, the thermodynamic piles or 'T.D. piles'. The tubes are closed at one end and at the other end are connected by pipes to the working cylinders. They are set in groups with their closed ends in the furnace, while the other ends are surrounded by water for cooling. The T.D. piles are built up of thin plates or tubes very closely spaced. The interior of the T.D. tubes, the very narrow spaces in the piles, the connecting pipes, and the working cylinders form a closed system completely full of water, which, when the engine is prepared ready for starting, is under an initial pressure of 1·4 tons per sq. in.

The engine depends for its action on the alternate expansion and contraction of the water in the system, due to the heating and cooling of the water in the T.D. tubes and piles, as the latter are moved to and fro in the tubes. For all practical purposes, the moving of the piles, which is done automatically by the engine, is equivalent to the alternate application and removal of the source of heat. Under these conditions the moving of the piles causes the pressure to rise to about 5·3 tons in one part of the stroke and then to fall to 1·4 tons per sq. in. Much ingenuity has been shown in the construction of the piles, which at first sight might appear likely to give trouble, but which have proved reliable on service.

Unfortunately, though the paper gave a few details of the several engines which have been built and run, these were by no means sufficient to form an estimate of the place the engine is likely to fill. One experimental engine was said to have run over 30,000,000 revolutions, and on three brake tests by three different independent engineers an indicated efficiency of 27 per cent was obtained. It was also stated that allowing for furnace and mechanical losses, it was anticipated with a 100 h.p. engine an over-all efficiency of 20 per cent can be obtained, and this on a weight of about 330 lb. per indicated horse power. In the conclusion of his paper Mr. Malone claimed that the new engine possesses features which make it suitable both for locomotives and for ships.

University and Educational Intelligence.

BIRMINGHAM.—The degree of D.Sc. has been awarded to the following: Jonquei Su-Kwang Lee, for published work on "The Fusulinidæ of North China" (*Palæontologia Sinica*, series B, vol. 4), "Some Characteristic Structural Types in Eastern Asia and their Bearing upon the Problem of Continental Movement", "Geology of the Gorge District of the Yang-tse with special Reference to the Development of the Gorge", and other papers; Harry W. Webb, for published work on "Absorption of Nitrous Gases", "Limitation of the Capacity of Platinum Catalyst in Ammonia Oxidation", and other papers.

Dr. A. Stanley Barnes has been appointed Dean of the Faculty of Medicine, in succession to Prof. Brash.

The following appointments have been made: Dr. R. H. Hopkins, lecturer and head of the Department of Brewing in the Heriot-Watt College, Edinburgh, to the Adrian Brown chair of brewing; Mr. R. D. Lockhart, lecturer in anatomy, University of Aberdeen, to the chair of anatomy; Mr. P. Gray and Mr. D. Richards, to be resident staff tutors for adult education under the Joint Committee of the University and the W.E.A.

Prof. A. M. Carr-Saunders has accepted an invitation to hold the Muirhead Lectureship for a further year.

CAMBRIDGE.—The Harkness scholarship for proficiency in geology, of value £117, has been awarded to Miss F. E. S. Caldwell, of Newnham College.

The Frank Smart prizes have been awarded to P. W. Richards, of Trinity College, for botany, and P. Ullyett, of Trinity College, for zoology.

EDINBURGH.—At the graduation ceremony on July 2 the honorary degree of doctor of laws was conferred on the following, among others: Dr. E. J. Allen, Director of the Marine Biological Laboratory, Plymouth; Sir George Andreas Berry, M.P. for the Scottish Universities, formerly lecturer in ophthalmology in the University of Edinburgh; and Sir Walter Morley Fletcher, secretary of the Medical Research Council.

The degree of doctor of science was conferred on Lucy Boyd, for a thesis on "Studies in the Post-Seminal Development of the Monocotyledonous Embryo"; A. Cunningham, for a thesis on "Studies on Soil Micro-Organisms"; Esmé Mary Gilroy, for a thesis on "The Influence of Arginine upon Growth and Tissue Repair"; Dr. M. Young, for a thesis on "A Contribution to the Study of the Growth of the Face in Childhood".

LEEDS.—At a graduation ceremony in connexion with the hundredth anniversary of the Leeds School of Medicine, the following honorary degrees were conferred, among others: Degree of doctor of laws—Prof. A. G. Barrs, emeritus professor of medicine at Leeds and for more than fifty years connected with the School of Medicine; Sir John Bland-Sutton, consulting surgeon at the Middlesex Hospital; Lord Dawson of Penn, president of the Royal College of Physicians; and Sir George Newman, Chief Medical Officer, Ministry of Health. Degree of doctor of science—Sir Walter Morley Fletcher, secretary of the Medical Research Council; and Sir Frederick Gowland Hopkins, president of the Royal Society

LONDON.—The late Mr. J. F. H. Knight has bequeathed to the University a moiety of his residuary estate for the furtherance of teaching and research in the University. The bequest is expected to amount to about £25,000.

