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Milk Production and the Farmer

IN an interesting speech delivered at the Taranaki Agricultural Society's Show on March 8, Lord Bledisloe, Governor-General of New Zealand, discussed the questions of the proposed dairy products quota to Great Britain and the removal of the embargo on the importation of pedigree live stock from Great Britain. Lord Bledisloe pointed out that, while the British farmer must insist that the dairy industry should be made a paying proposition, there is at the present time on the British market much imported foreign third grade dairy produce which is causing the slump in prices. It was agreed at Ottawa that, subject to the salvation from ruin of her own dairy farmers, Great Britain would not stand by and allow New Zealand farmers to suffer permanent impoverishment either in dairy farming or in any other branch of husbandry. The future of the Dominion depends upon its successful and progressive methods of pastoral husbandry; and while the standard of quality in New Zealand produce is already very high, it is being still further improved by scientific methods.

The case for the removal of the embargo on the importation of live stock from Great Britain rests on the necessity for the introduction of fresh blood in those breeds of cattle and pigs in which the numbers in New Zealand are low, and inbreeding prevalent. At present the cost is prohibitive through unnecessary detention in some other country *en route*; the risk of infection is small because of the short incubation period of foot-and-mouth disease and the long journey to New Zealand. High quality in her produce is the first essential to success, and New Zealand can afford no longer not to import pedigree animals direct from Britain and thus improve her live stock as her rivals are doing.

The question of the proposed dairy products quota and the apparently conflicting interests of New Zealand and British dairy farmers, which at the present time appear to threaten the existence of either one or the other, have an important bearing on present-day questions of milk production in Great Britain. Both countries are ideally situated climatically for dairy production. Up to the present time, the British farmer has looked to liquid milk consumption as the outlet for his supplies, while the New Zealand farmer, being a long way from the market, has produced mainly butter for export. Beef prices being so bad

recently, large numbers of British farmers have changed over from beef to milk production, and now there is a large amount of milk which is surplus to the present requirements for liquid consumption.

The question arises whether a quota should be put on New Zealand butter and the surplus British milk used for butter making. In our opinion this would be wrong. Under British conditions of high costs of production, butter-making on a large scale is not a paying proposition. If the price of butter is raised by quota restrictions to the level at which it will pay British farmers to produce it, then we shall see a return to the consumption of margarine by the poorer classes of the community. From a nutritional point of view this is undesirable.

What then can be done with the surplus milk now being produced in Britain? In addition to immediate action with regard to beef prices—something perhaps rather more drastic and simple than the Fat Stock Commission's recent report visualises—a large portion, if not the entire present surplus, could be consumed as fresh liquid milk and thin cream (16–20 per cent fat), if our public could be persuaded to consume as much milk *per capita* as does the average American.

No 'milk publicity campaign', however, will persuade the British public to consume more dairy products unless it shows them how this can be done. There is a limit to the amount of milk which one can take as milk puddings. But the thin cream market is virtually untapped. The only choice open to the housewife between whole milk and the type of cream that almost defies extraction from its carton is the cream that rises to the top of the milk bottle, or some tinned substitute. Few people accustomed to thin cream in tea and coffee and as an accompaniment to puddings, porridge, fruit and breakfast cereals would give it up unless forced to do so. A demand for this commodity stimulated among the middle and upper classes would suit the farming community very well, for it would leave skim milk on the farms for pig feeding—a supplementary protein feed which is badly needed to assist quality of the carcase of pigs sold under the Bacon Pig Marketing Scheme. Danish bacon produced without skim milk would lose its characteristics.

The large American consumption of milk, however, is mainly brought about by the city office workers consuming milk with their light lunch, whereas the British take tea or coffee. It is by serving milk attractively in bottles off ice that the

American has been persuaded to drink it. Tepid milk, as it is too often served in Great Britain, is not a 'clean' drink and does not quench the thirst as iced milk does: like cocoa, tepid milk leaves a thick taste in the mouth, so in the absence of iced milk the British public prefer a 'clean' drink like tea or coffee for lunch. Stimulation of the consumption of the surplus milk in Great Britain in these ways—iced milk and thin cream—would not only be more profitable to the British farmer and avoid doing injury to the business of the New Zealand farmer, but would also be to the nutritional advantage of all classes of the British community.

Leadership in Local Government*

THE very attention which the growing complexity of the problems confronting the administrator, whether in national or industrial life, has attracted, makes it easy to overlook the extent to which technical factors have become important in local government also. In the last twenty years, the powers and duties of local authorities have greatly increased. They have now far-reaching responsibilities, and the welfare of the community is largely dependent on the efficiency with which those responsibilities are discharged. Public health, education, housing, town and country planning, road construction and maintenance—these are only some of the activities of local government authorities, and more and more they require to have at their disposal officers on whom they can rely fully, both for advice on the critical questions which come before them and for the execution of their decisions when taken.

The local government service in Great Britain maintains a high standard, for which no small share of the credit is due to the National Association of Local Government Officers. This and other associations have laboured to secure improved qualifications of their members and have succeeded in developing an invaluable professional spirit and outlook. In spite of this, there are wide variations in the standards of recruiting and training of officers for local government service. No consistent efforts are made by local authorities as a whole to secure the best persons for their service and to make the best use of them. Recruitment is often haphazard and training is unsystematic. Although technical qualifications where held are usually fairly high,

* Ministry of Health. Report to the Minister of Health by the Departmental Committee on Qualifications, Recruitment, Training and Promotion of Local Government Officers. Pp. 91. (London: H.M. Stationery Office, 1934.) 1s. 6d. net.

not all the qualifications are entirely satisfactory, and thorough investigation of the field is required.

Investigation of the technical qualifications of local government officers was excluded from the scope of the recent inquiry into the qualifications, recruitment, training and promotion of such officers carried out by a Departmental Committee of the Ministry of Health under the chairmanship of Sir Henry Hadow, but the report none the less discusses a number of important factors bearing on the training of administrators competent to deal with the many important technical issues involved in local government service. While the Committee recognises the importance of appropriate technical and professional qualifications in the principal departmental officers, it points out that the functions of any chief officer of a major department are mainly administrative, and it is of opinion that, in the past, local authorities have not laid sufficient stress on the administrative qualifications.

The essential problem in local government to-day is to ensure that the service offers an attractive career for vigorous minds and strong personalities. Methods of recruitment, training, grading, promotion and remuneration are of importance as they contribute to this primary purpose. The satisfaction of this end indeed offers the only adequate safeguard against incompetence or corruption in the public service, and is accordingly an essential factor in the redemption of the politician from his low position in public esteem and in the restoration of confidence in democratic institutions.

Among the factors which promote the supply of administrators of the requisite quality, recruitment on a wider basis is essential, and for this reason the Committee insists not merely that local authorities should draw their professional and technical officers from all available sources, whether within the service or without, but also that difficulties in the way of recruiting university graduates without technical qualifications must be overcome. No source of supply of the rare and invaluable quality of leadership can safely be neglected, but it is equally important to remember that administrative powers can be developed by training and experience. The recommendations that deliberate efforts should be made to arrange to give promising young officers practical experience in administration and to encourage the study of the principles of public administration are vital.

The report is happily free from the suggestion that technical and scientific officers as a class are lacking in administrative ability. It is recognised that individuals of high professional or technical standing may be lacking in this quality; it is therefore the more important to recognise it and develop it where found. The report outlines principles which are fully as valid in industry or in the Civil Service as in local government service, whereby the requisite combination of technical knowledge, professional integrity and administrative capacity may be encouraged and brought to bear on the complex problems of to-day. Its recommendations for centralisation and unification of the service, like those bearing on promotion and remuneration, are significant so far as they contribute to the main purpose of creating a service which compares sufficiently well with those obtaining in private enterprise to secure a proportion of the ablest minds and strongest characters of each generation.

Chemical Factors in Plant Growth

Croissance des végétaux. Par Dr. Albert Demolon. (*Principes d'agronomie*, Tome 2.) Pp. ix+307. (Paris: Libr. Dunod, 1934.)

DR. DEMOLON is well known as one of the clearest thinkers and one of the most ingenious-minded among agricultural investigators. As chief scientific advisor to the French Ministry of Agriculture, he is kept in close touch with the practical problems of the French farmer, and as head of the research laboratories at Versailles he is equally closely associated with modern movements in science. In his earlier publication, "La Dynamique du Sol", he dealt with the formation and composition of soils and the changes occurring therein; in the present volume, which is by way of a continuation, he discusses the relations between the soil and the growing plant, the subject which as he truly points out is the foundation on which rests scientific agriculture.

In the first section of the book the author discusses the physical factors determining plant growth: the effects of light, of temperature, electricity and of various rays: also the amplitude of variations in yield due to meteorological conditions.

The greater part of the book deals with the chemical factors concerned in plant growth: the atmosphere, nitrogen and the mineral elements. The author sets out the facts clearly and discusses

them with considerable penetration. He has the happy power, common to the best French writers, of choosing the words that best express his ideas, and of saying what he has to say clearly, tersely and accurately.

A useful summary is given of the part played by mineral elements other than the nitrogen, phosphorus and potassium which for long were the only substances considered to have fertiliser value. The standard fertilisers for many years past have in point of fact supplied other elements: superphosphate contains about 50 per cent of gypsum; the usual potassic fertilisers contain sodium or magnesium or both; basic slag contains iron, manganese and other elements. In ordinary practice, therefore, farmers have been adding compounds of calcium, magnesium, sodium, iron, manganese, sulphur and chlorine along with the nitrogen, potassium and phosphate. But with recent improvements in technical chemistry, it is no longer necessary to use crude salts as fertiliser, and some of the new concentrated fertilisers attain a degree of purity hitherto unapproachable in agricultural practice. The question is now beginning to interest agricultural experts whether they should advise farmers to add deliberately to their soils some of the substances they have been adding only incidentally. It seems certain that in absence of these various elements, plant growth becomes abnormal and certain so-called physiological diseases are likely to be induced. This subject has been studied at the Institut Pasteur, Paris, at Rothamsted, the Waite Institute, Adelaide, various United States experiment stations and elsewhere. The author deals at some length with magnesium, which is now attracting some interest in France. Additions of manganese and boron to the soil seem to be necessary in certain cases, otherwise definite disease symptoms appear, but Dr. Demolon is less certain about the need for adding some of the other elements which refined water cultures show to be necessary.

Another subject now attracting much attention among agriculturists, and discussed at length by the author, is the possibility of toxin formation in soils. Some substances, hydrogen sulphide for example, are readily formed in anaerobic conditions: others, such as excess of soluble salts, may be brought in from outside, for example, by sea floods. Plant roots were at one time supposed capable of excreting substances toxic to themselves if not to others, then the idea was dismissed; but Pickering's work at Woburn shows that there

may be something in the old idea, and H. G. Thornton at Rothamsted has shown that lucerne seedlings certainly excrete something that stimulates bacterial development in the soil and that might therefore have some effect on other plants. The author summarises the facts clearly and concludes that no definite pronouncement can yet be made on this difficult subject.

After an interesting and succinct account of the relations of soil micro-organisms and plant growth, the author proceeds to summarise the present position in regard to the quantitative expression of plant growth phenomena by curves and equations. He discusses in the first instance the qualitative changes, the seedling stage, rapid vegetative growth, and maturation; these are not separated in point of time and at no time is the plant simply adding to its substance. The simpler formulæ put forward to express the relation between the supply of nutrients and the extent of growth are none of them satisfactory, though some of them may be sufficiently approximate to serve as a rough guide in fertiliser practice. Here too the author adopts a cautious reserve and prefers to await the result of further experiment before making too definite a pronouncement.

We can cordially recommend the volume to the student, both on account of its matter and of its presentation.

E. J. RUSSELL.

Celestial Mechanics

Planetary Theory. By Prof. Ernest W. Brown and Prof. Clarence A. Shook. Pp. xii+302. (Cambridge: At the University Press, 1933.) 15s. net.

THERE are various definite theorems bearing on the impossibility of solving the problem of three (or n) attracting bodies. What is certain, in a practical sense, is that no general solution is attainable in a form suitable for comparison with observations even for a limited interval of time.

Special methods have been devised for the two distinct types of motion which are present in the solar system, the motion of the planet and the motion of the satellite. In the latter case, when the satellite is identified with the moon, there results a problem of quite special character and quite extraordinary complexity. At the same time, it is essentially a single problem not lending itself naturally to piecemeal treatment. Adams, it is true, succeeded in discussing some of its leading features in an elementary way, besides obtaining

some original results of value in theory and method. G. W. Hill, again, laid the foundations of a new theory without pursuing the subject beyond the preliminary stage. But in general the lunar theory is a theme for the specialist prepared to make it his life's work. Such a devotee was found in Prof. E. W. Brown, who has had the satisfaction of seeing his vast undertaking completed in every detail. Now, with a collaborator, he has brought his experience gained in the more special field to bear on the wider and more varied problem of planetary motion.

The design of the present work is very different from that of the treatise on the lunar theory for which a generation of students has been indebted to Prof. Brown. There he reduced to an orderly scheme all the methods of proved value in the development of the subject. Here the ultimate object is the production of a general theory as required for comparison with observation in the various cases which arise. Practical methods, marked by an underlying unity, are developed with this aim in view. No attention is given to the history of the methods or to such theoretical aspects of the subject as those with which Poincaré concerned himself. These can be found elsewhere. There is an austere suggestion about this book that traffic ought to be confined to the public highway, and that stragglers along the bypaths ought not to be encouraged. The authors have certainly done much to consolidate the main road, and even the inveterate Rambler will appreciate their good work.

Elementary chapters provide a sufficient introduction for the reader who has no previous acquaintance with the subject. In a later chapter the direct calculation of the co-ordinates in terms of the true orbital longitude as independent variable is treated by an advantageous modification of a method given by Hansen. Apart from this, the work is based mainly on the use and transformation of elliptic elements. There is a very valuable section on the disturbing function and its derivatives, developed by various methods. The use of canonical equations, with the allied transformation theory, is very clearly explained. Thus it is shown that the terms of short period can be separated and removed by a single process, and in the case of disturbing planets with periods unrelated to that of the body considered, the problem of the motion presents comparatively little further difficulty.

The first approach to more difficult conditions

was found in the case of the long inequality of Jupiter and Saturn, arising from the nearly commensurate periods of the two planets. But problems of a completely different order are offered by the minor planets when the periods stand in a simple ratio to that of Jupiter within limits which amount to resonance. Criteria for these limits are investigated, with particular detail for the ratio $1/2$.

The Trojan group of asteroids have the same period as Jupiter, and to these the final chapter is devoted. The peculiar feature of their orbits is a long period libration in longitude. It becomes necessary to introduce non-integral powers of the mass of the controlling planet, and the disturbing action of Saturn is so modified by the presence of Jupiter that separation of the effects is impossible, and the problem becomes necessarily one of four bodies. This feature has been familiar in the planetary perturbations of the moon; it is a new circumstance in planetary theory. The discussion of resonance and the treatment of the Trojan group of planets constitute the most original parts of the present work, and will be found most interesting as well as valuable.

Remarks on the limitations to be attached to certain familiar results relating to the stability of the planetary system will be found at several points, and they are no doubt just. But it is a little hard to see the mean distance dethroned from its place as a linear parameter of special character. Naturally it owes this position, in spite of its name, not to any mean or average property, but to its occurrence in the simple statement of Kepler's third law. That point, however, has not been overlooked (see p. 67), or the necessity for strict definitions to which it is allied. In the third equation on p. 216 there is a slip (of little importance) not noticed in the errata.

It should be added that this valuable work has been admirably produced at a price which must be considered extremely moderate.

The March of Inorganic Chemistry

A Text-Book of Inorganic Chemistry: for University Students. By Prof. J. R. Partington. Fourth edition. Pp. viii+1062. (London: Macmillan and Co., Ltd., 1933.) 15s. net.

A GENERATION or so ago inorganic chemistry appeared to have frozen into immobility, and life in this field of science was easy and pleasant for both the author of an inorganic

chemical textbook and his readers. How different is the position to-day, when both writer and student can enter so whole-heartedly into the feelings of the Gilbertian policeman! So we find that in the twelve years succeeding its first publication, Prof. Partington's treatise has had to undergo no fewer than three extensive overhauls in order to keep its readers reasonably up-to-date. The subject still remains fluid; for, as the author remarks in his new preface: "Very recent investigation of the structure of atomic nuclei will probably before long considerably amplify and modify present views on atomic structure, and the student who wishes to ascertain the current state of this investigation must follow the periodical literature."

In the new edition, Prof. Partington has taken every care to keep his readers abreast of modern theory and practice in pure and applied inorganic chemistry, and the book retains its position as one

of the best available for regular use by university students, and for reference by advanced pupils in schools. There is no need to add here to the widespread encomiums which Prof. Partington's work has deservedly received; but attention may be directed to some outstanding alterations in the new edition. The chapter on atomic structure has been reorganised so as to include a revised account of Werner's co-ordination theory; newly found isotopes of hydrogen and other elements have been noticed; a tabulated list of the electronic structures of the rare-earth elements has been added, as have also certain electronic formulæ; the account of active nitrogen has been revised; and there is a general discussion of hydrides. These are straws showing the way the wind blows in inorganic chemistry at the present time. The wise restraint which has been exercised in keeping the work, in true scientific fashion, "at constant volume" (1062 pp.) is to be commended. JOHN READ.

Short Reviews

Biology in Everyday Life. By John R. Baker and J. B. S. Haldane. Pp. 123. (London: George Allen and Unwin, Ltd., 1933.) 3s. 6d. net.

THIS little collection of essays consists of six slightly modified talks broadcast in the spring of last year. Five of them are by Dr. Baker, and their scope is well indicated by the titles—"A Biologist's View of Everyday Life": "Social Life in Animals": "The Determination of Sex": "The Quality and Quantity of Mankind": "War, Disease and Death". This series becomes, as it progresses, increasingly socio-biological, and Prof. Haldane's concluding essay on "Biology and Statesmanship" forms a logical ending.

It would be easy to raise doubts and queries about many things in this book, especially about Dr. Baker's views, implicit or explicit, on human genetics and its social implications, but it would not be fair to do so without bearing in mind the very serious limitations felt by the scientific writer, or speaker, when he has to address a lay audience on a technical subject. It is only the rarest of expository geniuses who is able to combine absolute simplicity with complete accuracy. Dr. Baker is a little too afflicted with Dr. de Kruif's 'baby language' technique, and Prof. Haldane is just a little too objective and didactic for one to feel that either of them has yet reached the highest summit in this very difficult branch of scientific literature.

In any event the proof of such a book is in the reading. Presumably the authors intended to stimulate an interest in biology generally, and especially in the bearings of biology on the thought and activity of the ordinary citizen. Whether or

not they have succeeded must be a matter of experiment. Our experience was that the effect on a lay person of reading these essays was to stimulate a flow of highly pertinent questions, by no means all easy to answer. Indeed, many of them could only be answered by reference to further and somewhat more detailed or advanced books. Since this is presumably exactly the effect the authors wished to achieve, it points to the conclusion that their little volume is to be regarded as very successful. A. L. B.

Gleichgewichtsfiguren Rotierender Flüssigkeiten. Von Prof. Leon Lichtenstein. Pp. viii + 175. (Berlin: Julius Springer, 1933.) 15.60 gold marks.

THIS book may be regarded as a pendant to the author's "Foundations of Hydromechanics" and extends the same rigorous methods to the treatment of the problem of the equilibrium of rotating masses of liquid under their own gravitational attractions. It summarises researches carried out by the author and his pupils during the past six years, mainly on existence problems of figures of equilibrium, of rotating masses of liquid in the neighbourhood of known figures of equilibrium, of homogeneous and also of heterogeneous masses of such liquid. An integro-differential equation is constructed in each case and solutions are sought by the method of successive approximations, both for classical problems, such as those of Laplace and Liapounoff, and for new ones concerning one or more coaxial rings, Roche's satellites, liquid double stars with and without solid centres.

The work constitutes a very valuable contribution to the literature of the subject and presumes

a knowledge of calculus, potential theory and integral equations, but it is by no means easy reading, even for those possessing this knowledge, owing to the abstract nature of the reasoning employed. It is well printed and commendably free from misprints, and will prove indispensable to all proposing to make a study of this branch of hydrodynamics.

Yuman Tribes of the Gila River. By Leslie Spier. (The University of Chicago Publications in Anthropology: Ethnological Series.) Pp. xviii+433+15 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1933.) 19s. net.

THIS study of the Yuman tribes of the Gila River, Arizona, is based upon field-work sponsored by Yale University and the University of Chicago. It is concerned primarily with the Maricopa, although the community since the beginning of the nineteenth century has been composite, the reason being that it has been Maricopa in speech and organisation since its formation. Little of ancient custom remains. The old outlook persists best in everyday behaviour, mannerisms, personal relations and speech. Few are Christians. The sib system, and its attendant naming habits, is the most flourishing part of the old thought system. Dr. Spier by his investigation makes a valuable addition to the excellent series of studies of the Indians of California and the adjacent south-west, for which the University of California has made itself responsible.

The Physician's Art: an Attempt to Expand John Locke's "Fragment De Arte Medica". By A. G. Gibson. Pp. vi+237. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 7s. 6d. net.

DR. A. G. GIBSON modestly describes his book as an attempt to expand John Locke's fragment "De Arte Medica"—the opening of what was to be an essay on the philosophy of medicine, but which was left uncompleted. Locke's words may have inspired the task, but Dr. Gibson's views on the fundamentals of medical art are in no way an expansion of Locke's ideas; they are the reflections based not only on a professional life rich in experience in the arts of diagnosis, prognosis and treatment, but also on a real understanding of medical ideals and ethics. Few doctors can be so perfect in their art that they have no lesson to learn from this book, and to the practitioner with most of his experience before him it will be of greater value than a stock of textbooks and scientific articles.

The Spread of Tumours in the Human Body. By Dr. Rupert A. Willis. (Monographs of the Baker Institute of Medical Research, No. 2.) Pp. x+540+48 plates. (London: J. and A. Churchill, 1934.) 25s.

To the clinician, the secondary tumour is of significance only in its prognostic finality; for the

pathologist, the importance of the primary relegates the metastatic growth to the background. Yet much may be learnt about malignant tumours from a study of their paths in spreading and the nature of the tissues in which they prefer to form secondary growths. Extensive study of records, critical consideration of theories, and the most painstaking and minute post-mortem examinations, are the essentials in such research work; by adherence to them, Dr. Willis has well surveyed a neglected corner of the field of morbid processes. His book, if of limited interest to the physician and surgeon, is of primary importance to the pathologist, and an essential addition to the cancer research worker's library.

Geographical Regions of France. By Prof. Emmanuel de Martonne. Translated from the latest edition by H. C. Brentnall. Pp. xi+224. (London: William Heinemann, Ltd., 1933.) 7s. 6d.

PROF. DE MARTONNE'S work, which has had more than one edition in the original French, does not cover the whole of France, but most of the important areas find a place and no essential feature of the framework of French geography seems to be omitted. The book is the outcome of a course of lectures first delivered in the United States, and aims at relating the physical facts with the human interests. The outstanding physical features are clearly explained and the book succeeds in giving a rational explanation of the contrasts in scenery exhibited by different parts of France. It can be recommended for lucidity of exposition and simplicity of treatment.

Einführung in die theoretische Physik. By Prof. Dr. Clemens Schäfer. In 3 Bänden. Band 3, Teil 1: *Elektrodynamik und Optik.* Pp. viii+918. (Berlin und Leipzig: Walter de Gruyter und Co., 1932.) 37.50 gold marks.

THIS book contains a very complete account of electricity and magnetism in all their theoretical aspects, from the simple electrostatic field through crystal optics to the theory of relativity. The treatment is clear, but it is quite definitely designed to appeal to the mathematician rather than to the experimental physicist. The standard attains that of a postgraduate course, but the book lacks bibliographical details which one normally expects to find in a work of such importance.

Struktur der Materie: Vier Vorträge. Von Prof. P. Debye. Pp. iv+50. (Leipzig: S. Hirzel, 1933.) 3 gold marks.

IN this little booklet of fifty pages, Debye publishes four stimulating talks on the scattering of X-rays by molecules, the electrical structure of matter, the molecular structure of liquids—including a fascinating account of the Brillouin derivation of the ratio of the velocity of sound to the velocity of light—and on the nature of solutions of electrolytes.

Modern Ideas on Nuclear Constitution

By DR. G. GAMOW

WHEN the complexity of atomic nuclei was proved by the existence of spontaneous and artificial nuclear transformations, a very important question arose: From which of the elementary particles are the different nuclei built up? It seemed that this question could be simply answered as there were only two particles with pretensions to be elementary: the proton and the electron. The protons had to account for the main part of the nuclear mass and the electrons had to be introduced to reduce the positive charge to the observed value. For example, the nucleus of bismuth, with atomic weight 209 and atomic number 83, was considered to be constructed from 209 protons and $209 - 83 = 126$ electrons. It was also accepted as very probable that these elementary particles build up inside the nucleus certain complex units constructed from four protons and two electrons each (α -particles). All this construction was in good agreement with the experimental evidence, as electrons, protons and α -particles were really observed being emitted in nuclear transformations.

The theory treating the nuclei as constructed of α -particles, some protons and a certain number of electrons, was worked out by Gamow. Although this theory gave some interesting results as to the general shape of the mass-defect curve and the conditions of emission of α -particles, it met with serious difficulties. It was very difficult to understand, on the basis of the quantum theory of the electron, how the electron can exist in a space so small as that limited by the nuclear radius. It was also not clear why the nuclear electrons, behaving in quite a strange and obscure way, do not affect the processes of emission of the heavy nuclear particles, protons and α -particles.

About two years ago, it was shown by Chadwick that the experimental evidence forces us to recognise the existence of a new kind of particle, the so-called neutron, also with claims to be held to play an important rôle in nuclear structure. The discovery of neutrons considerably simplified the difficulties about electrons in nuclei. One could now suppose that the nuclei were completely constructed of neutrons and protons (for example, the nucleus of bismuth from 83 protons and $209 - 83 = 126$ neutrons) which probably sometimes unite to form an α -particle (two neutrons and two protons). Thus the first of the above-mentioned difficulties was, so to say, hidden inside the neutron, while the second one was actually removed.

On the basis of these new ideas, Heisenberg succeeded in building up a general theory of nuclear structure, accounting for the main features of nuclear stability. The basis of his theory is certain assumptions about the forces acting between neutrons and protons. It seems most

rational to accept the view that the interaction between particles of the same kind is only due to electric charges (that is, no forces between two neutrons and the usual Coulomb repulsion between two protons), while between two different particles (neutron and proton) strong exchange forces come into play. These last forces are probably of the same kind as the forces between atoms playing the main rôle in quantum chemistry, and may be considered as due to the exchange of charge between the two particles in question.

This hypothesis explains at once why the number of nuclear neutrons for heavy elements is considerably greater than the number of protons (that is, why the ratio of atomic weight to atomic number increases for heavier elements). In fact, if we neglect the Coulomb forces, the most stable state of the nucleus will correspond to equal numbers of neutrons and protons, as in this case all the possibilities of binding (by attracting exchange forces), between protons and neutrons are saturated. The presence of the Coulomb repulsion between protons will, however, shift the optimum in the direction of a smaller number of protons and the position of lowest potential energy of our system will correspond to the larger proportion of neutrons. As the importance of the Coulomb forces increases with the nuclear charge, one can understand that an equal number of neutrons and protons is possible only for the lightest elements (first ten elements of the periodic system), while for heavier ones the number of neutrons predominates (126 neutrons and only 83 protons in bismuth).

Accepting the simplest form for the law of variation of the exchange forces with distance:—

$$I = a \cdot e^{-br} \quad (1)$$

and applying the quantum statistical method, Heisenberg calculated the behaviour of the nuclear model constructed from n_1 neutrons and n_2 protons. The result is that the particles are rather uniformly distributed inside a certain volume proportional to the total number of particles. This result fits very well with evidence otherwise obtained, that the density inside the nucleus is rather uniform and does not depend greatly on the atomic weight. The formula obtained for the total binding energy E of the nucleus as a function of n_1 and n_2 looks rather complicated and depends, of course, on the numerical values of the coefficients a and b in the expression (1) for the exchange force. Comparing this formula with experimental values of the mass defects of different nuclei, one can estimate the values of a and b . One finds thus: $a = 4.05 \times 10^{-5}$ erg; $b = 1.25 \times 10^{12}$ cm.⁻¹.

Very interesting consequences can also be obtained from Heisenberg's theory concerning the question of nuclear stability. It is easily understood that nuclei with a high positive electric

charge must tend to emit positive particles. From the point of view of the energy balance, the most favourable case for such emission is the emission of an α -particle, as this removes from the nucleus a large amount of negative energy (the binding-energy of the α -particle itself), which is equivalent to the supply of an equal quantity of positive energy. The condition for the possibility of α -emission can be simply formulated if we consider it as a simultaneous subtraction of two neutrons and two protons from the nucleus in question. The work necessary for such subtraction is evidently

$$\frac{\delta E}{\delta n_1} \Delta n_1 + \frac{\delta E}{\delta n_2} \Delta n_2$$

or, as

$$\Delta n_1 = \Delta n_2 = -2, \\ -2 \left(\frac{\delta E}{\delta n_1} + \frac{\delta E}{\delta n_2} \right).$$

To make a spontaneous α -disintegration possible, this quantity must be smaller than the above mentioned energy-supply due to the binding energy $\Delta M_\alpha c^2$ of the α -particle from neutrons and protons. (The difference appears as the kinetic energy of the emitted particle.) Thus the condition for α -decay will be :

$$-2 \left(\frac{\delta E}{\delta n_1} + \frac{\delta E}{\delta n_2} \right) < \Delta M_\alpha c^2 \quad (2)$$

In Fig. 1, the ratio of the number of neutrons to the number of protons is plotted against the number of protons for all known isotopes. The α -stability curve as calculated from formula (2) is represented by a broken line (curve I) and one can see that it is situated too low. One notices, however, that the theoretical curve, apart from absolute values, gives a good idea of the general form of this stability limit. We may notice that the condition for the spontaneous emission of a proton :

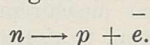
$$-\frac{\delta E}{\delta n_2} < 0 \quad (2')$$

will give us a stability limit located very far to the right of the α -stability curve, which means that spontaneous proton decay could only take place for very heavily charged nuclei (atomic number >200). On the other hand, the condition for the emission of a neutron :

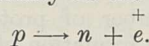
$$-\frac{\delta E}{\delta n_1} < 0 \quad (2'')$$

is never fulfilled, which can easily be understood if we remember that neutrons, having no charge, are not at all repelled by nuclei.

We must now turn our attention to the question of the emission of light particles. From the point of view of the neutron-proton model of the nucleus, we must accept the view that the process of ordinary β -emission is due to the transformation of a nuclear neutron into a proton with the liberation of negative charge in the form of an electron :



On the other hand, the recent discovery of the Joliot's of elements emitting positive electrons suggests the possibility of the reverse process :



We can easily estimate the stability limits for such processes if we consider the emission of a nuclear electron as the subtraction from the nucleus of a neutron and simultaneous addition of a proton. The condition for the positive energy balance of such a transformation will evidently be :

$$-\frac{\delta E}{\delta n_1} + \frac{\delta E}{\delta n_2} < \Delta M_n \cdot c^2, \quad (3)$$

where ΔM_n is the mass defect of a neutron as constructed from a proton and an electron. In an exactly analogous way we obtain for the

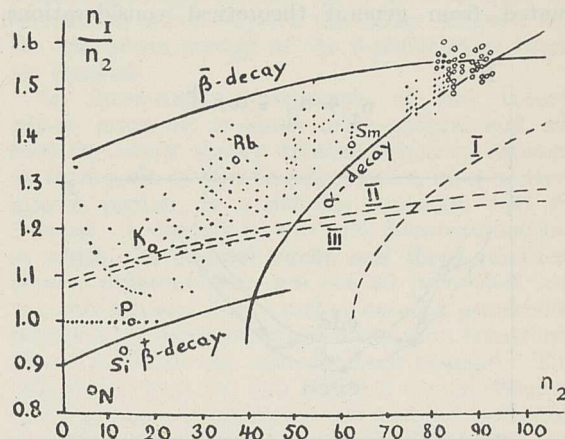


FIG. 1. A map of all known nuclei. Stable nuclei are indicated by full points, unstable nuclei by small circles.

possibility of emission of a positive electron the condition :

$$-\frac{\delta E}{\delta n_2} + \frac{\delta E}{\delta n_1} < \Delta M_p \cdot c^2, \quad (4)$$

where ΔM_p is the mass defect of a proton as constructed from a neutron and a positive electron. From (3) and (4) we can conclude that the nucleus can be stable relative to electron emission only if

$$-\Delta M_p c^2 < -\frac{\delta E}{\delta n_1} + \frac{\delta E}{\delta n_2} < \Delta M_n c^2,$$

conditions which correspond in the stability diagram (Fig. 1) to a very narrow band (curves II and III)*, in contradiction with the experimental evidence.

The stability region can, however, be made much broader if we consider more closely the energy conditions connected with electronic emission from nuclei. The point is that for a given total number of neutrons plus protons (that is,

* From the equations $n = p + e + \Delta M_n c^2$ and $p = n + e + \Delta M_p c^2$, we obtain $\Delta M_n c^2 - (-\Delta M_p c^2) = \Delta M_n c^2 + \Delta M_p c^2 = - + e + e = 2mc^2 = 1.6 \times 10^{-6}$ erg. This corresponds in Fig. 1 to a breadth of the stable region of about 0.016 units along the ordinate.

for given atomic weight) the nuclei are considerably more stable if the number of protons is even (even atomic number). The reason for this is that, with the increasing number of protons, each second one will lead to the formation of a new α -particle, and consequently correspond to larger liberation of energy. Thus if we plot the binding energy of isobaric nuclei against the atomic number (Fig. 2), the points corresponding to even-numbered elements will lie on a lower curve than those corresponding to the odd numbers. As can be seen from the diagram, this will have the result that for a series of elements extending some way both to the left and to the right side of the minimum, the emission of one electron (either negative or positive) will be energetically impossible. In such cases only the simultaneous emission of two electrons can be considered, but, as can be estimated from general theoretical considerations,

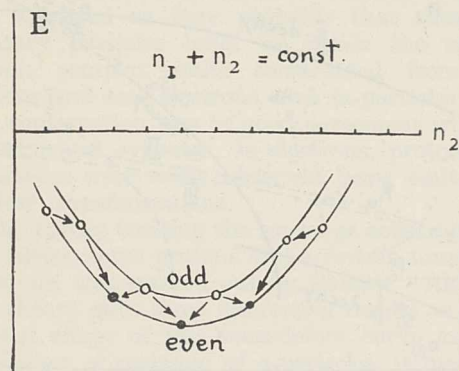


Fig. 2. Mass defect curves for typical isobaric nuclei. ●, stable nuclei; ○, unstable nuclei.

such a double emission has extremely small probability. The possibility is not excluded that the natural β -activity of potassium and rubidium has its origin in such a double process, which would easily explain their extremely long period of life.

According to these considerations we must push the limit of β -stability upwards and the limit of β -stability downwards, and thus get a considerably broader stability region. It can be seen from Fig. 1 that theoretical limiting curves give a good idea of the form of the actual stability limits, although, just as in the case of α -decay, the curves go again too low. It seems that both discrepancies have a common origin.

In Fig. 1, the points corresponding to unstable nuclei are shown by small circles. One notices that in the region of the heavy elements, where α - and β -stability curves run rather close to one another (and possibly cross), the sequences of α -disintegrations followed by two β -disintegrations are possible. For the lighter elements only a few cases of spontaneous disintegration are at present known. Samarium (most probably its lightest isotope) emits α -particles of about 1.5 cm. range and has an average life of about 10^{12} years. The lightest isotopes of nitrogen, silicon and phosphorus

(N_{7}^{13} , S_{14}^{37} , P_{15}^{30}), unknown in Nature and produced artificially by the Joliot's by α -bombardment of boron, magnesium and aluminium, give β -particles with an energy of 1–2 million volts and possess life-periods of several minutes.

The β -emission from potassium and rubidium must be explained either as a double electron emission from their heavier isotopes (K_{19}^{41} and Rb_{37}^{85}) or as due to some unknown isotopes of chlorine and bromine resulting from a very short range α -emission of the above mentioned elements (probably from K_{19}^{40} and Rb_{37}^{84}). As these ranges in air, as calculated theoretically from the value of the corresponding decay constants, are 0.24 cm. and 0.63 cm. respectively, one can understand why the α -particles have not yet been detected. Thus we see that our general theoretical considerations fit rather nicely with the experimental evidence.

We now turn our attention to the details of the processes of emission of α -particles and electrons, and the connexion of the disintegration energy with the average period of life. The process of α -emission can be explained on the basis of the ordinary wave equation of Schrödinger as the velocities of the emitted α -particles are small compared with the velocity of the light. It was shown by Gamow, and independently by Gurney and Condon, that the long life of α -decaying bodies is due to the fact that the α -particle leaving a nucleus must cross a very high potential barrier, the transparency of which is extremely small and decreases very rapidly with the decrease of the energy liberated in the disintegration. Theory leads us to the following formula for the decay-constant λ as a function of the α -particle velocity v :

$$\lambda = \frac{4h}{mr_0^2} e^{-\frac{8\pi^2 e^2 (Z-2)}{h} \frac{1}{v} + \frac{16\pi e \sqrt{m}}{h} \sqrt{Z-2} \sqrt{r_0}} \quad (5)$$

where Z is the atomic number of the disintegrating element and r_0 the nuclear radius. Accepting r_0 for radioactive elements to be of the order of magnitude 10^{-12} cm., one obtains very good agreement between the calculated and measured values of λ and can explain theoretically the empirical relation between $\lg \lambda$ and v found by Geiger and Nuttall.

For complete agreement one must, however, accept the view that the nuclear radius r_0 changes from one element to another in such way that the density of the nucleus remains constant ($r_0 \sim \sqrt[3]{A}$). Formula (5) permits us also to estimate one of the values λ or v if the other is measured. Thus, for example, the range of the α -particles of radium C, estimated from this formula to be equal to 4 cm., is in good agreement with the value found later by Rutherford, and the period of life of the very short lived product radium C' given by this formula (10^{-3} sec.) fits well with the recent measurements of Jacobsen.

It is also interesting to notice that formula (5)

may be successfully applied in the region of the lighter elements. According to (5) the period of life of samarium as estimated from the velocity of its α -particles must be about 10^{12} years, in good agreement with the observed value.