NOTTINGHAM.—Dr. Henry L. Brose, at present reader in atomic physics, formerly Rhodes Scholar at Christ Church, Oxford, has been appointed to the chair of physics, which is about to become vacant owing to the retirement of Prof. P. E. Shaw.

ST. ANDREWS.—At a meeting of the University Court on June 23, Dr. F. L. Arnot, of Trinity College, Cambridge, was appointed lecturer in natural philosophy in the United College, St. Andrews, as from Oct. 1. Dr. George L. Montgomery was appointed lecturer in clinical pathology in the University.

The Court confirmed the acceptance of contracts for the erection of a new building for the botany and geology departments, a new lecture theatre for the zoology department, and a new laboratory for the anatomy department, to form part of the group of Bute Medical and Bell-Pettigrew Museum Buildings at St. Andrews.

DR. J. D. STIRLING has recently been appointed to the staff of the Hannah Dairy Research Institute, Kirkhill, Auchincruive, Ayr. For the past three years Dr. Stirling has been doing research work in biochemistry at the University of Glasgow under the direction of Prof. E. P. Cathcart, and later at Tübingen in Germany and Graz in Austria.

THE second year's awards of the Sir James Caird Travelling Scholarships have recently been announced. The scholarships were instituted by the will of the late Mrs. Emma Grace Marryat, who was a sister of the late Sir James Caird, Bart., of Dundee. A sum of £200,000 was appointed to be held in trust for the foundation of the scholarships in engineering, electricity, aeronautics, and music. Only natives of Scotland, of either sex, who are not already holders of scholarships similar in nature to those offered, are eligible for these scholarships. Two classes, junior and senior, are offered. The value of the junior varies from £50 to £150 and the senior from £250 to £600 per annum. Each scholarship is tenable for one year; but may be extended yearly to a maximum of three years. Among the scholarships awarded for this year were the following: Engineering (junior of the maximum of £150), T. C. Inglis, W. A. Sangster; (senior of the normal amount of £400), J. Jamieson. Electricity (junior of the maximum of £150), J. C. M. Sanders, H. C. Thompson; (senior of the normal amount of £400), M. D. Kippen, J. M. Dodds. Aeronautics (senior scholarship of £300), J. A. J. Bennet.

THE Medical Research Council has made the ollowing awards of travelling Fellowships for the academic year 1931–32 on behalf of the Rockefeller Foundation: Mr. E. T. Conybeare, Guy's Hospital, London; Mr. G. M. Dean, Department of Surgery, University of Aberdeen; Mr. M. H. Finkelstein, Department of Bacteriology, University of Edinburgh; Prof. O. S. Gibbs, formerly professor of pharmacology, Dalhousie University, Canada; Mr. E. M. Lourie, Liverpool School of Tropical Medicine; Mr. A. W. Spence, St. Bartholomew's Hospital, London; Mr. C. H. Waddington, Strangeways Research Laboratory, Cambridge; M. K. H. Watkins, Royal Infirmary, Manchester. The Fellowships awarded to Prof. Gibbs and Mr. Waddington are tenable in Europe, the others at centres in the United States. These Fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine or surgery, and are likely to profit by a period of work at a chosen centre in the United States or, in special cases, in Europe, before taking up positions for higher teaching or research in the British Isles.

Societies and Academies.

EDINBURGH.

Royal Society, June 15.—**A. H. Reginald Buller**: (An address) Recent advances in our knowledge of the higher fungi. A mushroom is the reproductive part of the mushroom plant and is produced at the expense of the mycelium or spawn. A large mushroom may develop and liberate upwards of 10,000,000,000 spores. The basidiospores of all Hymenomycetes, all Uredineæ, the smut-genus *Tilletia*, and the yeast-genus *Sporobolomyces* are shot away by a drop-excretion mechanism, but exactly how this mechanism works is still a profound mystery. The terminal rate of fall of spores in still air varies with the size of the spores from about 0·5 to 4·0 mm. per sec. Spores are discharged from the under side of the caps of mushrooms and toadstools in a continuous stream for days or weeks. The clouds of spores escaping from a fruit-body can be made visible in a darkened room by means of a beam of light. Nocturnal excursions with an electric lamp may be made to observe spore-discharge from fruit-bodies attached to tree-trunks, etc. The organisation of the hymenium which covers the gills of mushrooms and toadstools has been worked out, and the time and space relations of the basidia which produce the spores and of the sterile elements called paraphyses are now known. The basidia come to maturity in a series of successive generations. The sexual process in mushrooms and toadstools is initiated in the mycelium with nuclear association, is continued there with conjugate nuclear divisions, and is completed in the fruit-body by nuclear fusion in every basidium.—**J. Thomson**: The ionising efficiency of electronic impacts in air: Experiments are described, the aim of which is the determination of the average energy required to produce one pair of ions in air by electronic impact, the initial energy of the electron being defined. The results show that the total number of ions produced is a linear function of the initial electronic energy. Hence it is shown by extrapolation that for fast-moving electrons (such as β-rays) the energy per ion-pair is 37 ± 2 electron-volts. This result is discussed in relation to other investigations, and the extrapolation is thereby justified.