In the process of α -decay, it may often happen that the nucleus of the product of disintegration is constructed in an excited state, which corresponds to the emission of α -groups with slightly smaller energy (fine-structure of α -rays). The formula helps us to understand the relative intensities of such α -groups and also permits us to draw certain important conclusions about the quantum numbers of the different excited nuclear levels. On the other hand, it also explains the small number of so-called long-range α -groups corresponding to the disintegration of excited nuclei.

In contrast with the theory of α -decay, the understanding of the process of β -disintegration presents serious difficulties. First of all, the electrons emitted in β -decay possess a continuous distribution of energy, which seems to be in contradiction with the law of conservation of energy. It was pointed out by Bohr that the law of conservation of energy need not necessarily hold for processes involving nuclear electrons for which the modern quantum theory is not applicable. But, as was shown by Landau, the rejection of the conservation law for energy will be connected with very serious difficulties in the general gravitational theory, according to which the mass present inside a certain closed surface is entirely defined by the gravitational field on this surface. It was proposed by Pauli that one might retain the energy conservation law by the introduction of a new kind of particle called a 'neutrino'. These neutrinos, having no electric charge and possessing very small (or even vanishing) mass, would be practically unobservable in all experiments and could easily take away the surplus energy of

β -decay. The existence of such particles is, however, at present rather doubtful.

An attempt to construct a theory of β -disintegration on the basis of Dirac's relativistic wave equation, treating the emission of a nuclear electron in a similar way to the emission of light quanta by an atom, has recently been made by Fermi. In this theory, one accepts the view that the transformation of a nuclear neutron into a proton is connected with the creation of an electron and a neutrino, which, being born, leave the nucleus, dividing between them the energy liberated in this transformation. Accepting a definite value for the interaction energy giving rise to such transformations (of the order of magnitude of about 10^{-14} erg), Fermi obtains reasonable values for the decay constants of β -disintegrating elements and a good fit with the correlation curve between the decay constant and the maximum energy of the β -particles as found by Sargent.

An interesting consequence of this theory, which, however, is much more general and will hold for every theory treating electron emission as the result of the transformation of a neutron into a proton, is a definite exclusion rule for β -decay. According to this rule, β -transformations in which the original nuclei and those produced possess different spins are not all permitted, and can only happen with a rather reduced probability (about a hundred times less often than transformations in which the spin does not change). This explains at once the two different curves obtained by Sargent as due to permitted and not permitted transformations. It has been shown by Gamow that the application of the above mentioned exclusion rule for β -decay to the analysis of radioactive families gives very good results and permits us to give definite spin values to normal and excited states of radioactive nuclei.

MM. Osty's Investigations of Rudi Schneider

(From a Correspondent)

SCIENTIFIC men who have been anxious to form a fair and impartial opinion about the alleged physical phenomena of spiritualism have found it very difficult to do so. There exist, indeed, records by a number of qualified scientific observers which if taken at their face value would establish the reality of these phenomena completely. We may instance the names of Crookes, Zollner, Richet, A. R. Wallace, Varley, De Morgan, Lodge, W. J. Crawford and R. J. Tillyard. These records have not produced general conviction, even in the view of those who have adequately studied them before undertaking to express an opinion, though it appears that those who have studied them have often been considerably impressed. The accounts given are often insufficiently detailed to satisfy the student. The possibilities of deception, of conjuring, of malobservation, and

even of hypnotic suggestion acting on the observer, and causing him to see the thing that is not, have been difficult to estimate. It is not often that the good faith of the experimenter has been questioned. Indeed, to profess a belief in these things has been so manifestly contrary to the personal interests of a scientific worker, that it would be gratuitous to suggest that his adhesion is inspired by anything but the love of what seems to him to be the truth. The circumstance that a poor light has usually been insisted upon is extremely suspicious, and justifies a very reserved attitude. It is proper to remark, however, that in some recorded instances the light has been good.

The object of this article is not to present a general or historical review of the subject, but to give a short account of some of the observations of Dr. Eugène and M. Marcel Osty with Rudi

Schneider, described in a work entitled "Les Pouvoirs Inconnus de l'Esprit sur la Matière", published in 1932 (Paris: Félix Alcan). These observations should be of special interest to physicists, because they were in large measure carried out by self-recording instruments. The graphs are reproduced for the student to examine, and he can form his own opinion of them. Mal-observation and hypnotic suggestion as possible explanations are therefore largely excluded. The possibility of deliberate deceit remains, and will require to be carefully assessed. But the scope for it seems to be much restricted as compared with previous investigations.

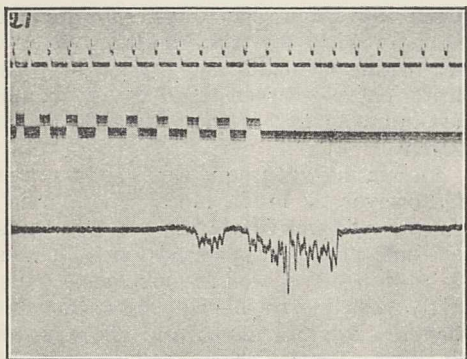


FIG. 1. Top: scale of seconds, advancing from left to right; middle: intermittent time signal; bottom: infra-red intensities as ordinates and times as abscissae.

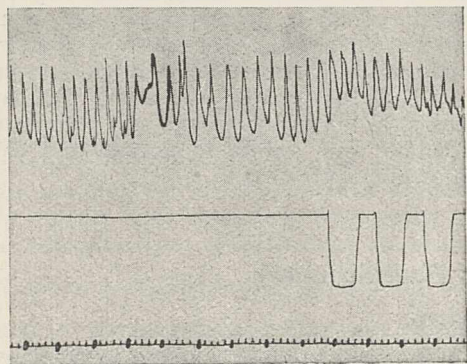


FIG. 2. Bottom: seconds and fifths, advancing from right to left (note the change); middle: signals synchronous with the other diagram; top: chest movements as ordinates and times as abscissae.

Attention was initially fixed on the alleged phenomenon of telekinesis, or moving of objects by an unknown agency in the presence of the (controlled) medium. It is generally known that a beam of light can be used to guard a treasure, a warning bell being rung when a potential thief approaches it too near and intercepts the beam. The method has been used when valuable objects are on public view. It depends on an obvious application of a photoelectric cell combined with a thermionic valve actuating a relay. Now it occurred to MM. Osty that by using a beam of infra-red light instead of visual light, this method could be

carried out in a dark séance room, and that the object (flower, handkerchief and the like) proposed for telekinesis could be guarded by the beam, so that if the medium succeeded in escaping from the controller who was by way of holding him, and attempted to seize the handkerchief in order to move it, a bell would ring and give warning. The controller would then be doubly on his guard, and, what was more important, a flashlight photograph could be taken, which would decisively reveal whether the medium or anyone else was doing anything suspicious. It will probably be agreed on all hands that this was a well-conceived plan of experiment, not suggestive of undue credulity on the part of the experimenters.

It was found that, in fact, the bell did ring on frequent occasions while the medium was, or purported to be, in trance. The ringing was sometimes maintained for half a minute, or even a minute. Flashlight photographs were taken while the bell was ringing, and they revealed the medium sitting in his usual hunched position, with his head sunk forward, his hands held, and his knees between the knees of the controller. Some of these photographs are reproduced in the volume; one of the best is on p. 45. There is nothing to be seen in the path of the infra-red beam.

It seems, therefore, that whatever it was that obstructed the beam, it was not an ordinary solid obstacle. Whatever obstruction it was that caused this effect seemed to fade away under the influence of ordinary light: for lateral illumination of the path of the beam, although it did not reveal anything, had the effect of promptly stopping the ringing of the bell.

Although the infra-red beam was intercepted, as if something was trying to reach the handkerchief or other object, the latter was not often moved, and the experimenters wisely decided to abandon this as a primary object of study and to concentrate attention on the unexplained phenomenon that was more easily obtained, namely, the obscuration of the infra-red ray. The bell was replaced by a galvanometer with a photographic recording drum adapted to give a continuous graph of the deflections. The obscurations previously indicated by the bell were now photographed on the drum, which gave a record of intensity and duration.

After the work had been in progress for some time, the ordinary galvanometer which had been in use was replaced by one of quick period (one-tenth sec.), with the view of examining in more detail how the obscuring action set in. A very significant fact was then noticed. When the ray was (partially) obscured, it was seen that the galvanometer spot moved in sympathy with the loud and rapid breathing of the entranced medium. The deflection was less (and the absorption therefore greater) during an inspiration or an expiration, than at the times intermediate between the two. It was clear, therefore, that the obscuring action was connected, directly or indirectly, with the

medium's muscular processes. This fact alone seems to rule out confederacy.

When the above relations had been recognised, arrangements were made for automatically recording the motions of the medium's chest, at the same time as the infra-red absorptions. A scale of seconds was placed on each record, and by an obvious electrical method, synchronous signals were made on each, so as to afford a time-origin from which to measure the frequencies. Sample records (Figs. 1 and 2) are here reproduced from MM. Osty's memoir. The absorption lasts for 7 seconds, and oscillates with a frequency of 5 per second. At the same time the breathing is at the rate of 2.5 per second. These are the figures given by MM. Osty. They can be approximately verified from the half-tone blocks in their publication, though the individual oscillations are not invariably well resolved in the reproduction.

In attempting to estimate the work of MM. Osty, we must consider in what directions there might be a chance of shaking their evidence. Mere topics of prejudice should be avoided. It has often been suggested that Rudi Schneider makes use of confederates, either secretly introduced, or openly present in the guise of sitters. Will it help us to assume that he did so in this case? The answer appears to be in the negative. It is not apparent how a confederate could assist in producing the rhythmic obscuration, in time with Rudi Schneider's breathing. When it has been shown that an assistant, working without disguise, can do this, the hypothesis of confederacy will require closer examination.

Again, it has often been argued that Rudi Schneider can get an arm free in spite of the apparent control. This hypothesis has the same weakness as the previous one. How can he use the (hypothetical) free arm to produce the effects?

No answer to these questions has so far been forthcoming.

Lastly, is it possible that MM. Osty were deceived, and that the records which they imagined they had obtained on their photographic drums were really prepared independently by Schneider or some confederate of his, and palmed off on MM. Osty before development in substitution for their own records? It must be remembered that the relation between Schneider's breathing and the infra-red intensity was first noticed visually by the motion of the galvanometer spot, before it had been recorded photographically; so that this hypothesis also seems to fail.

The value of the evidence of MM. Osty, or of any other witnesses, must depend on what view is taken of their good faith. This in turn must depend on general reputation, on internal consistency and coherence of evidence, and on the possible motives for deception.

It would be of the greatest importance for the work to be independently repeated in some other laboratory. Unfortunately, Rudi Schneider's powers are apparently failing. Some have considered this fact to be in itself suspicious. It must be remembered, however, that even at their best the phenomena were sporadic, with many blank sittings interspersed. In any event, it is not clear why the trick, if trick it was, should not continue to be played as long as it is profitable. On the alternative hypothesis, it seems not particularly unlikely that exceptional natural powers of this kind might pass off with time, as do, for example, the powers of 'calculating boys'.

Anyone who sees his way to a normal explanation for these effects would be doing a service to the cause of truth by setting up the apparatus and producing graphs similar to those published by MM. Osty.

Obituary

PROF. A. N. MELDRUM

BY the death of Prof. Andrew Norman Meldrum on March 12 the activities of one of the best-informed writers on historical matters relating to eighteenth and nineteenth century chemistry have come to a close. The history of the greater movements in the progress of theoretical chemistry formed a favourite branch of study and research, and from an early period Prof. Meldrum's attention was directed to the subject of the atomic theory, in connexion with which he published, so early as 1904, a thoughtful and elaborate monograph on "Avogadro and Dalton: The Standing in Chemistry of their Hypotheses". This was followed by a series of papers "On the Development of the Atomic Theory", contributed to the Literary and Philosophical Society of Manchester in 1909-11, and by a pamphlet with the same title published in India in 1920. He was engaged during a number of years upon an intensive study of the works of

Lavoisier and his contemporaries. In this period he accumulated a large amount of material for the production of the successive lengthy papers that appeared between 1924 and 1934, dealing with Lavoisier's part in "The Eighteenth Century Revolution in Science", with his historic "Three Notes on Combustion: 1772", and with his "Early Work in Science: 1763-1771". Besides these valuable papers, Meldrum contributed one of the three special commemorative addresses on Joseph Priestley that were read before the Chemical Society in April 1933, on the occasion of the bicentenary of that philosopher.

In his published historical work, Meldrum appears as a close student as well as a keen and, at times, outspoken critic. He was not willing to accept, without verification, the statements made by compilers, but was in the habit of making it a point to obtain first-hand information from original sources. In the case of his researches into Lavoisier's work, this usage involved the making

of extensive inquiries in Paris, not only by correspondence but also by personal visitation, and in this way he ensured the authenticity of his own statements. After the publication, so recently as last January, of his concluding Lavoisier paper, he had begun a study of the life and work of Black and was actively engaged a few days before his unexpected death in a minute examination of the contemporary and subsequent literature relating to Black's discoveries.

Meldrum studied chemistry with Japp at Aberdeen and took his D.Sc. degree at the University there in 1904, his graduation thesis being the Avogadro-Dalton monograph already mentioned. Afterwards he carried on research work in organic and in physical chemistry in collaboration with Japp, Perkin, jun., and others. In 1912, he was appointed to the professorship of chemistry in the Madhavlal Ranchhodol Science Institute, Ahmedabad, from which he was transferred later to the Royal Institute of Science, Bombay, both of these institutions being affiliated to the University of Bombay. From his post in the latter he retired in 1931 and resided thereafter in Edinburgh. He is survived by his widow and two daughters.

MR. R. LL. JONES LLEWELLYN

MR. RICHARD LLEWELLYN JONES LLEWELLYN, who died suddenly on April 19, had made a lifelong study of rheumatism and allied disorders, on which he was regarded as an eminent authority. The son of Surgeon-Major Morris Jones of Aberystwyth, he assumed the name of Llewellyn in 1911 on his marriage to the Hon. Mrs. Crosse of Hulbertson, only child of the fourth Lord Headley.

Llewellyn had been president of the Balneological and Climatological Section of the Royal Society of Medicine; consulting physician to the National Hospital for Rheumatism at Bath; member of the conference on chronic arthritis convened by the Medical Research Council; chairman of the Medical Committee of the National Campaign for the Prevention and Relief of Heart Disease in Children; and vice-president of the British Committee on Rheumatism, International Society of Medical Hydrology. He was also a member of the Board of Medicine, Welsh National School of Medicine; a fellow of the Royal Society of Medicine, of the Hunterian Society and of the Royal Meteorological Society.

In his researches into rheumatic diseases, Llewellyn was greatly helped by his brother, A. Bassett Jones.

Llewellyn was the author of several books and articles on rheumatism, arthritis, fibrositis and gout. At the time of his death he was engaged on a study of the relations of rheumatism to the absence of sunshine and the consequent failure of the skin to mobilise the chemical antecedents of the endocrines, a new view which has attracted considerable attention in the United States.

Llewellyn had been a member of the central

appeals tribunal of the Ministry of Pensions, and was widely quoted as the author of "Malingering or the Simulation of Disease" (1917) and "Pensions and the Principles of their Evaluation" (1919). Llewellyn's style was picturesque and vivid; his conversation was arresting, original and spiced by shrewdness and humour.

MR. C. E. BORCHGREVINK

CARSTEN EGEBERG BORCHGREVINK, whose death at Oslo is announced, was born in that town, then Kristiania, in 1864. After an education in Norway and Saxony, he went to Australia in 1888 and spent some years in Queensland and New South Wales, first as a land surveyor and later as a teacher of modern languages and natural science.

When in 1894 Svend Foyn sent a ship to the Antarctic under the command of L. Kristensen and H. J. Bull to explore whaling possibilities, Borchgrevink signed on as an ordinary seaman, having failed to get accepted as a passenger. The ship reached lat. 74° S. in the Ross Sea and Borchgrevink in landing at Cape Adare was one of the first to set foot on the Antarctic continent. He also was the discoverer of plant life within the Antarctic Circle.

Returning to Europe, Borchgrevink tried in vain to equip a trading expedition to South Victoria Land to search for guano. In 1898, however, he induced Sir George Newnes to fit out the *Southern Cross* (formerly the Norwegian whaler *Pollux*) for a scientific expedition to the Ross Sea, the first since that of Sir James C. Ross in 1841. A wintering was made at Cape Adare where many valuable observations were made by L. Bernacchi, N. Hanson and others, and on the return of the ship in spring a voyage was made south to the Barrier face. Borchgrevink and W. Colbeck travelled over the Barrier to lat. 78° 50' S., at that time a southern record.

In 1902 Borchgrevink investigated volcanic conditions in the West Indies on behalf of the National Geographic Society and in the later years of his life was curator of the Tömte Biological Station in Norway. He received the Patron's medal of the Royal Geographical Society in 1930, and a medal of the Royal Scottish Geographical Society in 1900. His chief publications were "First on the Antarctic Continent" (1901), "Das Festland am Südpol" (1905) and "The Game of Norway" (1920-25).
R. N. R. B.

WE regret to announce the following deaths:

Dr. Angel Gallardo, formerly Argentine Minister for Foreign Affairs, rector of the University of Buenos Aires since 1932, and president of the Academy of Sciences in Buenos Aires since 1927, aged sixty-six years.

Prof. C. W. Rolfe, emeritus professor of geology in the University of Illinois, an authority on the geology of Illinois, on April 6, aged eighty-three years.

News and Views

Prof. A. Fowler, F.R.S.

PROF. A. FOWLER, who, at the meeting of the Royal Astronomical Society on May 11, was presented by Dr. Edwin Hubble with the Bruce Medal of the Astronomical Society of the Pacific, is the *doyen* of English-speaking spectroscopists. So long ago as 1885, he became attached to the Solar Physics Observatory at the Royal College of Science under the late Sir Norman Lockyer, with whom he remained until 1901 when, on Lockyer's retirement, he was given the charge of the astrophysical work of the College. The intimate experience he acquired of the practical aspects of spectroscopy—a subject much more specialised then than now—was turned to good account, and his share with Lockyer in recognising the existence and importance of 'enhanced' lines (the basis of modern ionisation theory) was rapidly followed by the attribution of the *M*-type stellar absorption bands to TiO and the 'comet-tail' bands to low pressure CO, the identification of many solar spectrum lines with bands of water vapour and magnesium hydride, and other astronomical work of the first importance.

THE sudden prominence given to spectroscopy in 1913 by Bohr's theory of the hydrogen atom offered an opportunity for the application of Prof. Fowler's peculiar knowledge which he was not slow to accept. The interpretation of enhanced lines as radiations from ionised atoms in the general case was mainly due to his work, and in a series of subsequent papers he provided some of the most fundamental observational data for the extraordinary development of atomic physics in recent times. Under his influence and direction, a considerable school of spectroscopists has grown up, and many vital contributions to modern spectroscopy have been made by workers who received their original impetus from him. Prof. Fowler was in large measure responsible for the organisation of the International Astronomical Union, of which he was the first general secretary, holding office for six years. Since 1923 he has been Yarrow research professor of the Royal Society—a position from which he retires at the end of the present session. In addition to the Bruce Medal, his long list of honours is to be augmented this year by the award of the honorary Sc.D. and D.Sc. degrees of the Universities of Cambridge and Durham, respectively.

Sir Richard Redmayne, K.C.B.

AT the annual meeting of the Institution of Civil Engineers held on May 8, Sir Richard Redmayne was elected president in succession to Brigadier-General Sir Henry Maybury. This is, we believe, the first time a mining engineer has been chosen for this position of distinction, and Sir Richard's election is a mark of recognition of his important services to Great Britain and to the mining industry generally. Born at Gateshead-upon-Tyne on July 22, 1865, Sir Richard, after being taught privately, passed through

the Durham College of Science, Newcastle-upon-Tyne, and at eighteen years of age began practical work in the Hetton Collieries, Durham, of which he became the under-manager. In 1891–93 he was in South Africa, and then returning home, was for eight years resident manager of the Seaton Delaval Collieries, Northumberland. In 1902, at the age of thirty-seven years, he was appointed professor of mining in the University of Birmingham, and to him fell the task of planning the Department of Mining. Six years later he was appointed H.M. Chief Inspector of Mines, and this important position he held throughout the War and until 1920. He had previously been employed by the Government on official inquiries and he afterwards served on many committees and Royal Commissions appointed to inquire into the use of electricity in mines, the organisation of rescue work, safety lamps, explosions and spontaneous combustion, and the organisation of the coal-industry. Both when at Birmingham and since his retirement from the Home Office, he has practised as a consulting mining engineer. He has served as president of the Institution of Mining and Metallurgy and is a vice-president of the British Science Guild and president of both the Institution of Professional Civil Servants and the Association of Scientific Workers.

New Foreign Members of the Linnean Society

PROF. CAMILLE SAUVAGEAU of Bordeaux, and Prof. G. Otto Rosenberg, professor of botany in the University of Stockholm, were elected foreign members of the Linnean Society at the meeting on May 10 to fill the vacancies caused by the deaths of Prof. K. von Goebel and Dr. Erwin Baur. Prof. Sauvageau first came into prominence in 1877 by his work on Tunisian cryptogams in collaboration with N. Patouillard. Since then he has been concerned almost exclusively with the study of the brown seaweeds. He has worked out the life-histories of a number of these algæ, choosing representatives of all the natural orders, and was the discoverer of the filamentous gametophyte in Laminariales. He has also made elaborate taxonomic studies of the difficult genera *Fucus* and *Cystoseira* based on extended collecting experience. Sets of his specimens illustrating the monographs have been distributed to the principal herbaria. Prof. Rosenberg is well-known for his cytological studies, mainly devoted to development in flowering plants. His thesis for his doctorate in 1897 was on the physiological cytology of *Drosera rotundifolia*. This was followed ten years later by an account of the cytology of the hybrid *Drosera longifolia* × *rotundifolia*, in which he established the occurrence of chromosome segregation. Other valuable researches have been on the embryology and pollen development of *Zostera* and the discovery of the phenomenon of apogamy in *Hieracium* and *Crepis*. His broad outlook on cytology has enabled him to make several generalisations which have had considerable influence on problems of taxonomy and phylogeny.

Mr. R. H. Burne, F.R.S.

THE retirement of Mr. R. H. Burne from the physiological curatorship of the Royal College of Surgeons' Museum was marked by a complimentary dinner which was held in his honour at the Langham Hotel on May 10. Among those present were Sir Holburt Waring, Sir Cuthbert Wallace, Sir Arthur Keith, Sir Arthur Smith Woodward, Sir Peter Chalmers Mitchell, Dr. Tate Regan, Sir Charles Ballance, Prof. E. Barclay-Smith, Prof. William Wright, Sir Buckston Browne, Prof. E. S. Goodrich and Mr. C. Forster-Cooper. Mr. Burne's contributions to zoological and anatomical literature have been outstanding in that they have been the result of painstaking dissection of the most intricate kind. The physiological series of the Royal College of Surgeons contains innumerable examples of his masterful skill with the scalpel. Many of these preparations illustrate discoveries which he has himself made, but has never published. His election to the fellowship of the Royal Society in 1927 was the recognition of his scientific work in the College Museum. The complimentary dinner was in its turn a mark of appreciation by his friends of his modest and retiring personality.

Television Committee

THE Postmaster-General announced in the House of Commons on May 14 that the Television Committee is to be constituted as follows:—Lord Selsdon (chairman); Sir John Cadman (vice-chairman); Col. A. S. Angwin, Assistant Engineer-in-Chief, G.P.O.; Mr. Noel Ashbridge, Chief Engineer, B.B.C.; Mr. O. F. Brown, Department of Scientific and Industrial Research; Vice-Admiral Sir Charles Carpendale, Controller, B.B.C.; Mr. F. W. Phillips, Assistant Secretary, G.P.O. The secretary of the Committee is Mr. J. Varley Roberts, Telegraph and Telephone Department, G.P.O., E.C.1, and the terms of reference are: "To consider the development of television and to advise the Postmaster-General on the relative merits of the several systems and on the conditions under which any public service of television should be provided."

It does not appear that any of the members of the Committee appointed by the Postmaster-General have that practical knowledge of the scientific problems involved in television desirable for the consideration of the position and possible development of the subject. It will be difficult, therefore, for the Committee to estimate with authority the value of the various systems which have been developed. Even in regard to the commercial interests involved, and the attempts made in other countries to popularise television, the Committee will have mainly to depend upon the experience or knowledge of others. Moreover, since the relative merits of the systems of television to be examined may have to be decided on patent issues, it is strange that no member of the Committee familiar with patent law and practice has been appointed. It seems, therefore, that the Committee will have to base its report upon evidence

given by the various television interests; and we suggest that it would have been better if the Postmaster-General had convened a conference of these interests and asked them to present an agreed report on the two main questions submitted to the Committee he has appointed. He might thus have had the fullest technical information on television presented to him direct by the companies who command the services of all the television experts available. As it is, the Committee will have a difficult task in securing such information and assessing its value; and whatever report is issued is likely to be challenged by companies concerned with the development of television.

Plague of Blood-sucking Flies in Yugoslavia

WE learn from the *Times* of May 12 that an insect plague is causing serious trouble in parts of Yugoslavia. The insect in question is referred to as the 'golubatz fly', which has recently appeared in parts of the country not previously troubled by the pest. Several peasants and some 500 cattle and sheep have already perished. A poisonous fluid injected by the fly has the effect of breaking down the red blood corpuscles, so that when the 'bites' become numerous death may supervene. From the account given, it is evident that the fly in question is a species of *Simulium* or buffalo gnat. This genus comprises blood-sucking flies which are troublesome pests in several parts of the world. In regions bordering on the Danube the species *S. columbaezense*, which is most probably the fly involved in the present outbreak, causes at times heavy mortality, especially among horses, as the result of its blood-sucking propensities. Its larvæ and pupæ live in streams and rivers while the adult flies sometimes occur in immense swarms. In 1923, an invasion in Rumania is computed to have caused a loss to farmers of about £80,000 through the deaths of horses, sheep, pigs and other domestic animals. Although human beings are also attacked and severely bitten, fatal cases seem to occur but seldom. In their efforts to control the plague, the farmers used smoke screens and applied various repellent smears to their stock. Much the same methods are being used in the present outbreak, the peasants lighting bonfires in order to protect their stock, the herds being kept indoors during the day and allowed to graze only between sunset and sunrise. A feature of such outbreaks is that the flies may be carried long distances by the wind, with the consequent invasion of areas where the farmers have no previous experience in applying control measures.

Dust Clouds in the United States

A RARE meteorological phenomenon was experienced in New York on May 11, when a cloud of grey dust enveloped that city. This cloud of dust is described as having reached the eastern seaboard of the United States early on that day, and is said to have extended from New England down to Washington, to have been denser in the Middle West and to have measured 1,500 miles by 900 miles in the horizontal and about three miles in the vertical.

The damage and discomfort caused by the dust was evidently very great. A synoptic weather chart for that day prepared in the Meteorological Office, Air Ministry, from wireless weather bulletins, supports the suggestion made in the *Times* that the dust was carried by the wind from a region in Western Canada and the neighbouring States which is suffering from severe drought, for a vigorous circulation of wind around a deep cyclonic depression is shown on the chart, and this circulation is in about the expected position. Aeroplanes are said to have encountered the dust cloud, the pilots having estimated that it was travelling eastwards at speeds between 60 miles and 100 miles an hour. The phenomenon can safely be compared in its origin with the dust storms of Egypt and Northern India; a fall of red rain in London due to a circulation of wind round an anticyclone, which brought down dust from the Sahara—investigated many years ago by Shaw and Lempfert—was essentially similar in character. It appears to be one of the attendant evils of North American droughts that fine tilth can be removed from its proper place in the farmers' fields and be deposited in distant States where its presence—even in agricultural country—is far from being immediately beneficial.

Centenary of Liverpool Medical School

ON May 11, the University of Liverpool celebrated the centenary of the Liverpool Medical School. In connexion with the celebrations, a brief illustrated account of the School by Arthur A. Gemmill has been issued ("The Liverpool Medical School, 1834-1934". Hodder and Stoughton, Ltd., London. 1s.). On the occasion of the conferment of honorary degrees to celebrate the foundation of the School, an address was delivered by Prof. John Hay, professor of medicine in the University. Until 1821, St. Bartholomew's, St. Thomas's, Guy's and the London Hospitals held the monopoly of medical teaching; then the barrier against provincial teaching was broken down by the Society of Apothecaries in recognising the teaching of Dr. Joseph Jordan in Manchester. In 1824, the clinical teaching at the Manchester Infirmary School was recognised; thus Manchester was the first provincial medical school in England. Undoubtedly the efforts of the Manchester medical men were a stimulus to those in Liverpool. Anatomy schools were developed first, and finally a School of Medicine. In 1837, the School was recognised by the London Society of Apothecaries, the College of Surgeons, and the University of London. In 1884, it was incorporated with University College when the latter, which was founded in 1881, was admitted into Victoria University. In 1903, when the University of Liverpool was granted its charter, the School became its Faculty of Medicine. Among the distinguished occupants of the endowed chairs in the past have been Lodge, Campbell Brown, Herdman, Gotch, Paterson, Boyce, Sherrington, Benjamin Moore and Ronald Ross.

ASSOCIATED with the School of Medicine at Liverpool is the School of Tropical Medicine, with seats on the

Faculty of Medicine. This School was founded in 1899, and has the distinction of being the first of its kind in the world. In 1921, the School established a permanent laboratory at Freetown, Sierra Leone, and already has a brilliant record of studies in malaria, yellow fever, sleeping sickness, blackwater fever, vomiting fever, as well as entomology, helminthology and tropical sanitation. At the celebrations, the honorary degree of D.Sc. was conferred on Prof. H. R. Dean, professor of pathology in the University of Cambridge; Sir Thomas Lewis, physician, University College Hospital; Mrs. May Mellanby, investigator for the Medical Research Council; Wilfred Trotter, Sergeant Surgeon to the King; and LL.D. on Prof. William Blair-Bell, emeritus professor of obstetrics and gynaecology in the University; Prof. H. Briggs, emeritus professor of obstetrics and gynaecology in the University; Herbert R. Hurter, Liverpool, past president of the Liverpool Medical Institution; W. S. Paget-Tomlinson, lately chairman of the Public Health Committee of Westmorland; Prof. Charles H. Reilly, emeritus professor of architecture in the University of Liverpool.

Excavations at Ur, 1933-34

DR. C. L. WOOLLEY'S lecture on "The Year's Work at Ur", given at the Royal Institution on May 11, afforded his audience a more favourable opportunity of appraising the results of this brief season's excavations than has been possible from the summary reports which have appeared in the Press. The elucidation and study of the earlier phases of the occupation of the site have been carried down through pre-flood strata to the bottom of the marsh before man appears on the scene. The history of the ziggurat, dating in its present form from 2300 B.C., of the attendant temples of the First Dynasty (3000 B.C.) and of the antecedent buildings which they replaced, has been brought back to the very beginning of the 'plano-convex' period, while beneath have been found still earlier periods of which the later must belong to the 'Jemdet Nasr' age. It was not possible at this point in the excavation area to carry the work to its logical conclusion by deeper digging; but Dr. Woolley traced the course of excavations at the south-eastern end of the Temenos area from the modern ground-level right down to virgin soil, through deposits of the age of Nebuchadnezzar, the Kassite age (1400-1000 B.C.), the Sargonic period (2600 B.C.) and through a continuation of the Royal Cemeteries of the fourth millennium. It was at this point, in what was evidently a soldiers' burial ground, that the unique discovery of a female statue deposited as a funerary offering was made. Below this were the archaic written tablets and seal impressions and at a still greater depth the graves, extending over a considerable period of time, which have proved so amazingly rich in stone vases of varied form and material. In the mixed soil in which, as well as in the sandy flood deposit, were found the earlier graves yielding Jemdet Nasr ware, there were abundant sherds of Al 'Ubaid ware, thus completing a remarkable record which covers the complete range of Mesopotamian history from the middle of the first

millennium B.C. to man's earliest occupation of the site, a period of not less than three millennia, possibly more.

Parallels of Habits and Beliefs

THE Frazer Lecture was delivered at the University of Oxford on May 10 by Prof. H. J. Rose, of the University of St. Andrews. The title of the lecture was "Concerning Parallels", and Prof. Rose discussed the legitimacy of the sort of parallels to classical religious phenomena which Frazer uses, leading up to a discussion of polygenetic versus distributionist views in anthropology. His general argument was that the use of parallels between the habits and beliefs of one people and another, while particularly conspicuous in the works of Frazer, is nothing new, being prominent in works published so early as the eighteenth century. It has generally involved recognition of the principle laid down by Bergier (1760) that "partout les hommes se ressemblent". Frequently there has gone with it a shallow conception of human evolution, tacitly assuming that the resemblance between different peoples at approximately the same stage of culture is so close as to amount to identity, and also that the stages of culture can be dated by merely placing first in time those which appear simplest and most brutish. This being the result of false reasoning and the neglect of elementary philosophic principles, has led to unsound results. In consequence, the attempts of the so-called historical school, of which Graebner, Pinard de la Boullaye and W. Schmidt are outstanding representatives, to establish objective criteria of dating and a strictly scientific method of handling the facts must be welcomed, whether the results they have so far achieved are acceptable or not. The criteria are, however, open to serious objection. Examples can easily be found of usages from peoples, wholly unconnected ethnologically, illustrating each other in a most welcome fashion, the common humanity of the minds of both being more important than any specific difference. The most fruitful activity of an anthropologist is rather psychological than historical or geographical, although these aspects should not be neglected; and to misunderstand the motive of an action may result in failure to place it even in its right historical context.

Royal Cornwall Polytechnic Society

THE hundredth annual report of the Royal Cornwall Polytechnic Society is of unusual interest. It contains among other matter accounts of the hundredth annual meeting held at Falmouth on February 21, 1933, and of the centenary summer meeting held on July 18-21. At the opening session of the latter the president, Viscount Clifden, occupied the chair and a series of addresses of congratulation was presented on behalf of the Royal Society, Royal Institution and other bodies. During the four days there were excursions and visits to works, and five addresses were delivered by well-known men of science. Sir Richard Gregory's address dealt with "Science Applied to Industry"; Sir John Cadman spoke on "Science, One and All", making special

reference to the operations in the oil-fields of Persia and Iraq; Sir Napier Shaw on "Unofficial Meteorology"; Dr. G. C. Simpson on "Modern Methods of Weather Forecasting"; and Prof. S. J. Truscott on "Problems of Mining at Great Depths". These addresses are printed in full in the report, and that by Sir Napier Shaw is accompanied by an interesting series of photographs.

FREQUENT references were made at the meeting to some of the pioneers in Cornish industry, and one of the visits was to the Safety Fuse Works of Messrs. Bickford-Smith and Co. Ltd., Tuckingmill. The invention of the safety fuse was due to William Bickford, who had been struck by the frequency of accidents in mines and the number of men in Cornwall totally or partially blinded through them. Appended to the report is an account of the work of the Falmouth Observatory, which has actively co-operated with the Meteorological Office since 1868. This was referred to in the address of congratulation from the Meteorological Committee signed by Sir Philip Sassoon, Under-Secretary of State for Air. Recently the old observatory tower, where the observations were made from 1868 until 1885, has had a commemoration tablet fixed to it.

Photography of Sound

"SOME Photographic Aspects of Sound Recording" was the subject of the Sir Henry Trueman Wood Memorial Lecture, which was given by Dr. C. E. Kenneth Mees, of the Eastman Kodak Company, at the Royal Society of Arts on May 16. Dr. Mees stated that the introduction of sound recording has influenced every section of the motion picture industry, from the nature of the original material selected for the presentation to the architectural design of the motion picture theatre itself. Two methods of sound recording are in general use, leading in one case to records in which the density of the photographic deposit varies, and, in the other, to records in which the area occupied by the photographic deposit varies. Reproduction depends on three qualities, loudness, frequency of pitch and wave form quality or timbre. The intensity range is limited primarily by the ground noise, which is chiefly due to physical defects in the films, such as scratches and dirt, although even in a perfectly clean film there is a very small amount of ground noise due to the granular structure of the silver deposit. By the use of special apparatus it is now possible to reduce ground noise considerably. The reproduction of high frequencies is dependent upon the resolving power of the photographic film. Special experimental apparatus has been designed to analyse the wave form and quality of the reproduction. "Improvements in the reproduction of sound by photographic means," Dr. Mees concluded, "will depend, in the future as in the past, on intensive scientific research in relation to sound, electricity, and photography."

Historical Physical Apparatus

SIR HENRY LYONS, formerly director of the Science Museum, delivered his presidential address to the

Institute of Physics on May 15, taking as his subject "Physics and Science Museums". Sir Henry referred in particular to the work which the Board of the Institute has done through a special committee in locating pieces of physical apparatus of special historical importance, and ensuring so far as possible that they should be preserved from deterioration or possible loss. This committee was appointed in 1925, and since then it has brought to light many objects which were little known to physicists generally and of which the historical importance was not always appreciated at its full value. It was not until the middle of the eighteenth century that the first institution was established for the preservation of scientific instruments and technical apparatus; this was the museum of the Conservatoire des Arts et Métiers in Paris, which was founded in 1794 to include all kinds of machinery, models, tools, instruments, etc. Little can now remain of the instruments and apparatus in use in earlier times, not only because in those times there was no institution where they could be deposited, but also because for the most part their historical importance was seldom realised. Then probably more than now, an instrument once acquired was treasured for there were few of them, but it passed in time to a later generation which neither appreciated it nor understood its importance. The same influence operates to-day and there is much difficulty in securing for posterity the more important examples of apparatus which has played a part in the advance of science. The address will be published in due course and copies will be obtainable from the Institute of Physics, 1, Lowther Gardens, Exhibition Road, London, S.W.7 (1s. 1d. including postage).