PARIS.

Academy of Sciences, May 18.—**A. Lacroix**: The nepheline and leucite phonolites of the island of Ua-Pou (Marquesas Archipelago).—**A. Cotton**: Comparison of the magnetic rotations of crystallised quartz and fused quartz. The specific magnetic rotation of fused quartz was found to be greater than that of crystallised quartz.—**L. Cayeux**: The petrographic characters of the magnesian irregularities in the chalk of the Paris basin.—**Charles Richet**: The reflexes of acquisition (Pavloff's conditional reflexes). A claim for priority as regards the work of Pavloff.—**Charles Nicolle and Ugo Lumbroso**: The *Bacterium granulosa* of Noguchi in its relations with the etiology of trachoma. Two strains of this bacillus (Noguchi, Olitski) proved to be devoid of pathogenic power. It is mentioned as possible that there might have been an attenuation of the virulence due to the age of the culture.—**S. Finikoff**: Congruences of which the two sheets of the focal surface are projectively applicable one on the other by the corresponding focal points.—**Marcel Vasseur**: A geometrical interpretation of Moutard's transformation.—**J. Leray**: A system of partial differential equations which governs the permanent flow of viscous fluids.—**Mlle. Nina Bary**: The representation of continued functions by means of functions with limited variation.—**R. Gosse**: The investigation of a category of equations of the first