A New Nature Reserve in New Zealand

THE property of Brooklands, New Plymouth, New Zealand, was handed over by the trustees of the late Mr. Newton King to the Borough of New Plymouth as a public reserve and officially opened by His Excellency the Governor-General, Lord Bledisloe, on March 10. It adjoins the beautiful Pukekara Park, and forms a natural extension of it. Together they comprise an area of more than 100 acres, forming a park second to none in the Dominion either in size or natural beauty. In addition to the actual property of Brooklands, the Trustees presented five acres of native bush nearby, and, to give access to it and make the whole one large reserve, Mr. T. C. List and Mr. C. A. Wilkinson gave an area of seven and a half acres. In his speech, Lord Bledisloe, after paying tribute to the late Mr. King, pointed out some of the many natural advantages which the Dominion possesses, and said that it is unique in the number, variety and grandeur of its many beauty spots within a relatively small area and in its incomparable native bush; he prophesied that eventually New Zealand will find its tourist traffic the main source of its wealth. While admiring the fine specimens of introduced trees, Lord Bledisloe gave a word of warning against the mixing of exotic trees with the native vegetation. All those who have the preservation of the native vegetation of the Empire at heart

will feel grateful for the interest which Lord Bledisloe has in their efforts, and for the help he is giving them.

Safety in X-ray work

IN a paper to the Institution of Electrical Engineers read on February 22, by Mr. L. G. H. Sarsfield, safety measures for workers with X-ray plant were discussed. He discussed the risks of fatal injury and the advantages and disadvantages of using signal lights. The concluding portion of the paper dealt with the use of high voltage flexible cable and described some new types of cable which are coming into use. Stress was laid on the need for definite instructions so as to avoid electrical dangers. He suggested that the Institution should co-operate with the British Institute of Radiology in framing rules. In the discussion, Dr. V. E. Pullin said that at Woolwich they had to legislate for uninstructed use, and so had to make the equipment absolutely safe. Dr. G. W. C. Kaye, speaking as secretary of the International Protection Committee which will meet at Zurich next July, pointed out that international recommendations were framed as the result of the British Protection Committee's work, and these recommendations play a very important part in the design of equipment all over the world. The League of Nations has issued a very comprehensive publication on the subject. The British recommendations are now being revised and he hopes that the use of rubber floor mats and insulating shoes will have more consideration. Dr. B. J. Leggett said that too much talk of the need of protection made patients nervous. In some cases, too much protection will prevent results being obtained. In reply, Mr. Sarsfield said that there is a real need for earthing the conductor at intervals along its length.

Rothamsted Experimental Station

THE appeal for funds to purchase the Rothamsted fields has now secured in cash or good promises the £10,000 necessary to claim the munificent donations of £15,000 by Mr. Robert McDougall and £5,000 by the Sir Halley Stewart Trust (see NATURE, 133, 442, March 24, 1934). The success of the purchase scheme is therefore assured, and the appeal is being kept open only a few days longer in order to enable the Committee to obtain the further amount needed to meet the agreed addition to the purchase price consequent on the ascertainment of the tithe charges, timber evaluation and other items. Several organisations still have to make their final decisions, but it is confidently expected that the whole amount including these additional payments will be secured within the next few days, so that the Rothamsted Committee can enter into possession free of all financial obligation and free therefore to devote the whole of its resources to the important agricultural investigations in hand.

Annual Meeting of the British Medical Association

THE one hundred and second annual meeting of the British Medical Association will be held in Bournemouth during the week commencing July 23

under the presidency of Dr. S. Watson Smith, and an interesting account by Mr. Bernard Calkin of some of the geological and archaeological features in the neighbourhood of Bournemouth is given in the *British Medical Journal* of May 5, p. 814. Palaeolithic implements, bronze and early iron age relics, and Roman remains have been found in several localities. Eight of the seventeen known Hampshire earthenware 'beakers' of the 'Beaker Folk' (circa 1700 B.C.) were found at Bournemouth. Early Iron Age sites in Bournemouth generally yield little beyond pottery fragments, whereas in similar sites around Swanage, animal bones and bone implements are frequent, being preserved in the limestone district there, but perishing in the sand and gravel of Bournemouth.

Announcements

PROF. W. J. DAKIN, Challis professor of zoology in the University of Sydney, has been elected president of the Linnean Society of New South Wales.

LIEUT.-COL. S. P. JAMES, of the Ministry of Health, has been awarded the Darling Memorial Medal and Prize of the Health Committee of the League of Nations for his work on malaria therapy.

THE Abbé Henri Breuil has accepted the presidency of the Prehistoric Society of East Anglia for 1934 and will give an address at the meeting of the Society at the rooms of the Society of Antiquaries, Burlington House, London, on May 23 at 2.30 on "Engraved and Sculptural Stone Monuments in the British Isles of the Transition Period between the Stone and Bronze Ages; an Essay of Chronology and Interpretation". Non-members of the Society wishing to be present should apply to the honorary secretary, Mr. G. Maynard, The Museum, Ipswich.

THE following awards have been made by the Royal Aeronautical Society: Simms Gold Medal to Sir Gilbert Walker, for his paper on cloud formation; Taylor Gold Medal to Mr. A. Plesman (managing director of K.L.M.), for his paper on the Amsterdam-Batavia service; Wakefield Gold Medal to Señor J. de la Cierva, for his work on the development of the autogiro; Busk Memorial Prize to Mr. A. V. Stephens, for his paper on recent research in spinning; Pilcher Memorial Prize to Mr. W. H. Lewis, for his paper on duralumin in aircraft construction.

THE Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1933-34, or accepted for publication: Institution premium to W. Kidd and J. L. Carr; Ayrton premium to B. A. G. Churcher, A. J. King, and H. Davies; Fahie premium to T. S. Skillman; John Hopkinson premium to Dr. W. G. Thompson; Kelvin premium to B. L. Goodlet; Paris premium to Dr. J. L. Miller, and J. E. L. Robinson; Webber premium to G. Shearing; Overseas premium to S. P. Chakravarti; extra premiums to Dr. M. A. B. Brazier, Capt. B. S. Cohen, C. W. Marshall, P. D. Morgan, W. G. Radley and Dr. S. Whitehead, H. Rissik. *Wireless Section*

Premiums: Duddell premium to T. Walmsley; Extra premiums to L. H. Bedford and O. S. Puckle; E. B. Moullin, and H. D. M. Ellis; A. H. Reeves. *Meter and Instrument Section Premiums*: Silvanus Thompson premium to Dr. A. H. M. Arnold; extra premiums to J. B. Lees, Dr. E. Mallett, G. F. Shotton. *Willans Premium*, for a paper dealing with the utilisation or transformation of energy: Mr. D. B. Hoseason for his paper on:—"The Cooling of Electrical Machines".

PROF. G. ELLIOT SMITH writes: "Acting on the advice of my physicians, I have been persuaded that it is essential on grounds of health to resign the position of president of the recently established International Institute of Psychical Research. I deeply regret the necessity for this action at the present moment, when the Institute is about to embark upon certain interesting experiments the results of which should afford ample justification for its existence."

THE Royal Society of Edinburgh commemorated the completion of its hundred and fiftieth year at a meeting of the Society held on May 7, 1934, with Sir E. A. Sharpey-Schafer, president, in the chair. Prof. D'Arcy W. Thompson delivered an address entitled "Fifty Years Ago". In the evening the Lord Provost, Magistrates and Council of the City of Edinburgh gave a civic reception to the fellows in the Galleries of the Royal Scottish Academy, which, as the "Royal Institution", was for more than eighty years the home of the Society.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A University demonstrator in physical chemistry at the University of Cambridge—Mr. H. Thirkill, Clare College (May 24). A lecturer in biology at the Diocesan Training College, Fishponds, Bristol—The Principal (May 26). A chief assistant engineer to the Rivers Mersey and Irwell Catchment Board—The Clerk to the Board, County Offices, Preston (May 26). A psychologist at the North West District Child Guidance Clinic—The Secretary, 18, Belsize Crescent, London, N.W.3 (May 30). Junior technical assistants (mechanical engineers and chemists) in the Supply Board Technical Establishment, under the Director of Ordnance Factories—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (May 30). A lecturer in geology at the Wigan and District Mining and Technical College—The Principal (May 31). A head of the Civil and Mechanical Engineering Department, and a lecturer in electrical engineering at the Northampton Polytechnic Institute, St. John Street, London, E.C.1—The Principal (May 31). A principal of the Municipal Technical College, Bolton—The Director of Education, Education Offices, Nelson Square, Bolton (May 31). A lecturer in geography and a lecturer in mathematics at Lincoln Training College—The Principal. An assistant lecturer in zoology, and a lecturer in economics, at the University College of North Wales, Bangor—The Registrar (June 2).

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.]

Radioactivity Induced by Neutron Bombardment

EXPERIMENTS have been carried out to ascertain whether neutron bombardment can produce an induced radioactivity, giving rise to unstable products which disintegrate with emission of β -particles. Preliminary results have been communicated in a letter to *La Ricerca Scientifica*, 5, 282; 1934.

The source of neutrons is a sealed glass tube containing radium emanation and beryllium powder. The amount of radium emanation available varied in the different experiments from 30 to 630 millicuries. We are much indebted to Prof. G. C. Trabacchi, Laboratorio Fisico della Sanità Pubblica, for putting at our disposal such strong sources.

The elements, or in some cases compounds containing them, were used in the form of small cylinders. After irradiation with the source for a period which varied from a few minutes to several hours, they were put around a Geiger counter with walls of thin aluminium foil (about 0.2 mm. thickness) and the number of impulses per minute was registered.

So far, we have obtained an effect with the following elements:

Phosphorus—Strong effect. Half-period about 3 hours. The disintegration electrons could be photographed in the Wilson chamber. Chemical separation of the active product showed that the unstable element formed under the bombardment is probably silicon.

Iron—Period about 2 hours. As the result of chemical separation of the active product, this is probably manganese.

Silicon—Very strong effect. Period about 3 minutes. Electrons photographed in the Wilson chamber.

Aluminium—Strong effect. Period about 12 minutes. Electrons photographed in the Wilson chamber.

Chlorine—Gives an effect with a period much longer than that of any element investigated at present.

Vanadium—Period about 5 minutes.

Copper—Effect rather small. Period about 6 minutes.

Arsenic—Period about two days.

Silver—Strong effect. Period about 2 minutes.

Tellurium. Period about 1 hour.

Iodine—Intense effect. Period about 30 minutes.

Chromium—Intense effect. Period about 6 minutes.

Electrons photographed in the Wilson chamber.

Barium—Small effect. Period about 2 minutes.

Fluorine—Period about 10 seconds.

The following elements have also given indication of an effect: sodium, magnesium, titanium, zirconium, zinc, strontium, antimony, selenium and bromine. Some elements give indication of having two or more periods, which may be partly due to several isotopic constituents and partly to successive radioactive transformations. The experiments are being continued in order to verify these results and to extend the research to other elements.

The nuclear reaction which causes these phenomena may be different in different cases. The chemical separation effected in the cases of iron and phosphorus seems to indicate that, at least in these two cases, the neutron is absorbed and a proton emitted. The unstable product, by the emission of a β -particle, returns to the original element.

The chemical separations have been carried out by Dr. O. D'Agostino, Dr. E. Amaldi and Dr. E. Segrè have collaborated in the physical research.

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April 10.

Induced Radioactivity

CURIE and Joliot¹ and Ellis and Henderson² have observed that positrons were emitted when aluminium, magnesium and boron were bombarded with high energy α -particles. They noted, further, that the positrons could be detected after the α -particle bombardment had ceased. It was therefore assumed that these electrons were produced by the radioactivity of the unstable nuclei resulting from the capture of the α -particle and the expulsion of the neutron. Danysz and Zwy³ obtained similar results when they bombarded nitrogen with α -particles.

In order to account for the results obtained by bombarding certain ammonium salts in which hydrogen was in part replaced by deuterium with dipions, Oliphant, Harteck and Rutherford⁴ assumed that a helium nucleus of mass 4 and charge 2 was formed by the union of two dipions, which differed from the ordinary α -particle in having a large excess energy and being in consequence unstable. It is the purpose of this note to point out that in a similar manner the radioactivity of the light elements is due to the formation, within their nuclei, of an unstable proton of excess energy which disintegrates by emitting a positron. It is suggested that the similarity of the disintegration phenomena observed is due to the radioactivity of this 'radioproton'.

It has been shown⁵ that the emission of protons from neon, magnesium, silicon, sulphur and argon can be explained by assuming that pairs of electrons are formed by the interaction of α -particles and nuclei as suggested by a formula due to F. Perrin⁶. By assuming that the positron of the pair unites with a neutron to form a proton, it was found possible to retain the hypothesis of stability of nuclei of mass $4n$, the feeble proton emission of the elements mentioned being due to the less abundant isotopes. The mechanism was extended to the other proton-emitting elements and the conclusion arrived at in a previous paper⁷ was confirmed, namely, that there are no 'free protons' in nuclei, these particles being combined with neutrons either as α -particles or dipions. This hypothesis will account for the induced radioactivity as follows.

Consider, for example, the case of aluminium. It is supposed that the proton emission is caused by the positron of the electron pair uniting with the free neutron, the negative electron combining with the positron of the dipion to produce a quantum of γ -radiation and leaving the stable nucleus ${}_{13}\text{Si}^{30}$. When the energy of the α -particle increases beyond a critical value, it is supposed that the neutron is emitted before the high energy positron unites with it. The radioproton is formed, however, as the positron unites with one of the two neutrons produced

when the negative electron combines with the positron of the dipton. This proton with excess energy disintegrates by emitting a positron. From the reaction suggested it is expected that the positrons emitted will have definite energy and not a continuous range of energies as with the β -rays of the normal radioactive elements. The varying periods of disintegration are thought to be due to the varying nuclear fields in which the radioproton is formed.

Further, it is to be anticipated that similarly induced radioactivity will be observed with all elements which give rise to protons under α -particle bombardment. A full account of this hypothesis will be published shortly.

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¹ Curie and Joliot, *C. R.*, **198**, 254; 1934.

² Ellis and Henderson, *NATURE*, **133**, 530, April 7, 1934.

³ Wertenstein, *NATURE*, **133**, 564, April 14, 1934.

⁴ Oliphant, Harteck and Rutherford, *NATURE*, **133**, 413, March 17,

1934.

⁵ Walke, *Phil. Mag.*, in print.

⁶ Perrin, *C. R.*, **197**, 1302; 1934.

⁷ Walke, *Phil. Mag.*, **17**, 729; 1934.

Accurate Electron Diffraction Measurements

IN order to compare the diffraction pattern of a substance of unknown characteristics with that of a known material, Shishancow and Tartarinowa¹ suggest using two convex specimens mounted face to face, the two patterns being recorded simultaneously.

This method is obviously inapplicable to transmission diffraction, and in the case of diffraction at grazing incidence the defects compared with the double shutter method² will be apparent. Thus, (1) owing to the specimen shadows, the two sets of rings do not meet at a common pattern boundary, (2) the rings are not described about a common centre, (3) structural changes of a single specimen cannot be recorded under comparative conditions, and (4) since only two relatively small segments of the 'beam cylinder' are diffracted, rings corresponding to large Bragg plane spacings are obscured. (1), (2) and (4) militate directly against the attainment of accuracy, (3) precludes the application of the method to a wide range of interesting phenomena³, and (4) is conducive to error in assigning the correct crystal structure.

The hollow cylindrical type of beam employed by Shishancow and Tartarinowa and previously described by de Laszlo and Cosslett⁴, is a phenomenon well-known in high-speed cathode ray oscillography, and is often observed with a badly pitted cathode. The effect can be still further exaggerated by the use of a discharge tube of a design unsuitable for the production of the homogeneous 'solid' pencil of cathode rays employed by us in our experiments.

Other workers⁵ in this field besides ourselves have used curved surfaces, wires, fibres, etc. Where possible, however, the flat, or approximately flat surface is generally preferred, partly on account of the ease with which it can be prepared and systematically explored with the beam, and also because the ratio of diffracted to undiffracted electrons is higher.

We have previously shown that the occurrence of any voltage change during the recording of a double shutter pattern is automatically rendered self-evident in the resulting photograph². The double

shutter method permits of the attainment of a high order of accuracy, comparable with that of X-rays, and can be employed in both transmission and grazing incidence diffraction; its successful practice, however, like that of precision spectrography, calls for suitable equipment and instrumental technique.

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May 7.

¹ *NATURE*, **133**, 686, May 5, 1934.

² Finch and Quarrell, *NATURE*, **131**, 842, June 10, 1933. *Proc. Phys. Soc.*, **46**, 148; 1934.

³ Finch, Quarrell and Roebuck, *NATURE*, **133**, 28, Jan. 6, 1934.

⁴ *NATURE*, **130**, 59, July 9, 1932.

⁵ For example, Yamaguti, *Proc. Phys. Math. Soc. Japan*, **14**, 57; 1932. **12**, 203; 1930. Trendelenberg, *Die Naturwissenschaften*, **21**, 173; 1933; and Eisenhut and Kaup, *Z. Electrochemie*, **37**, 469; 1931.

Full Period Effect in Miller's Ether Drift Experiment

IN his memoir¹ on the ether drift experiment, Dayton C. Miller mentions that harmonic analysis of the curves of the displacements of the fringes, obtained by a complete rotation of the interferometer, puts in evidence in all cases the existence of a full period effect which accompanies the Michelson half-period effect, utilised in the elaboration of the results of the experiment. The amplitude of the full period effect is of the same order of magnitude as the Michelson effect; it is, however, proportional to the number of visible fringes in the field of view and—in the most favourable conditions for the experiment, with six visible fringes—perceptibly less than the amplitude of the half-period effect.

According to Miller, the full period effect is identified with that foreseen and calculated by Dr. Hicks in a memoir of 1902², as a consequence of the small angular displacement μ of a few seconds of arc from its theoretical position, that must be given to one of the mirrors, to obtain the interference fringes.

That this explanation of the full period effect cannot hold, results at once if we consider that the Lorentz contraction ought to eliminate entirely any effect of the ether drift on the phenomenon of interference, although it should influence only the half-period effects. It is then clear that the ether drift, supposing it should appear, is only able to produce half-period effects, that is displacements of the interference fringes that are reproduced identically every half turn of the interferometer. This occurs, of course, whatever may be the effective adjustment given to the various parts of the instrument including the telescope.

A direct demonstration may be derived from the results obtained by me³ in 1925, in treating by a new method and in a complete manner the theory of the Michelson experiment, following up the work of Righi⁴, quoted by Miller in his memoir, which was interrupted by the death of the author. My theory leads to the following formula for the displacement of the fringes, when we take into consideration only the terms variable with the orientation of the interferometer given by the angle α ,

$$\Sigma = \frac{D\xi^2}{\lambda} \cos 2\alpha + \mu \frac{D^1\xi^2}{\lambda} \cos 2\alpha - \mu \frac{(D-D^1)\xi^2}{\lambda} \sin 2\alpha, \quad (1)$$

where ξ is the velocity ratio, λ the wave-length, D the effective length of the arm of the interferometer, D^1 the distance of the plane on which the observed inter-

ference fringes are localised. Generally $D^1 = D$, that is, the telescope is focused on the surface of the end mirror; in such cases the formula becomes:

$$\Sigma = \frac{D\xi^2}{\lambda} \cos 2\alpha + \mu \frac{D\xi^2}{\lambda} \cos 2\alpha. \quad (2)$$

The first term here represents the Michelson effect; the others show that a supplementary effect of amplitude proportional to the angle μ , or to the number of fringes visible in the field of view, may also be expected. But such an effect is (a) of half-period like the Michelson effect, (b) of amplitude μ ($\sim 2 \times 10^{-5}$) times less, so that any possibility of an experimental verification is out of the question.