class.—Stefan Kempisty: The integral (A) of Denjoy.—A. Rauch: The generalisation of theorems of Valiron on meromorph functions of positive order.—Jean Brille: A property of functions presenting a certain complex character of resolvability.—F. E. Myard: Closed chains with four rotoid non-concurrent couples, deformable at the first degree of freedom. Toric isogram.—Henri Poncin: Cavitations (in fluids) of permanent form.—A. Lafay: The deviations of the push of the wind on a cylinder produced by very small superficial projections on the latter.—Mme. G. Camille Flammarion: Photographs of the planet Mercury. A detailed description of the markings observed is given, with a drawing. It is the first time that details of the surface of this planet have been obtained by photography.—Z. Horák: The space-time line of a material point in classical mechanics.—G. Ribaud: The distribution of the temperatures in the cross-section of a flat incandescent filament.—R. Jouaust and N. Stoÿko: The propagation of short radio-electric waves. For some time in 1930 and 1931 radiotelegraphic transmissions on 18·5-metre waves between Indo-China and France were bad; for each signal sent more than one was received. The difference of time between the two signals received has been measured on a Blondel oscillograph and found to be 0·0681 second. In the light of this figure, two hypotheses regarding the paths of the waves are discussed.—P. David: A valve generator with very stable frequency. Instead of controlling the frequency of an emitting valve with a quartz oscillator or tuning fork, the author proposes the use of a valve with two grids, and describes the arrangement of the circuit found to be most suitable. For variations in the voltages of 15 per cent the variations in the frequency do not exceed five millionths.—F. Esclangon. The theory of the discharge without electrodes. According to the theory of Sir J. J. Thomson, the electrodeless discharge in a rarefied gas placed inside a solenoid carrying a high-frequency current is to be attributed to the electric field induced by the alternating magnetic field of the solenoid. Townsend and Donaldson showed that the electrostatic changes on the turns of the solenoid produce an additional and more intense field. Experiments are described by the author by which these two effects can be separated.—Mlle. Pàule Collet and G. Foëx: The influence of the field on the magnetic states of platinum. In these experiments the magnetic fields varied from 14,000 gauss to less than 3000 gauss, and the temperature from −180° C. to 200° or 400° C. The results are summarised in two diagrams.—P. Lainé: The errors introduced by inexactitude of the half-wave plates in the analysis of slightly elliptical vibrations, and on the standardisation of half-wave and quarter-wave plates.—C. Salceanu: The natural and magnetic rotary polarisation of some organic compounds studied in the liquid state. Wiedemann's rule, that the ratio of the magnetic to the natural rotation is independent of the wave-length, holds for menthol, but not for fused camphor or carvone.—S. Takvorian: Investigation on element 61 by means of the X-rays. Starting with 14 kilograms of cerium earths, after a preliminary treatment increasing the proportions of neodymium and samarium oxides, the method of fractional crystallisation of the double magnesium nitrates was used. The fractions examined, which were those in which element 61 ought to be concentrated, and which only represented 1/200th of the weight of the initial oxides, gave no evidence of the presence of element 61, at least in a proportion higher than 1 in 10,000.—M. Schérer: The magnetic double refraction of liquid hydrocarbons.—A. Sanfourche: The electrometric titration of phosphoric acid. The results obtained with hydrogen and quinhydrone electrodes using soda, lime, strontia, and baryta as alkalis are shown graphically.—Mlles. C. Chamié and A. Korvezee: The centrifugation of solutions of polonium in the presence of various electrolytes. A solution of polonium, filtered before the experiment, gives a precipitation of 40 per cent of the polonium. This proportion is increased by the addition of electrolytes ranging from 50 per cent for sodium nitrate to 99·6 for silver nitrate.—H. Colin and Mlle. A. Chaudun: The hydrolysis of sugar by strong acids in the presence of their salts.—Barbière and Desmaroux: The solvent power of the alcohols for the nitrocelluloses.—F. Bourion and Mlle. O. Hun: The boiling point determination of the molecular equilibria of pyrocatechol in lithium chloride solutions.—A. Damiens: A new porcelain without silica, based on pure fluorspar. Starting with mixtures of finely divided fluorspar and precipitated calcium fluoride, it has been found possible to prepare a material resembling porcelain, and which is unattacked by fluorine or by hydrofluoric acid.—G. Arrivaut: The action of arsenic chloride upon nickel. The first product of the reaction between finely divided nickel and an acid solution of arsenious chloride was the compound Ni_3As_2.—J. Bougault and G. Schuster: A new triglyceride obtained from cocoa butter: a palmitostearoazelain.—Tseou Héou-Féo: The condensation of an amine and of formaldehyde with quinaldine and picoline.—J. Wyart: Study of chabase.—A. Rivière: Remarks on the stratigraphy of the base of the Eocene in central Elbourz.—Jean Lacoste: Tectonic observations on the southern Rif (Moulay Bou Chta region).—Joseph Blayac and Marcel Thoral: The discovery of Georgian Trilobites in the Montagne Noire (Hérault).—J. Thoulet: Deep submarine volcanoes.—H. Arsandaux: The morphological evolution of the dome of Montagne Pelée.—F. Roman and J. Dareste de la Chavanne: The presence of an elk (*Alces latifrons*) in the upper Pliocene of Senèze (Haute-Loire).—A. Duparque: The microscopic structure and origin of anthracite.—Alfred Carpentier: Some imprints of seeds of Pteridosperms.—Mlle. G. Py: The evolution of the cytoplasmic constituents of the nutritive layer of the pollen in *Vincetoxicum officinale*.—A. Guillaumin: The transformation of the lower portion of the axis of inflorescence into a hook in the Uncaria.—Paul Becquerel: The development of the male fern in a pure aseptic culture starting from the spore.—J. Chaze: Experimental proofs of the excretion of nicotine from the aerial parts of the tobacco plant. A direct proof is given that nicotine is excreted by the tobacco plant and evaporated into the surrounding air.—M. Bridel and C. Charaux: The purgative complex of elder buckthorn bark, soluble in water and hydrolysable by rhamnodiastase.—Henri Perrin: Indices of aridity and types of forest vegetation.—Charles Pérez: Statistics of infestation of hermit crabs by *Chorogaster*.—Mme. Lucie Randoin and Mlle. Andrée Michaux: Variations in the proportion of globulin and serum in blood serum under the influence of a diet thrown out of equilibrium by the complete absence of antiscorbutic vitamine.—J. Vellard: Poison of the ray (*Tœniura*) from the Rio Araguaya (Brazil).—Emile Haas: The extent to which the central visual acuteness is altered when a very bright object is near the test to be defined. A study of the effects of dazzle.—A. Leulier and B. Drevon: Action of the blood on morphine chlorhydrate.—H. Bierry: Specificity and chemical structure.—Bunzô Hayata: The dynamic system of plants based on the theory of participation.—J. Laurin: The hypoglycæmic action of the bulbs of *Allium cepa*.—Raymond-Hamet: The mechanism of the action of the sympathomimetic amines.

GENEVA.