The full period effect shown by interferometrical experiments cannot be in any way justified by the classical ether drift theory. It is therefore the more important to know more thoroughly the characteristics of this effect, which may be deduced from the rich observational material collected by Miller. It may be either systematic perturbations introduced in the elaboration of the results of observation, or a phenomenon depending on another cause varying with the rotation of the interferometer, perhaps the same that causes the difference between the results obtained by Miller and others who have experimented on the Michelson effect⁵, and the unexplained anomalies that it represents¹.

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March 30.

¹ D. C. Miller, *Rev. Mod. Phys.*, **5**, 203; 1933.

² W. M. Hicks, *Phil. Mag.*, (6), **3**, 9; 1902.

³ G. Valle, *Nuovo Cimento* (N.S.), **2**, 39, 201; 1925.

⁴ A. Righi, *C. R.*, **168**, 837; 1919. **170**, 497, 1550; 1920.

⁵ 171, 22; 1920.

⁶ G. Joos, *Phys. Rev.*, **45**, 114; 1934. D. C. Miller, *ibid.*

Photography of the Infra-Red Solar Spectrum to Wave-length 12,900 A.

WITH the aid of the new Agfa infra-red sensitive plates (maximum of sensitivity 10,600 A.) I have succeeded in photographing the solar spectrum to 12,900 A. in the first order of a 3 m. grating (dispersion 5 A./mm., time of exposure 10 hours). The blackening of the exposure obtained does not alter appreciably from 12,400 to 12,900 A. (end of the plate used), so that it seems easily possible to extend the limit quite considerably.

The plates so far obtained show the water vapour absorption band at 11,300 A. well resolved into its fine structure lines and extending about 1000 A. to both sides. It exhibits the same sort of complexity as the shorter wave-length bands photographed and analysed by Mecke and his co-workers¹, but is much more intense.

In addition, there is a very interesting atmospheric oxygen band between 12,500 A. and 12,750 A., also, of course, with very well-resolved fine structure. This band has already been observed with ordinary infra-red apparatus and low dispersion by Ellis and Kneser² in the infra-red absorption spectrum of liquid oxygen together with other bands, and they have identified it with a weak maximum in Abbot's bolometer curves of the solar spectrum. That this band is really due to the oxygen molecule and represents the 'forbidden' transition from the ground-level $^3\Sigma_g^-$ to the low $^1\Delta$ -level first predicted by Mulliken³ is rigorously proved by a preliminary fine

structure analysis. The observed structure shows that the selection rule $\Delta J = 0, \pm 1$ still holds for $^1\Delta - ^3\Sigma$; but besides $\Delta K = 0, \pm 1$ (P, Q and R branches), transitions with $\Delta K = \pm 2$ occur with about equal intensity (S -form and O -form branches). The band on the whole is very much weaker than the ordinary atmospheric oxygen A -band at 7600 A., in agreement with the expectation that a $^1\Delta - ^3\Sigma$ transition is more strongly forbidden than $^1\Sigma - ^3\Sigma$. Preliminary constants for the $^1\Delta$ -level are $\nu_0 = 7881.6 \text{ cm.}^{-1}$, $B_0 = 1.415 \text{ cm.}^{-1}$, $r_0 = 1.220 \text{ A.}$ A value for the vibrational frequency cannot be given because the 1-0 band observed by Ellis and Kneser at 10,600 A. in liquid oxygen does not occur in the solar spectrum.

A full account of this work will appear elsewhere.

In conclusion it is a pleasure to acknowledge the kindness with which the firm of Agfa placed their remarkable new plates at our disposal.

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April 10.

¹ R. Mecke and W. Baumann, "Das ultrarote Sonnenspektrum von 7500-10,000 A.," Leipzig, 1933.

² J. W. Ellis and H. O. Kneser, *Z. Phys.*, **86**, 583; 1933.

³ R. S. Mulliken, *Phys. Rev.*, **32**, 880; 1928.

Velocity of Light

M. E. J. GHEURY DE BRAY has directed attention to an apparent decrease in the velocity of light¹. I have recently tried to explain this on the basis of the theory of the expanding universe. If the speed of light is a true constant, independent of any variation in our unit of length, then a doubling of the radius of the universe should cause the measured velocity of light to diminish by half. If the radius of the universe doubles every K years, then the velocity of light will be proportional to $(\frac{1}{2})^t$ where K is the unit of time. Thus, the logarithm of the measured velocity of light must be a linear function of the time. I determined the two constants of such a function from de Bray's data and found that it represented the observations in a satisfactory manner. I then solved this equation for the length of time it would take the velocity to diminish by half. The time is of the order of 60,000 years, which is considerably shorter than the value derived from a study of the recession of the external galaxies². Consequently, this observed variation cannot be explained by the expanding universe theory unless we assume that the rate of expansion is much more rapid in the vicinity of the earth than it is at the distance of the spirals.

It is also possible that the variation is not a continuous decrease, but is a periodic function of the time. A rough graphical analysis shows that the observations are well represented by

$$V = 299,885 + 115 \sin 2\pi/40 (t - 1901).$$

The largest deviation is 21 km./sec. and the others are all under 10 km./sec. It is possible that these residuals could be improved by further adjustment of the constants.

Unfortunately, the only evidence for a periodic variation is the observations in 1879.5, 1882.7 and 1882.8. These observations were made over short base lines, and are presumably not as accurate as those made over longer base lines. If we reject them, as we may feel justified in doing, then the

variation is a continuous decrease with the time. If we keep them, the variation is periodic. Either hypothesis beautifully represents the observations which are used. The unfortunate lack of observations in the periods 1883-1902 and 1902-1924 makes it impossible at present to decide between the two hypotheses. However, by 1941 the velocity will be 299,885 km./sec. if the variation is periodic or 299,735 km./sec. if the variation is a linear decrease with the time. It is to be hoped that those who have been performing velocity experiments will continue their work until this matter is settled.

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April 14.

¹NATURE, 120, 602, Oct. 22, 1927. 133, 464, Mar. 24, 1934. *Ast. Nach.*, No. 5520; 1927. *Ciel et Terre*, various papers, 1927-1931.

²"The Expanding Universe", page 14.

Static Charge on a Galvo-Millivoltmeter

A SOMEWHAT curious state of affairs has recently been brought to light in this Laboratory in connexion with a Unipivot galvo-millivoltmeter. The needle of this instrument, which is used in the determination of *pH* values by the electrometer valve - glass electrode method, was found to behave erratically in respect of reproducing its maximum position. On closer examination it was found that, particularly in the case of certain individual operators, rubbing the glass cover of the instrument with the finger, or even strong finger pressure, produced deflection of the needle sometimes sufficiently violent to lift it from its suspension. Return of the needle, though not exactly to its former position, could usually be effected by tapping the glass.

Neither distortion of the case, nor capacity effects, were present, and breathing on the glass cover was sufficient to restore a normal zero or maximum.

Although the case, in common with other vital parts in the electrical system, is normally earthed, it seems clear that a static charge on the glass is responsible for the phenomenon, and the necessity for bearing this possibility in mind, when cleaning or removing dust becomes necessary with such an instrument, is obvious.

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Purification of Plant Viruses

THE following is a practical method of preparing a purified suspension of any of the 'x' group of plant viruses, from the extracted juice of the diseased plant.

Starting with volume *V* of extracted juice:—

(a) *V* is cooled to 0° C. and diluted to 15 *V* with water at 0° C. Carbon dioxide gas is passed through the mixture at 0° C. for 30 minutes. This mixture is then centrifuged rapidly for as short a time as will give a clear straw-coloured supernatant, for example, 15 minutes at 3,000 r.p.m. The precipitate, which contains about one third of the original solids, is discarded.

(b) The supernatant is diluted to 200 *V* with water at 35° C. Carbon dioxide gas is passed through the mixture at 35° C. for 15 minutes. This mixture is then centrifuged for a considerable time, for

example, 1 hour at 2,000 r.p.m. The supernatant is discarded.

(c) The precipitate is suspended in *V* c.c. distilled water at room temperature and centrifuged for a short time, for example, 15 minutes at 3,000 r.p.m. The precipitate is discarded. The supernatant is faintly opalescent but colourless. It contains most of the virus and practically no protein.

In (a) the flask is immersed in a freezing mixture. The best results are obtained when only a small amount of ice is formed in the solution, and the temperature during the spinning does not go above 15° C.

In (b) cautious use of a micro burner will keep the temperature within half a degree of the optimum.

The long spinning of the large volume in (b) is the greatest fault of this method. The length of the spinning required to bring down a precipitate can be shortened to less than half an hour if higher speeds are used; also by adding a trace of aluminium sulphate, or leaving the mixture in the cold overnight.

The method is a modification of one used by Warburg and Christian (1932)¹ to purify a water-soluble ferment. (The application of the method to virus studies was suggested by Prof. D. Keilin, to whom grateful acknowledgment is due.) The temperatures and dilutions given here have been determined after careful variation of all the constants. With virus 'x' from infected tobacco plants, a final suspension can be produced, which will infect 3 out of 5 *Nicotiana glutinosa* plants at a dilution of 1/50,000 as compared with 4 out of 5 with crude sap at the same dilution.

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¹*Biochem. Z.*, 254, 440; 1932.

Inheritance of Habits

Do thought-habits produce a physical change in the organism? I once asked a friend of mine who is a great experimentalist. He replied: "I don't know." Does any habit produce a physical change? He again replied: "I don't know." Could he suggest any experiment to ascertain this point? Once again he replied in the negative. I could see the discipline of science had produced a habit in him which the stimulus of my suggestion was not strong enough to overcome.

Were it not the case, then why do people find it difficult to change from one habit to another? It is not only difficult but it is often accompanied by a feeling of positive pain. A transformation from one thing to another implies loss or gain of energy; and this energy must be summoned and given a direction before a change could be produced from one habit to another. Consider, for example, the difficulty many people are now experiencing in assuming the habit of a 24-hour clock.

Can habits be inherited? For anything to be inherited, the reproductive cells must be affected in a particular way. Experiments have been performed to settle this question. Mice have been trained to thread a maze of a particular configuration, and the offspring of such trained mice have been able to thread the same maze with the least difficulty and

in the shortest time. This seems to indicate that acquired habits can be inherited. Recently experiments have been undertaken in Prof. E. W. MacBride's laboratory to see if the parthenogenetic stick insect of Ceylon could inherit the habit of eating plant *B* (which it can eat but does not usually do) instead of *A* which is its usual food-plant. An account of this was published in *NATURE* of April 21 (p. 598). The result seems to show that such a preference can be transmitted to the offspring.

The difference between the maze-threading experiment and that of compelling the acquisition of a new food-plant is that in the former case no foreign matter is introduced into the body of the organism, while in the latter case a different kind of food is introduced. In the former the habit is not accompanied by an obvious physical change in the organism, while in the latter it is nothing but the acceptance on the part of the organism of a physical fact.

Whatever may be the conclusions drawn from these experiments, to determine whether a habit is inherited or not, information on the following points is first necessary: (1) Does habit produce a physical change, (2) if so, how can it be measured, (3) in what way is this change registered in the reproductive cells?

It seems to me that the experiments so far undertaken have the same hit-and-miss character as those of the animal breeders before Mendel's time. For example, it could not be predicted that a particular egg taken out of the lot produced by those insects that easily accepted the second food-plant would result in an insect which showed a definite predilection for this alternative host-plant.

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Mimicry in Insects

PROF. T. D. A. COCKERELL points out¹ that parallelism and convergence are so frequent that they indicate deeply-seated tendencies "which find expression without any reference to immediate utility", and that "if mimicry is promoted by natural selection these resemblances are the raw material on which it works".

May I remark that the last words quoted are misleading in their suggestion that convergence may play a large part in the causation of *all* the cases of resemblance of one animal to another which are, unfortunately, classed together in the common usage of the term 'mimicry'.

It is indeed possible that convergence (or arrested divergence) has played a part in the production of synaposematic resemblance such as Prof. Cockerell mentions in the case of wasps, although even in such cases there is no relation between the degree of resemblance and the degree of consanguinity. The similarity between species of the well-known Burnet moths in England might, with justice, be claimed as a good example. But this explanation, so simple and plausible, is of much too limited applicability to deal with the phenomena of 'mimicry'. It cannot explain such examples of true, Batesian mimicry as the pseudoposematic resemblance of a caterpillar to a snake which deceived Bates himself. Nor can it possibly apply to the analogous and equally deceptive procryptic resemblance of a caterpillar to a stick, or a moth to a bird-dropping.

I find it difficult to understand how parallel development can have played any part in the production of a similar appearance in insects of different degrees of relationship by entirely different means: a phenomenon in mimicry too often left out of account in discussions. Upholders of the Darwinian explanation of mimicry are still awaiting an alternative which will embrace the above mentioned and many other phenomena which fall into line.

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¹ *NATURE*, 133, 329, March 3, 1934.

Pseudopodial Movements of Foraminifera

WORK of recent years has done much to elucidate the protoplasmic changes accompanying amoeboid movement. The endoplasmic streaming which is the most striking feature in the pseudopodium of an amoeba is not, however, present in most other rhizopods in which locomotion by creeping is less well developed, and it seems that the time is ripe for a careful re-examination of the different types of pseudopodia.

In the Foraminifera, the pseudopodia are long, fine protoplasmic threads containing granules, the size of which varies with the species and which are in rapid longitudinal movement. Commonly, both centrifugally and centripetally moving granules are present simultaneously in the same thread, often passing one another even though the thread may be less than a micron in diameter. Sometimes also a pseudopodium may be increasing in length at a time when the predominant movement of the granules is centripetal, indicating a movement of the clear ground-protoplasm independent of that of the granules. The granules are usually (perhaps always) near the surface of the pseudopodium, and it is commonly supposed that the clear axial part of the protoplasm is of a more solid nature, thus conferring stability on the fluid thread, which otherwise would be expected to break up into drops owing to the fact that its length is often some hundred or more times its diameter.

Though it is at present impossible to give a clear account of the exact location of these various moving streams, or of the nature of the motive force producing them, or of the conditions of stability of the fluid pseudopodia, the following preliminary observations have some bearing on these questions.

(1) In all the species examined by me the pseudopodia are enclosed by a relatively tough moving 'skin' which can be demonstrated by various methods. Crawling ciliates may pluck the pseudopodium, pulling and stretching it considerably without adhering to it. Small flagellates may even come to rest against a pseudopodium, be carried along passively for a considerable distance and then swim away without any sign of sticking. In transporting food, on the other hand, the pseudopodia show themselves to be very sticky. This may be due, as Verworm¹ believed, to active secretion of a sticky substance, but seems to be more probably due simply to penetration of the 'skin' by the captured object, causing it to come into contact with the viscous internal fluid.

(2) The mean velocity of the granules in different pseudopodia of an individual at any instant is fairly

uniform and quite independent of the diameters of the pseudopodia. Hence their movement cannot be compared to the flow of a viscous liquid in a tube.

(3) The flow is not influenced in any way by contact with a solid substratum, a fact which is quite inconsistent with any simple interpretation based on surface tension differences. Normal streaming of granules takes place even in pseudopodia having no free tip (that is, running from one part of the periphery of an animal to another part), and so can have nothing to do with conditions at the tip or with any kind of physiological gradient between the tip and the base. There is likewise no evidence of any reversible sol-gel process or of any contracting tube of plasma-gel.

(4) Injurious stimuli (chemical or thermal) cause the pseudopodia to break into liquid droplets, or, less commonly, into short rods. These two reactions might appear to represent the effects of increased and decreased fluidity respectively, but this explanation does not fit in with the known effects of the stimuli in question on other kinds of protoplasm. In fact, sometimes a single stimulus produces both of the reactions simultaneously in different parts of a single individual. If the stability of the threads depends upon the presence of a relatively solid axial structure, it seems strange that reagents which normally increase the viscosity of protoplasm should cause the threads to break into drops. Cyanide causes a cessation of movement without any immediate disintegration, so stability of the threads does not depend upon movement as suggested by Lepeschkin².

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¹ Quoted by Jensen, *Arch. ges. Physiol.*, **87**; 1901.

² *Biologia generalis*, **1**, 1925.

A Rapid Test for Pregnancy on *Xenopus laevis*

IN a recent communication Bellerby (1933)¹ has shown that injection of acid or alkaline extracts of bovine anterior lobe of the pituitary gland into female South African clawed toads (*Xenopus laevis*) produces extrusion of ova through the cloaca within 18 hours.

The well-known Zondek-Ascheim test, or its modification by Friedman, using the rabbit, is based on the occurrence in the urine of pregnancy of an anterior pituitary-like gonado-kinetic hormone.

These considerations led us to investigate the possibilities of *Xenopus laevis* as a test animal for pregnancy. The urine is detoxicated, precipitated and concentrated according to the method of Zondek (1930)². The aqueous extract is injected into each of six female South African clawed toads. Twelve to eighteen hours later at room temperature, that is, about 18° C., a positive reaction is indicated by either (a) extrusion of macroscopic ova through the cloaca, or (b) post-mortem examination of the animal (in the absence of ovulation), when one ovum or more is seen in either or both of the oviducts. If (a) occurs in any one animal, post-mortem examination of the remaining animals is unnecessary. A negative test is repeated on a further six animals.

At higher temperatures, for example, about 27° C., the reaction is speeded up considerably and ovulation has already occurred so soon as 5-6 hours after injection.

In a series of 97 cases investigated by this method to date, 52 correct positive and 45 correct negative findings have been recorded.

Xenopus is a suitable test animal as it does not ovulate spontaneously under laboratory conditions. As a matter of fact, in about 250 toads fresh from the ponds examined during the breeding season, no ova were detected in the oviducts (Zwarenstein and Shapiro, 1933)³. However, during the breeding season (July to September in South Africa) as an additional precaution it is necessary that the test animals from the ponds should be isolated under laboratory conditions for at least one week and controls killed and examined.

We have observed that if the toads have been maintained under laboratory conditions for longer than three to four weeks, they appear to undergo a desensitisation to the urinary prolactin, when incorrect negatives may be obtained. The laboratory age of the test animals should therefore not exceed three to four weeks.

The advantages of the test are as follows:—

1. The test animal is cheap, easily available and inexpensive to maintain.

2. It is not necessary in the majority of cases to kill the test animal, as it is with rats, mice and rabbits.

3. The extremely short time taken for the test—16-18 hours at room temperature (18°-20° C.). A technique for further shortening the post-injection latent interval is being investigated.

4. The simplicity of the end-reaction—extrusion of easily visible ova through the cloaca or their presence in the ducts. In Amphibia, extrusion of the ova is a sufficiently obvious and unequivocal phenomenon.

5. Small volumes of aqueous extract may be injected into the test animal, in a single dose, repeated and divided doses being unnecessary.

Although extrusion of ova does not occur in *Rana* after injection of anterior pituitary extract⁴, a reaction is obtained in the oviducts and this indicates the possibility of using *Rana* also as a test animal.

In collaboration with Dr. A. I. Goldberg the test is being applied in the investigation of cases of endocrine anomalies.

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April 12.

¹ Bellerby, C. W., *Biochem. J.*, **27**, 615; 1933.

² Zondek, B., *Klin. Wochenschr.*, **9**, 964; 1930.

³ Zwarenstein, H., and Shapiro, H. A., *J. Exp. Biol.*, **10**, 372; 1933.

⁴ Bellerby, C. W., private communication (1933).

A New Guinea Fish Poison

UNDER this heading Prof. A. K. Macbeth refers in NATURE of April 28, p. 649, to a probable Derris species, the native name of which he gives as *Tua* or *Tuwa*. Without any philological gymnastics, this name is evidently a variant on the Malay name *Tuba*, applied to various Derris species. In Polynesia I believe that the word is also softened to *Duwa* or *Tuwa*.

Further information on the use of *Tuba* will be found in the late J. D. Gimlette's "Malay Poisons and Charm Cures" (third ed., 1929, p. 240 *et seq.*).

H. E. DURHAM.

Dunelm,
Hereford.

Research Items

Egyptian Head-rests. Among recent acquisitions noted in the *British Museum Quarterly*, vol. 8, pt. 3, is a small collection of Egyptian objects of exceptional interest which are described by Mr. S. R. K. Glanville. Among these are two head-rests, of which one of limestone is reported to have come from Dair Mawas, on the other side of the river from Al-Amarnah. It is remarkable both for its form and its decoration. It is adapted from the type with octagonal fluted column found commonly in the Eighteenth Dynasty and more rarely in the Fourteenth. The space between the horns of the rest proper and the base has been only partially cut away, so as to leave a panel of stone on either side of the shaft. This minimised the risk of breaking off the tips of the rest. These panels have been decorated in low relief with four figures, one on each side of the shaft. On what is probably the front of the head-rest two figures of Bes face inward to the support. The figure on the right brandishes a serpent in his left hand and carries a spear in the other. Two more snakes are held beneath his teeth. He wears the lotus flower, often shown on the head of Bes and Taurt in the Eighteenth Dynasty. A hieroglyphic inscription down the centre reads: "Good Sleeping in the West, the Land of Righteousness, by the Royal Scribe Qenherkhepeshef, justified". On the back of the rest a griffin on the left, with lotus flower head-dress, faces a lioness eating a snake. Both rest their feet on conical supports and are armed with knives. Two more inscriptions run down the edges of the panels, of which one survives in a mutilated state. The four figures are reminiscent of those on carved ivory wands of the Seventh to Eighteenth Dynasties, the use of which is still debated. If the head-rest is to be dated to the Eighteenth to Nineteenth Dynasty, this is the earliest representation of Bes with a spear, giving him a warlike character. The magical character of the figures and the inscriptions indicate that the head-rest was part of the tomb furniture and not for ordinary use.

Anthropometric Technique. A critical examination of the methods of anthropometric measurement on the living has been made by Dr. C. B. Davenport, Dr. Morris Steggerda and Dr. William Drager (*Proc. Amer. Acad. Arts and Sci.*, 69, 6). Errors in anthropometry are both extrinsic and intrinsic. Among extrinsic errors, while the apparatus used may be regarded as standardised, the determination of particular landmarks is a frequent cause of error. A matter insufficiently investigated as yet is the error due to differences in posture of the subject and the fluctuations due to his or her psychological or physiological state. It is known that there are considerable differences according to the time of day at which the measurements are made. Within limits, anthropometry is a form of psychometry. Variation due to differences in pressure on the skin in taking measurements has not been sufficiently considered. With the view of testing the effect of these sources of error, forty-nine measurements were made repeatedly under certain controls. It was found *inter alia* that stature and sitting height were significantly greater in the morning than in the evening. A woman's indoor clothing does not appreciably affect the significance of the measurement, though it may obscure the

location of the point measured. The diameters of the head are easily measured with a probable variation in repeated measurements of less than 1 mm. Certain dimensions have a high variability with a probable error of single measurements of 5 mm. or more. These are waist girth, chest girth, projective arm measurements from the floor and trochanter breadth. It was found that the subject measured was significantly larger on her left side than her right. As an intrinsic error it was found that in the personal equation, the percentage inaccuracy varies greatly, being low in large dimensions. The inaccuracy is partly inherent, but practice leads to increased precision.

A New Trout from California. Mr. John Otterburn Snyder has recently described a new species of cut-throat trout, *Salmo selenis* (*Proc. Californian Acad. Sci.*, Fourth Series, 20, No. 11; 1933). This has been found in certain headwaters of Silver King Creek, a tributary of East Carson River, which is part of the Lahontan drainage area. The habitat is restricted by an impassable fall to the creeks of Fish Valley in the high Sierra of California. The author states that it is an isolated variant of *S. henshawi*, differing markedly in the absence of spots from the body, the retention of parr marks to maturity and the relatively smaller and more numerous scales. "The differentiation of this form from the more generally distributed parent species is directly parallel with that of the golden trouts west of the Sierra, as they differ from the rainbow in a reduction of the spots, the retention of parr marks, and a notable increase of the number of scales." There is little variation from the type in this trout.

Regulation of Blood Salinity in Aquatic Animals. Vol. II, Nos. 1-6 of the Sydney University Reprints (Series 13, Zoology, 1933), contains several papers, conspicuous among them being Prof. Dakin's and Miss E. Edmonds' work on the regulation of the salt contents of the blood of aquatic animals, and the problem of the permeability of the bounding membranes of aquatic invertebrates, reprinted from the *Australian Journal of Experimental Biology and Medical Science*, 8, 1931. The authors have found new subjects for investigation in the mangrove swamps, setting up a temporary summer laboratory actually on the edge of the swamp in order to keep the animals in as healthy a condition as possible. *Helacius cordiformis* lives in the mangrove swamp not far from the sea, in water of high salinity but subject to occasional freshenings of considerable extent after rain. It is able to regulate the blood salinity in the sea-water which is diluted with fresh water, the blood being more saline than the surrounding medium, the difference between the blood and the external medium becoming greater as the latter approaches fresh water. It seems, however, to show a greater independence than other marine invertebrates so far investigated in that the blood tends to retain its normal constitution when the external sea-water is made more concentrated. It is shown that the changes in the blood salts which accompany changes in the outer medium are likely to be due to movements of salts or their ions inwards or outwards. *Onchidium chameleon* increases in weight

in diluted, and decreases in concentrated, sea-water. Changes in the salinity of the external media are accompanied by changes in the body fluids, but the body wall acts more like a semi-permeable membrane and water movements through it are more facile than the passage of salts, which, however, also takes place.

X-Chromosome of *Drosophila*. Through the work of Muller, Painter and others it is now recognised that about half of the X-chromosome in *Drosophila melanogaster* is 'empty' of genes, and that this inert region is homologous with the Y-chromosome. Mr. S. Gershenson (*J. Genetics*, 28, No. 2) has recently used for further study a strain with an X-chromosome obtained through crossing-over between two differently inverted X-chromosomes, which therefore carries a duplication and a deficiency. The condition is lethal in XX females, but XXY females are viable. It was also found that the deficiency included the gene for bobbed bristles, but no other known genes. In males carrying this X-chromosome, there was failure of synapsis between the X and Y in more than 60 per cent of the spermatogonia. In oögonia having this chromosome, one X was shown cytologically to be much shorter than the other. It is pointed out that such deficiency in the X would weaken the synaptic affinity between the X and Y and as a result the XO type of sex-determination could be derived from the XY type. This work confirms the general views regarding the inertness of the Y-chromosome and its similarity to the inert portion of the X. It also shows that genetical deficiency means the real absence of the corresponding portion of the chromosome.

Classification of Sesame. A recent study of the sesame (*Sesamum indicum*, L.) by Hildebrant (*Bull. App. Bot., Gen. and Plant Breeding*, 4, 4; 1932, Institute of Plant Industry, Leningrad), is based on 500 samples of seed collected by various expeditions; more than a third of these came from Central Asia and Asia Minor. As a preliminary to classification, the author deals with the variation in the characters of the plant in relation to geographical distribution. The species is divided into two sub-species according to the number of carpels in the capsule. A morphological basis is used for division into varieties. The mass of sesame in all countries is composed mainly of two varieties, the other varieties occurring mostly in mixtures with these varieties. The author considers Africa to be the primary centre of origin of the species, with India and Japan as secondary centres. Palestine appears to be the centre of high oil-yielding strains, the percentage of oil diminishing as one goes farther away from that country.

Nutrition of the Angiosperm Embryo. A very interesting general account of this subject is presented by René Souèges in the *Revue générale des Sciences*, 45, No. 5, of March 15. He shows how practically every tissue, either of the ovule or of the mature embryo sac, may be modified in ways that suggest a definite contribution to the nutrition either of the embryo sac itself or of the maturing embryo. Sometimes these adaptations take the form of remarkable haustorial constructions which are carried deeply into the chalazal end of the ovule or, in some cases, into the placenta by way of the micropyle. Although there may be little doubt that these structural features, upon which emphasis is laid, contribute to the

nutrition of the developing embryo, it must be admitted that the paths along which such transference of material takes place and the mechanism of translocation remain as yet entirely obscure.

Varieties of *Lilium candidum*. The *Gardeners' Chronicle* of April 7 contains a short article by the Abbé Souillet on "*Lilium candidum* and its Varieties". This particular lily originated in Asia Minor, and in the wild state is extremely fertile, though small-flowered. The varieties *Charles X*, *peregrinum*, *Salonica*, *spicatum*, *foliis variegatis* and *purpureo striatum* are described in detail, and particular attention is given to stability of form and fertility. It is interesting to note that the Abbé Souillet is attempting to breed a red *Lilium candidum* by crossing the female-sterile variety *purpureo striatum* with the variety *Charles X* as the seed parent. Many of the varieties are subject to severe attacks by the fungus *Botrytis elliptica*.

Magmatic Problems. In his presidential address to the Geological Society of Washington, Dr. C. N. Fenner describes some striking cases of assimilation which seem to be incompatible with the requirements of the well-known theory of crystallisation differentiation advocated by Bowen and others (*J. Wash. Acad. Sci.*, 24, 113-124; 1934). According to this theory, rhyolitic magma is produced by separation of crystals from a more basic parental magma, and it is therefore the coolest liquid of the series. It follows that if rhyolitic magma should engulf fragments of basalt, it should normally be no more able to melt them or take them into solution than a cooling salt solution that had deposited crystals could redissolve those crystals on continued cooling. Dr. Fenner gives ample evidence, however, that both in the Katmai region and in Yellowstone Park, rhyolite magma has been able to dissolve large amounts of basic andesites and basalts. In one of the Yellowstone occurrences, assimilation produced homogeneous-looking andesitic rocks. Analyses of two of these hybrids showed that they were respectively 30 per cent basalt plus 70 per cent rhyolite, and 69 per cent basalt plus 31 per cent rhyolite. Evidently there were heat reserves in the acid magma not recognised in the theory of crystallisation differentiation. In the Katmai region not even the reaction principle can be invoked, for here no precipitation of new minerals occurred. The contaminated magma became wholly liquid. The problem of heat supply is a difficult one, but it may be suggested that if the rhyolites were products of refusion in depth, the difficulty would be largely met.

Forecasting Rainfall in China. A paper entitled "China Rainfall and World Weather" by Chang-Wang Tu (*Mem. Roy. Met. Soc.*, 4, No. 38) deals with the problem of forecasting the seasonal rainfall of China from statistical relationships—established as the result of a special inquiry—between the quantity to be predicted and the values of certain meteorological elements in various parts of the world previous to the rainy season. The method followed is that devised by Sir Gilbert Walker and others, who demonstrated the existence of large-scale fluctuations known as the North Atlantic, the North Pacific and the Southern oscillations. In this paper, China has been divided into four climatic regions: (1) the North China coast, (2) the Yangtze delta, (3) the Yangtze valley and (4) the South-east China coast. This division was found to be very necessary,

the maps showing the correlation between the rainfall of the four divisions and contemporary deviations of pressure from normal in different parts of the world being very different. The final achievement was the working out of equations for the seasonal rainfall using connexions with three or four distant centres, giving the equivalent of single total correlation coefficients having the following values: North China coast (rainfall), June–September, 0.78; Yangtze delta, June–August, 0.62; Yangtze valley, May–August, 0.68; and South-east China coast, May–August, 0.68. The enormous loss of life and damage to property caused by floods in North China is well known, and some assistance towards prediction of these disasters will obviously result from any success in foreshadowing the seasonal rainfall. For purposes of prediction a correlation coefficient of 0.78 is by no means negligible; results of practical value may therefore be hoped for in time.

The Production of Positive Electrons. Chadwick, Blackett and Occhialini have described a number of experiments on the production of positrons by various radiations (*Proc. Roy. Soc., A*, March). The positrons were examined in the usual way with a Wilson chamber in a magnetic field. Positrons were produced in fair number when the hard γ -rays of thorium C'' passed through lead, and the upper limit of their energy spectrum was consistent with the Dirac view that the energy of the γ -ray was used in the creation of a negative and positive electron of approximately equal mass (requiring together about one million volts) and that the remaining energy is distributed between these particles. By comparing the curvature of the positron tracks with the recoil tracks produced by Compton absorption of the γ -rays, it was possible to get a fairly accurate upper limit to the positron energies, and accepting the Dirac view, the mass of the positron is found to be very close to that of the electron. The probability of positron production in lead by the 2.6 million volt γ -rays from thorium C'' may be as high as 0.2–0.3 of the probability of the liberation of an electron by the normal processes of scattering and absorption, and it is interesting to note that this is just sufficient to account for the anomalous absorption discussed by Gray and Tarrant and others (see *NATURE*, 133, 618, April 21, 1934). Further experiments showed that a large number of positrons come from a bare thorium active deposit source, as has previously been found by Thibaud, and it is probable that they have their origin in the radioactive atoms themselves. Experiments with the mixed radiation obtained by bombarding beryllium, boron or fluorine with α -particles seemed to indicate that the neutrons as well as the γ -rays may produce positrons in their passage through lead, though this may be an indirect effect in which a γ -ray is first produced by the neutron.

International Atomic Weights. The report of the Committee on Atomic Weights of the International Union of Chemistry is now available (*J. Chem. Soc.*, April, and *J. Amer. Chem. Soc.*, April). In the case of carbon, a higher value, 12.011, has been reported, but the Committee awaits further confirmation. A long discussion of potassium is given, and the value 39.096 is adopted. The value for arsenic has been changed from 74.93 to 74.91, and that of selenium from 79.2 to 78.96. Tellurium is changed from 127.5 to 127.61. The new value for caesium, 132.91, agrees

exactly with Aston's corrected value. Erbium and ytterbium are changed to 165.20 and 173.04, respectively, osmium to 191.5; thallium is given the value 204.40, agreeing with Aston's 204.39, and some recent values for isotopes of lead are reported. Although both Baxter and Alter and Hönigschmid, Sachtleben and Baudrexler obtained a value 207.21 for common lead, the value given in the table is 207.22.

Dielectric Constants of Polar Solutions. Observations on the dielectric constants of solutions of α -aminobutyric acid and glycine in water show that the dielectric constant is a linear function of concentration (mol/litre) to the highest concentrations studied (Wyman, *J. Amer. Chem. Soc.*, March 1934). For the same solute in different solvents (water, ethyl alcohol solutions, urea solutions, α -aminobutyric acid in glycine solutions and vice versa), the increment δ in dielectric constant per mol of ampholyte added to the solution is practically constant, whilst the dielectric constant of the solvent varies considerably. In polar solvents, therefore, the dielectric constant is a nearly additive property. The results are interpreted by the assumption that the polarisation per c.c. is linear in concentration, which implies that the effective field F shall be the same as the intensity E , the contribution of polarisation, F_2 , being equal and opposite to the polarisation, F_3 , due to dielectric inside a small sphere surrounding a molecule. F_3 is usually neglected in dielectric theory. Thus $(\epsilon - 1)/3 = p$ (polarisation per c.c.) is obtained in place of the classical equation $(\epsilon - 1)/(\epsilon + 2)\rho = p'$ (polarisation per gram; ρ = density). This leads to much larger values for the polarisation when ϵ is large, and these are supposed to represent better the assumed polarisations of zwitter ions of ampholytes.

Automatic Arc Welding. The use of the electric arc for welding metal plates is rapidly increasing and doubtless affects the employment of riveters. Many attempts have been made to develop an automatic arc welder, which will still further affect the market for skilled manual labour. The automatic welder feeds the electrode over its required path by a special mechanism. The automatic control of the electrode-fee keeps the arc constant so that even an unskilled labourer can work it. Continuous operation is possible as the electrode wire is coiled on a reel. This avoids the dangers of porous welds, which are apt to occur with hand welding owing to the necessary interruptions for changing the electrodes. With the machine, the current enters the electrode close to the arc and thus larger currents can be used. In the *Asea Journal* of January (Allmänna Svenska Elektriska A.B.), a full description is given of the new Asea-Ipsoweld automatic welder. The drawbacks to earlier designs of automatic welder seem to have been overcome. In particular this machine can weld longitudinally, transversely and round circles and other forms of curve. It is suitable for either indoor or outdoor use. A rough estimate is given that an automatic machine can replace two or three hand welders. Placing the yearly cost of one hand welder at £200, the saving per year would be at least this sum. It is concluded that an automatic welding plant working full time pays for itself in two years. Carbon electrodes only burn at the rate of eight inches per hour and the amount of filling wire used per hour is about 4½ lb.

Some Exhibits at the Royal Society Conversazione

THE first of this year's conversazioni at the Royal Society, held on May 9, produced as usual a number of interesting exhibits and demonstrations. Several have been the subject of recent communications in our correspondence columns, and descriptions of some of the remainder taken from the programme are printed below.

Mr. George H. Gabb showed a telescope of 1646 by Maria de Rheita, which is the earliest known dated optical instrument in the world. Maria de Rheita (1597-1660), a Capuchin Bohemian monk whose name was Antonius V. Schyrle before his monastic conversion, was the first to invent a terrestrial telescope with an image-erecting eyepiece of three lenses. He described its construction in a folio work, "Oculus Enoch atque Elia", published in 1645, a copy of which is in the library of the Royal Society. No example of his telescopes was hitherto known to have survived.

Mr. Henry Balfour showed an interesting collection of stone implements from Tasmania, from the fashioning of which the culture of the Tasmanians is regarded as corresponding to that of Cromagnon man in Europe.

Mr. R. W. Paul exhibited a simple apparatus for prolonged artificial respiration, which was designed at the suggestion of Sir William Bragg. It has already been used in one case of progressive muscular atrophy unceasingly for a period of eight months, and has prolonged the life of the patient, who, without aid, would die in less than two minutes. It comprises three main units: (1) an inflatable air bag, or belt, encircling the chest; (2) a pulsator which rhythmically inflates the air bag; and (3) a controller governing the speed of the pulsator. The pulsator on its upward stroke inflates the air bag, causes a pressure to be applied to the chest and squeezes air out of the lungs. On the downward stroke of the pulsator, air is released from the bag, the chest resumes its normal position and air is inhaled. The volume of air inhaled can be varied by altering the pressure in the air bag. The apparatus is silent and automatic in operation, simple to adjust and easily transportable.

Dr. W. R. Jones showed microscope preparations illustrating his view that minerals other than uncombined silica can cause silicosis. Sections of many silicotic lungs show innumerable acicular fibres of sericite, a silicate of aluminium and potassium, which greatly outnumber the quartz particles. In the Kolar Goldfield, India, silicosis is rare, and sericite is also rare in the Kolar quartz; on the other hand, the gold-bearing rock worked on the Rand contains sericite, and many cases of silicosis occur.