Society of Physics and Natural History, Feb. 19.—G. Dejardin: (1) The utilisation of ultra-violet light in photoelectric cells with glass bulbs. The author exhibits photoelectric cells in which the quartz, as transparent material, is replaced by an extremely thin glass window (some hundredths of a millimetre). For ordinary cells, without the thin wall, the spectrum range can be extended considerably by depositing on the window a thin layer of a fluorescent substance such as mineral oil, vaseline, or esculin incorporated in gelatine.—(2) The extension of the spectrum sensibility of photoelectric cells under the action of oxygen. The spectrum sensibility of very thin films of the alkali metals increases considerably when the surface of the metal serving as the support (copper, silver, magnesium) is oxidised. In the case of potassium, the presence of the oxygen produces a displacement of the whole spectrum towards the red of the sensibility curve. The author shows that by this method films can be obtained with potassium which can in many cases replace those of cæsium.—E. Briner and B. Susz: The maximum concentration of endothermic compounds at high temperatures (calculated in collaboration with E. Rod). Following on earlier researches, the authors establish by calculation the existence of a maximum concentration for endothermic compounds such as ozone and nitric oxide. For ozone the maximum concentration is very low. For nitric oxide it amounts to 3·6 per cent at 4000° Abs. in an equimolecular mixture of nitrogen and oxygen at atmospheric pressure.—P. Balavoine: The analytical characters of caramel regarded as a colouring matter for food. A close study of certain analytical characters of this colouring matter compared with artificial colouring matters. A new reaction is described suitable for detecting caramel in the presence of other natural colouring matters.—G. Ladame: The central Rhodopes and the Balkans. Geological and mining outline. After some brief geological data based on the work of Stephan Bončev, the author gives five analyses of selected specimens of sulphide ores of zinc, lead, and copper, the latter containing more or less silver. Fairly numerous researches have not resulted in extensive mining operations. There are important deposits of tertiary lignites, and mining for these is more probable.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 17, No. 1, Jan. 15).—Matilda Moldenhauer Brooks: The penetration of 1-naphthol-2-sulphonate indophenol, *o*-chloro phenol indophenol, and *o*-cresol indophenol into *Valonia*. As with indigo sulphonates, the first does not penetrate into the sap, suggesting that the sulphonate radicle is responsible. The other dyes penetrate in a colourless form.—Henry Borsook and Howard M. Winegarden: (1) The work of the kidney in the production of urine. The minimum work performed by the kidney in man in the production of urine, analysed by the second law of thermodynamics, is of the order of 0·7 gm. cal. per c.c. of urine or 70 gm. cal. per gm. of nitrogen excreted.—(2) The energy cost of the excretion of urine. Production of hyper- or hypotonic urine entails work by the kidney. The energy consumed by the normal healthy kidney in man is 6-11 kgm. cal. per gm. nitrogen excreted, an efficiency of only 1-2 per cent. The healthy kidney has a great capacity for work, which is much reduced by disease, drugs, etc. The paper contains an extensive review of work on the subject.—J. H. Hodges and E. F. Linhorst: The thermal decomposition of nitrogen pentoxide. At 35° C., the reaction appears to be unimolecular at partial pressures of 0·12 mm. to 0·06 mm.; below 0·06 mm. pressure, specific reaction rate decreases with pressure, and below 0·004 mm. pressure it appears to be bimolecular.—Oscar Knefler Rice: On the transfer of energy between atoms at collision. A theoretical discussion. A modification of Born's method is outlined, taking into account the mutual kinetic energy of the particles. The method gives an upper limit to the radius of action.—G. A. Miller: Groups which admit five-eighths automorphisms.—M. S. Knebelman: Multivectorial curvature.—Tracy Yerkes Thomas: On the unified field theory (3). A general existence theorem is derived and the characteristic surfaces of the four-dimensional world are determined.—E. H. Kennard: Quantum mechanical motion of free electrons in electromagnetic fields. Formulæ are obtained by Ehrenfest's method for the motion of the centroid of a wave-packet; only the non-relativistic case is considered, based on Schrödinger's equation. The general result is that in a uniform electric or magnetic field the packet-centroid moves as an electron should according to classical theory, and in non-uniform fields its acceleration is a kind of average of the classical value.—Carl Størmer: Remarks on a paper: Note on the nature of cosmic rays, by Paul S. Epstein. The results for the motion of electrons in the field of an elementary magnet obtained by Epstein (*Proc. Nat. Acad. Sci.*, Oct. 1930) were derived by Størmer in 1904.—Ernest O. Lawrence and David H. Sloan: The production of high-speed canal rays without the use of high voltages. A series of metal tubes in line are attached alternately to the inductance of a high frequency oscillatory circuit. An ion between the first and second tubes is accelerated into the second tube, and if the length of this tube is such that the time taken to pass through it is equal to the half-period of the oscillator, the ion will be further accelerated into the third tube and so on. An apparatus containing twenty-one accelerators has been made and with it mercury ions of kinetic energies of more than 200,000 volts have been obtained with a maximum applied voltage of about 10,000 volts. The method is capable of further development.—G. Breit: On the interpretation of Dirac's α-matrices.

Official Publications Received.

BRITISH.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1362 (E. 44—I.C.E. 782): Detonation, Mineral Lubricating Oils and Blended Fuels. By R. O. King and Dr. H. Moss. Pp. 11+7 plates. 9*d.* net. No. 1367 (Ae. 494—T. 3022): Longitudinal Control and Stability when Stalled. By E. T. Jones and R. P. Alston. Pp. 8+11 plates. 9*d.* net. No. 1366 (Ae. 493—T. 3021): Drag and Heat Dissipation of Three Radiator Systems. By E. T. Jones. Pp. 14+9 plates. 1*s.* net. No. 1368 (Ae. 495—T. 3049): Flow of Air adjacent to the Surface of a Rotating Cylinder in a Stream. By E. G. Richardson. Pp. 12+12 plates. 1*s.* net. No. 1359 (Ae. 490—T. 3017): Heat Transmission between Surfaces and Fluids flowing over Them. (1) The Case of Two-Dimensional Flow. By W. F. Cope. Pp. 8+2 plates. 6*d.* net. No. 1365 (E. 45—I.C.E. 787): The Limits of Compression Ratio in Diesel Engines. By D. R. Pye. Pp. 9+3 plates. 9*d.* net. No. 1373 (Ae. 500—T. 3037): Eddies behind a Circular Cylinder. By Dr. A. Thom. Pp. 8+4 plates. 6*d.* net. No. 1370 (Ae. 497—T. 2961): Drag of Circular Cylinders and Spheres. By A. Fage. Pp. 6 + 2 plates. 6*d.* net. (London: H.M. Stationery Office.)

Department of Public Instruction, Technical Education Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1930. Pp. 6. (Sydney, N.S.W.)

Annual Report of the Calcutta School of Tropical Medicine, Institute of Hygiene and the Carmichael Hospital for Tropical Diseases, 1930. Pp. 131. (Calcutta: Bengal Government Press.)

Hull Museum Publications. No. 167: Record of Additions. Edited by T. Sheppard. Pp. 43. No. 168: Record of Additions. Compiled by T. Sheppard. Pp. 43. No. 169: Bronze-Age Remains, including Beaker, Bracer, Jet Ornaments, Spear Head, and Clay Moulds for Implements, etc. Edited by T. Sheppard. Pp. 33. (Hull.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1344 (Ae. 476: T. 2988): The Influence of a Fuselage on the Lift of a Monoplane. By A. S. Hartshorn. Pp. 14+8 plates. (London: H.M. Stationery Office.) 9*d.* net.

The Himalayan Journal: Records of the Himalayan Club. Edited by Kenneth Mason. Vol. 3, April. Pp. vi+172+11 plates. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 5 rupees; 8*s.*

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1930. Pp. 18. (Pretoria: Government Printing Office.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 69, No. 414, June. Pp. 673-804+xxvi. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 3, No. 31: The British and Belgian Carboniferous Bellerophontidae. By Dr. John Weir. Pp. 767-861+9 plates. 16*s.* 6*d.* Vol. 57, Part 1, No. 1: An Analysis of the Vegetative Organs of Selaginella grandis Moore, together with some Observations on Abnormalities and Experimental Results. By Dr. S. Williams. Pp. 24+2 plates. 3*s.* 6*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Year 1930. Pp. 19. (Birmingham.)

Foreign.

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Čis. 128: Generis Trigonella L. revisio critica, III. Scripsit G. Sirjaev. Pp. 31. Čis. 129: Příspěvek k analytickému studiu reakcí oximů (Contribution à l'étude analytique des réactions des oximes). Napsali J. V. Dubský, Fr. Brychta a M. Kuraš. Pp. 26. Čis. 130: Contribution à la théorie des séries trigonométriques généralisées et des séries à fonctions orthogonales. Par Dr. F. Wolf. Pp. 34. Čis. 131: Několik poznámek o Markovových řetězech (Quelques remarques sur les chaines de Markoff). Napsal Jos. Kauchy. Pp. 22. Čis. 132: O vlivu kysličníku dusičitého na světélkování fosforu (Influence of nitrogen peroxyde on the glow of phosphorus). Napsal Dr. Fr. Schacherl. Pp. 29. Čis. 133: Hydrolysa solí beryllnatých a hlinitých, odvozených od silných kyselin, Část 2 (Hydrolysis of beryllium and aluminium salts derived from strong acids, Part 2). Napsal Václav Čupr. Pp. 50. Čis. 134: Měření hydrolysy síranu zinečnatého a kademnatého vodíkovou a chinhydronovou elektrodou (Measurement of hydrolysis of zinc and cadmium sulphates by means of the hydrogen and quinhydrone electrodes). Napsali V. Čupr a O. Viktorin. Pp. 18. (Brno: A. Píša.)

Sborník vysoké Školy Zemědělské v Brně (Bulletin de l'École Supérieure d'Agronomie, Brno). Sign. D17: Příspěvek ke studiu degradace humusokarbonátových půd v oblasti Moravského Krasu (The Contribution to the study of degradation of rendzina soils in the Moravian Karst). Napsal Dr. Ivan A. Zvorykin. Pp. 48. Sign. D18: Addenda ad floram Čechoslovakiae mycologicam, V. Scripsit Dr. Richard Picbauer. Pp. 30. (Brno: A. Píša.)

Svenska Sällskapet för Antropologi och Geografi. Geografiska Annaler 1930, Heft 4: The Tidal Force, a Study in Geophysics. By Otto Pettersson. Pp. 261-322. (Stockholm.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 3, No. 5, Mai. Pp. 241-284. (Prague: Regia Societas Scientiarum Bohemica.)

Bulletin of the Imperial Agricultural Experiment Station of Japan. Vol. 3, No. 2, November 1928. Pp. 77-160. Journal of the Imperial Agricultural Experiment Station, Nishigahara, Tokyo. Vol. 1, No. 1, March 1929. Pp. 106+9 plates. Vol. 1, No. 2, October 1929. Pp. 107-182+plates 10-16. (Tokyo.)

Svenska Linné-Sällskapets Årsskrift. Årgång 14, 1931. Pp. vi+196. (Uppsala.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 302: On the Catalytic Oxidation of Non-Benzenoid Hydrocarbons and Mineral Oils in their Vapour. By Rinta Shimose. Pp. 251-276. 30 sen. No. 303: On the Hydrosol of Silicic Acid. 3: On the Stability of the Hydrosol and the Influence of Electrolyte on it. By Kenkyo Inaba. Pp. 277-287. 20 sen. No. 304: On the Separation and Determination of Gallium. 3: The Separation of Gallium from Bivalent Elements and those of the Rare Earths, and the Determination of all these Elements. By Sunao Ato. Pp. 289-301. 40 sen. (Tōkyō: Iwanami Shoten.)

Proceedings of the California Academy of Science. Fourth Series, Vol. 19, Nos. 13 and 14: Report of the President of the Academy for the Year 1930, by C. E. Grunsky; Report of the Director of the Museum and of the Aquarium for the Year 1930, by Barton Warren Evermann. Pp. 399-482. (San Francisco.)

University of California Publications in Zoology. Vol. 32, No. 8: Adaptive Modifications in the Woodpeckers. By William Henry Burt. Pp. 455-524. 1 dollar. Vol. 37, No. 1: Critical Comments on Mammals from Utah, with Descriptions of New Forms from Utah, Nevada and Washington. By E. Raymond Hall. Pp. 13. 25 cents. (Berkeley, Calif.)

Catalogues.

A Catalogue of Book Bargains. (No. 528.) Pp. 16. (London: William Glaisher, Ltd.)

Catalogue de livres anciens et modernes, rares ou curieux, relatifs à l'Orient. (No. 17.) Pp. 126. (Paris: Librairie Adrien-Maisonneuve.)

Philips X-Ray Tubes for Structure Research. Pp. 9. (London: Philips Lamps, Ltd.)

Autograph Letters, Documents and Manuscripts. (Catalogue 540.) Pp. 52. (London: Francis Edwards, Ltd.)

Diary of Societies.

TUESDAY, JULY 14.

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.

THURSDAY, JULY 16.

GENETICAL SOCIETY (at Entomological Society of London, 41 Queen's Gate, S.W.7), at 3.—Exhibits and Demonstrations by Prof. E. B. Poulton, Dr. A. D. Imms, J. C. F. Fryer, and others.—At 5.—Annual General Meeting.

NATIONAL SMOKE ABATEMENT SOCIETY (at 71 Eccleston Square, S.W.1), at 3.15.—W. Prescott: Smoke Abatement from the Manufacturers' Point of View (Address).

CONGRESSES.

JULY 6 TO 11 (IN EDINBURGH).

CONGRESS OF UNIVERSITIES OF THE EMPIRE.

Friday, July 10, at 10.30 A.M.—Address by Sir Donald Macalister, Bart.

At 11 A.M.—Dr. H. L. Eason and others: Discussion on Post-graduate Study in Medicine and Surgery in Great Britain.

Sir Thomas H. Holland and others: Discussion on Facilities for Overseas Students in British Universities.

Saturday, July 11.—Visits.

JULY 9 AND 10.

OPHTHALMOLOGICAL CONGRESS (at Oxford).

Friday, June 10.—Dr. Baillart: Tonometry.

P. Adams: An Ophthalmological Mélange (Doyne Memorial Lecture).

J. Craig and Prof. Schüller: Discussion on Penetrating Wounds of the Eye.

JULY 10 AND 11.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at Rothamsted Experimental Station, Harpenden).

Friday, July 10 (In Chair: Dr. W. B. Brierley).

At 11.30 A.M.—W. H. Pearsall: The Effects of Calcium on the Metabolism of *Chlorella*.

J. H. Priestley: Growth as a Factor in Food-transport in Plants.

M. A. H. Tincker: Some Factors Affecting Tuber Formation.

At 2.—Address by Sir John Russell.

At 5 (In Chair: Dr. A. D. Imms).—V. B. Wigglesworth: The Physiology of Excretion in a Blood-sucking Insect, *Rhodnius prolixus*.

R. P. Hobson: Digestion in Blow-fly Larvæ.

At 6.—Business Meeting.

Saturday, July 11 (In Chair: Dr. D. Ward Cutler).

At 10.30 A.M.—N. N. Murti: The Artificial Production of Double-pored Larvæ in *Asterias glacialis*.

S. Zuckerman: The Reproductive Mechanism in Primates.

J. S. Huxley: Recent Work on Differential Growth.

Boris Zavadovsky: Research Work at the Institute of Neuro-humeral Physiology, Moscow.

A. T. Yoffe: Recent Work on Mitogenetic Rays.

JULY 13 AND 14.

INTERNATIONAL UNION FOR BIOLOGICAL SCIENCES (at Brussels).

JULY 20 TO 23.

BRITISH PHARMACEUTICAL CONFERENCE (at Manchester).

Monday, July 20, at 8 P.M.—Civic Reception by the Lord Mayor and Corporation.

Tuesday, July 21, at 10 A.M.—Chairman's Address.

At 11.15 A.M. and 2.15 P.M.—Science Meetings.

At 2.15 P.M.—Delegates' Meeting.

Wednesday, July 22, at 10 A.M. and 2 P.M.—Science Meetings.

At 10 A.M.—Delegates' Meeting.

Thursday, July 23, at 10 A.M.—Closing Session.

JUBILEE CELEBRATION AND ANNUAL MEETING.

JULY 13 TO 19.

SOCIETY OF CHEMICAL INDUSTRY (in London).

Monday, July 13 (at Central Hall, Westminster), at 11.30 A.M.—Opening of Chemical Plant and Research Instruments Exhibition.

Tuesday, July 14 (at Royal Academy of Music), at 10.30 A.M.—Annual General Meeting.

Sir Harry McGowan: Presidential Address.

(At Salters' Hall, St. Swithin's Lane), at 7 P.M.—Dr. G. Engi: Recent Developments of the Society of Chemical Industry in Basle.

Dr. H. Schicht: Address.

(At Home Office Industrial Museum, Horseferry Road), at 9 P.M.—Prof. R. V. Wheeler: Dust Explosions.

Wednesday, July 15 (at Royal Academy of Music), at 10.30 A.M.—Presentation of Society's Medal to Dr. H. Levinstein and Address by the Medallist.

Thursday, July 16 (at Leathersellers' Hall, St. Helen's Place), at 10.30 A.M.—Dr. H. Sörensen: Hydrogen Ion Concentration.

(At Great Central Hotel), at 10.30 A.M.—Reading and Discussion of Papers.

Friday, Saturday, and *Sunday, July* 17, 18, and 19.—Visits.

SUMMER MEETINGS.

JULY 13 TO 17.

INSTITUTION OF MECHANICAL ENGINEERS (at Cambridge).

Tuesday, July 14, at 10.30 A.M.—Prof. C. E. Inglis: Cambridge as a Place of Education (Address).

At 11 A.M.—H. N. Gresley: Locomotive Experimental Stations.

Wednesday, Thursday, and *Friday, July* 15, 16, and 17.—Visits.

JULY 18 TO 23.

INSTITUTION OF ELECTRICAL ENGINEERS (in Northern Italy and Western Switzerland).