The Entomological Department, Rothamsted Experimental Station (Dr. C. B. Williams and Mr. D. Morland) showed a light trap, which catches and kills the insects attracted to it at night and sorts them into eight groups according to the time of night at which they enter. The captures are correlated with various weather conditions including temperature, wind, humidity, the cloudiness of the sky and the duration of moonlight. A photoelectric method of measuring the cell space ratio in woods was demonstrated by the Forest Products Research Laboratory. The quantity of light transmitted by a suitably stained micro-section of the wood is measured as a percentage of the total quantity of

light falling on the section. By adjusting the magnification of the projected image of the section, measurements may be made either on an integral number of annual rings, giving an average value of the cell space ratio, or on a small area confined to the spring or summerwood separately. Dr. F. G. Gregory and Mr. H. L. Pearse showed a self-recording apparatus for measuring changes in aperture of stomata. A glass cup attached to the lower side of a leaf by a gelatine washer is connected in series to a constant pressure aspirator through a variable capillary resistance, and air is thus drawn through the stomata. The pressure between the leaf and the resistance is recorded by a manometer, the varying level in which interrupts a beam of heat focused on a linear thermopile.

Some silica-glass from the Libyan Desert was shown by Dr. L. J. Spencer (Department of Mineralogy, British Museum (Natural History)). This material was recently discovered by Mr. P. A. Clayton during the work of the Egyptian Desert Surveys in the unexplored region bordering on Italian Cyrenaica, about 500 miles south-west of Cairo. The material is a nearly pure silica-glass containing SiO_2 97.58 per cent, pale greenish-yellow in colour and makes an effective gemstone. It is quite distinct from the fulgurites formed by lightning. It resembles most closely the still problematical tektites; the presence of a trace of nickel suggests a relation to the silica-glass found around meteorite craters.

Sir Gilbert Walker and Mr. A. Graham demonstrated the formation of artificial clouds. If a layer of liquid or air at rest is heated below or cooled above, the vertical instability will produce motion in polygonal cells; but if the fluid moves with considerable shear, there will be longitudinal cells parallel to the direction of the shear. In air, a slow shear produced by sliding along the glass top of the containing trough produces transverse cells and an intermediate velocity a rectangular pattern. These can be identified with cloud forms. Prof. E. J. Baldes demonstrated micro-methods of measuring vapour pressure. It can be shown theoretically that the vapour pressure thermopile consisting of 50 couples of constantan silver, with wires of high thermal conductivity, is inefficient and that similar measurements can be made with a single thermocouple. The technique of measuring vapour pressures of small drops of liquid (1 mgm. or less) suspended from the junctions of a thermocouple was demonstrated. Mr. R. C. Brown showed some methods of studying capillary waves. Ripples produced on a liquid surface by a point- or line-source maintained by a valve oscillator are made to appear stationary by intermittent illumination of the same frequency. The frequency is determined by connecting an Osgilim lamp across the oscillator output and allowing this to illuminate a stroboscopic disc controlled by a 50-cycle tuning fork. Thus measurements of wavelength and amplitude can be made over a range of frequency, the validity of Kelvin's equation tested, and surface tensions measured. It is also shown that a liquid surface over which ripples are passing may be used as a plane reflecting diffraction grating for visible light.

Prof. E. G. Coker and Prof. A. V. Hill combined

to show some experiments on thermo-elasticity. The adiabatic thermal changes during extension and compression of materials have long been known, but measurement has been difficult. By employing a radiation thermopile and a galvanometer of high sensitivity and short period, the thermal effect of loading a specimen can be read on a scale, or recorded photographically, in a few seconds. The stresses in rigid materials can be measured with an accuracy comparable with any other known form of measurement, and strange to say, the order of the measurements depends on the coefficient of expansion of the material employed and not on Young's modulus and Poisson's ratio as in some other methods. Steel, brass, vulcanite and other bodies possessing a coefficient of expansion or contraction confirm this. In cases of plane complex stress, the measurements give the sum of the principal stresses. The adiabatic compression of various liquids, including water, has also been measured in this way, at pressures up to 1,500 lb. per sq. in., and the simple thermo-electrical arrangements used are such that the range of pressures can be extended almost indefinitely.

The Metropolitan-Vickers Electrical Company, Ltd., exhibited a portable noise-measuring apparatus, working on the aural balance principle. It consists essentially of a valve oscillator, a calibrated attenuator and a telephone earpiece. The oscillator generates current at 800 cycles which is fed to the telephone through adjustable attenuators. The apparatus is calibrated so as to indicate directly the intensity of the 800 cycle tone in the telephone in decibels above threshold of 0.0003 dynes/sq. cm., measured in the ear or 0.00021 dynes/sq. cm., measured in free space. The observer places the telephone on one ear and presents the other to the complex noise to be measured. He then adjusts the attenuators until he judges the loudness of the 800 cycle note heard in the telephone to be equal to that of the complex noise. The equivalent value of the complex noise is then read in decibels above threshold from the settings of the attenuators.

A fractional seconds chronograph was shown by Mr. E. A. Nehan (Mathematical Department, Imperial College of Science). This instrument is designed to record visibly on paper tape, 0.01 sec. at 1/10th inch scale, up to four events simultaneously. A tuning fork controls a synchronous motor, which through a 3-speed gear gives motion to a printing train and paper feed at the selected speed. Four

inking pens record any event, translated as a simple make and break circuit, which mark on the tape is squared down to the time scale printed on the tape. The machine is portable, self-contained and worked from a 12-volt accumulator. Mr. J. Harvey, of the same Department, showed an integrator. By rolling a horizontal spur wheel on a rack in one direction and moving the rack perpendicularly, the axis of the wheel can be made to trace a curve whose Fourier coefficients are required. The wheel makes n turns over a range of rack representing $0 - 2\pi$. On a horizontal arm fixed to the axle of this wheel, is a wheel which rolls on the paper and registers the coefficients a_n and b_n . Six harmonics can be found. The mechanism is adapted to find area, and first and second moments of area about an axis, on the principle of Amsler's moment integrator.

The National Physical Laboratory (Mr. R. A. Watson Watt, Mr. J. F. Herd and Mr. L. H. Bainbridge-Bell) showed a cathode ray tube which has been made to serve as a magnetic compass. The cathode ray beam is deflected by the earth's magnetic field and may therefore be used as a compass needle free from inertia. In the present instrument light signals controlled by collector electrodes in the tube indicate any change in the magnetic bearing of the platform carrying the tube. Changes of a small fraction of a degree can be indicated. Among the exhibits by the Director of Scientific Research, Admiralty, was an apparatus which enables the deaf to hear by bone conduction. Amplified currents from a microphone are supplied to a coil wound direct on to a straight nickel iron wire which has a high magnetostriction coefficient. The wire vibrates with the frequency of the current and the vibrations may be transmitted to the cochlea through the bones of the head or jaw either by clenching the wire in the teeth or by pressing it on the mastoid bone behind the ear. The same Department also showed an automatic radio direction finder. This instrument is of the Bellini-Tosi type comprising two crossed frame coils and a goniometer, the search coil of which is rotated by an electric motor. The goniometer is connected to a radio receiver followed by a special rectifier and relay system which reverses the direction of the electric motor whenever the high frequency current in the search coil increases; thus, since the direction of rotation of the search coil is reversed whenever the minimum is passed, the search coil hunts a position at minimum.

Interpretation of Evidence for the Recession of Nebulae

AT Oxford on Tuesday, May 8, Dr. Edwin Hubble, of the Mount Wilson Observatory, delivered the Halley Lecture on "Red-Shifts in the Spectra of Nebulae". As is indicated by the title, the lecture was concerned with a non-speculative account of those investigations, largely due to Dr. Hubble himself, which have led to the far-reaching speculations of de Sitter, Eddington, Milne, and others on the expansion of the universe. After a masterly account of the use of Cepheid variables in determining the distances of the nearer extra-galactic nebulae, of the statistical methods involving the intrinsic luminosity of the average nebula for the distances of the remoter objects, and of the radial velocities or red-shifts measured by Slipher and Humason, Dr. Hubble developed in full the velocity-distance relation

which bears his name. For the 150 nebulae of which spectra have now been obtained, and which lie within a sphere of 150 million light years radius, he was able to show that the red-shifts, expressed as velocities, increase linearly by roughly one hundred miles per second for each million light years of distance; further, he was able to show that the difference between the linear relation for isolated nebulae and for clusters of nebulae is wholly the effect of selection, and thus to harmonise the results from all observed nebulae.

The lecture concluded with an attempt to interpret the observed red-shift on the basis of the available observational material alone. If the red-shift is produced by some unspecified cause, Doppler effect being thus expressly excluded, then the brightness

of the nebula will be reduced by the factor $(1-d\lambda/\lambda)$ because each quantum carries less energy, and also roughly by the same factor again because the weaker ultra-violet part of the spectrum is displaced into the photographic region (the correction from bolometric to photographic magnitude). If, on the other hand, the red-shift is due to an actual velocity of recession, then not only does each of the two previous effects reduce the brightness in the ratio $(1-d\lambda/\lambda)$, but also there is a reduction by a similar factor because the nebula is receding and fewer quanta reach the photographic plate per second. From counts of nebulae made to five different apparent magnitudes, the numbers of nebulae in each of the five corresponding spheres of increasing radius can be found, the radius of each sphere being given by the intrinsic luminosity of the average nebula and its apparent luminosity, corrected either by $(1-d\lambda/\lambda)$ for pure red-shift, or by $(1-d\lambda/\lambda)^3$ for red-shift interpreted as velocity of recession.

These counts indicate that, if the red-shift is due to velocity, then the number of nebulae per unit volume must increase rapidly with increasing distance—a somewhat startling result; on the other hand, if the red-shift is not produced by a Doppler effect, then the counts indicate that the nebulae are uniformly distributed over the sphere of 350 million light years radius which is within the range of the 100-inch reflector at Mount Wilson. While this particular result was not stressed by Dr. Hubble, he concluded by pointing out how the completion of the 200-inch reflector will enable such counts and velocity determinations to be extended over a far larger volume of space, and will thus permit a definite interpretation of the red-shift, either as due to velocity of recession, or as due to some other yet unknown physical cause.

Decrease of the Barn Owl in England and Wales

PRECISE knowledge of the standing of particular birds in Britain should result from the increasing number of national censuses which have been initiated in recent years. Where the statistical information is thorough, it will form an invaluable basis of comparison with similar data gathered in future years; even where statistics have been dropped and reliance is placed upon the opinions of many observers scattered over a wide area, the consensus of opinion may still be a reliable guide to the fluctuations of the population.

Both kinds of information have been utilised in a census of the barn owl in England and Wales, made between May and December 1932, the results of which have been summarised by G. B. Blaker in an attractive pamphlet published by the Royal Society for the Protection of Birds. By making reasonable estimations in areas where direct information was not forthcoming, the author assesses the total breeding population of barn owls (*Tyto alba*) in England and Wales at 12,000 pairs. Non-breeding birds averaged one to every 50 square miles, so that the total adult population of barn owls in the summer of 1932 was about 25,000 individuals.

The absolute number is not so important as knowledge as to what relation it bears to that of former years, and here the statistics of one season, which contain no time element, cannot help. But

putting one scrap of evidence regarding former conditions with another, Mr. Blaker has no difficulty in coming to the conclusion that the fears of those who suspected a serious decline in the numbers of the barn owl are justified. "From all districts in central and southern England the reports brought the same tale—fewer occupied nests than a few years ago. . . . In parts of Essex and Suffolk the decline was less marked, while in Devon and Cornwall the barn owl seems to be holding its own. Northumberland, Cumberland and Westmorland are the only counties to record an increase."

The decline in numbers over the greater part of the country appears to be no new thing: it has been noted for the last thirty or forty years. The disturbing point is that it has been speeding up during the last six years or so, until it has reached a point when, so far as the records can be interpreted, about four per cent of the population (or 1,000 birds) disappears annually; this, of course, over and above the annual wastage which would keep the population at a steady number.

Several factors contribute to the falling numbers of the barn owl. Nesting sites are fewer, partly because church authorities object to the occupation of towers and belfries by the ghostly 'cherubim', and fence the old nesting holes with wire entanglements; partly because modern barns with corrugated iron roofs do not offer openings like the 'owls' windows' of the old type. Food is probably more scarce since 'rat weeks' were instituted and the farmer has generally intensified his campaign against vermin. This has had a further effect in that the methods of destroying rats by poison has, the evidence indicates, resulted in the poisoning of owls which have devoured living but poisoned rats. Finally, there is the deliberate destruction of barn owls by people who should, but seemingly still do not, know better.

The author suggests, without definitely formulating the charge, that inefficiency of the Wild Birds Protection Acts is involved in the decline of the barn-owl, but he states quite clearly the crux of this matter, namely, that it is in the administration of the law that the weakness, if any, lies. Were the critics of the present Birds Protection Acts to report the offences and insist with witnesses upon the prosecution of the offenders (and they seem to be well supplied with instances of law-breaking), they would be making a contribution of value to the working of the law, and making no more of a contribution than the laws in question expect and make provision for them and other well-disposed citizens to make. But indeed, with regard to the barn owl, it is legitimate to ask whether the probability is that its present status would have been better or worse had there been no bird protection laws, and further why, if the law is a source of evil, the brown owl should have increased in numbers so enormously in the years when the barn owl has been declining? J. R.

University and Educational Intelligence

BIRMINGHAM.—Mr. Stuart McDonald has been appointed lecturer in pathology in succession to Dr. F. W. M. Lamb, who has been appointed professor of forensic medicine at Cairo.

CAMBRIDGE.—Dr. W. W. Watts has been appointed to represent the University at the centenary of the Edinburgh Geological Society on September 3-4.

At St. John's College, A. V. Stephens has been elected to a fellowship. Mr. Stephens gained a first class in the Mechanical Sciences Tripos in 1930 with distinction in aeronautics and the award of the Seeley Prize. For the last three years he has been engaged in scientific research at the Royal Aircraft Establishment, Farnborough, and has conducted experiments and published papers on the spinning of aeroplanes.

In Congregation on May 11, the degree of Sc.D. was conferred on John Read (Emmanuel College), professor of chemistry in the University of St. Andrews and formerly professor of organic chemistry in the University of Sydney. Prof. Read is the author of publications on organic chemistry and historical chemistry, and is known also for his original investigations on stereochemistry, terpene chemistry, and the chemistry of Australasian natural products.

SHEFFIELD.—Mrs. Edward Mellanby has been appointed honorary lecturer in the Department of Physiology.

THE following Commonwealth Fund Fellowships, among others, tenable by British graduates in American Universities for the two years beginning September 1934, have recently been awarded: R. N. Arnold (Glasgow and Sheffield) to the University of Illinois, in engineering; Stewart Bates (Glasgow and Edinburgh), to Harvard University, in economics; J. H. Brown (Glasgow and Oxford), to the University of California, in philosophy; Philip Chantler (Manchester) to Harvard University, in economics; C. J. M. Fletcher (Oxford) to the University of California, in chemistry; E. N. Fox (Cambridge), to the University of Michigan, in engineering; E. G. Hancox (Liverpool and Imperial College of Science and Technology), to the University of Arizona, in geology; Joseph McGinn (Armstrong College, Newcastle), to Harvard University, in business administration; F. G. W. Smith (Imperial College of Science and Technology), to Princeton University, in zoology; A. D. Thackeray (Cambridge), to the California Institute of Technology, in astrophysics; J. C. Trevor (Oxford), to Northwestern University, in anthropology; A. G. M. Weddell (St. Bartholomew's Hospital Medical College), to the University of Rochester, in medicine; Shaun Wylie (Oxford), to Princeton University, in mathematics.

The following have been appointed to fellowships tenable by candidates from the British Dominions: M. M. Burns (New Zealand and Aberdeen), to Cornell University, in agriculture; James Melville (New Zealand and Imperial College of Science and Technology), to Yale University, in biochemistry.

The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: J. D. W. A. Coles (Witwatersrand and Department of Agriculture, South Africa), to Washington University, in veterinary science; Dr. R. H. Le Pelley (Imperial College of Science and Technology and Department of Agriculture, Kenya Colony), to the University of Illinois, in entomology; H. E. McMillan (Saskatchewan and the Department of Agriculture, Canada), to the University of California, in entomology; E. A. Moore (Bristol and the Irrigation Department, Bengal), to the University of Illinois, in engineering; C. W. O. Turner (Wales and the Public Works Department, New Zealand), to Stanford University, in engineering.

Science News a Century Ago

Poinsot and Poisson

Among the journals of a century ago which recorded scientific events were the *Athenæum*, from which the following note is taken. It was at a sitting of the Paris Academy of Sciences on May 20 that M. Poinsot commenced reading his memoir, a "New Theory of the Rotation of Bodies", in which he presented new views. Having arrived at these by a direct consideration of the nature of rotation, M. Poinsot launched out into praise of the mode of discovery and spoke at the same time in terms rather slightly of the analytic and algebraic modes of examining a question. M. Poisson, an academician of the analytic school, took fire at these reflections and came down the next week with refutations. M. Poinsot rejoined, instancing a mistake made by D'Alembert. During the discussion, divers allusions, so the writer said, were made such as in a certain honourable house would have called for the interference of the 'Speaker'. Upon the whole, the synthetic method seemed to have had the best of the argument, although M. Libri, the Florentine geometer, joined his anger and argument to those of M. Poisson.

London Mechanics Institution

The tenth anniversary of this institution, now known as Birkbeck College, was held in the theatre of the institution in Southampton Buildings, Chancery Lane, London, on May 22, 1834. Dr. Birkbeck presided over an audience which included many distinguished literary and scientific men. After some preliminary remarks by Dr. Birkbeck and the award of the prizes, five resolutions were passed. The third of these was "that the manifestation of talent developed within the walls of this institution shown on the present, as on former occasions, is a proof of the wisdom of the plan here first widely called into practice of disseminating useful science through the industrious classes of the community and gives substantial earnest that through the agency of these self-ruled and self-supported establishments the barbarism of ignorance, with its concomitants, vice and misery, will be more rapidly dispelled and the moral, the intellectual, and the social condition of man be raised to that higher level which becomes his character as a rational and responsible being". By the fifth resolution the meeting offered "its unalloyed congratulations to Dr. Birkbeck on the steady advancement and the present state of this flourishing and useful institution over which he has from its foundation paternally and anxiously presided without deviation, and that the most hearty thanks of this meeting are due, and are hereby presented to that able individual for the powerful assistance given to this institution on this and every occasion".

The Franklin Institute

At the monthly conversation meeting of the Franklin Institute held at Philadelphia on May 22, 1834, Prof. Johnson made experiments on the centrifugal force of liquids, in refutation of certain statements made by M. Thayer, in a paper read to the French Institute, an outline of which had been given in the *Revue Encyclopedie* of September 1833. The liquids used were oil, water, alcohol and mercury,

and the experiments embraced the cases of rotation about the axis of a vessel in which the oil and water were placed, as well as the vibration of the vessel containing alcohol, water and mercury.

At the same meeting, Dr. Jacob Green exhibited an electromagnetic apparatus by Dr. Henry for the production of reciprocating motion, by the combined action of electromagnetic currents and of permanent magnets, and Prof. A. O. Bache showed apparatus for the polarisation of light. This apparatus had recently been imported for the Friends' College at Haverford. The polarising effect of the tourmaline was seen by a simple arrangement of two plates of that mineral cut parallel to the axis, and fitted with wire rings so as to admit of rotation while the planes remain parallel to each other.

The Duke of Sussex's Soirées

"His Royal Highness the Duke of Sussex, as president of the Royal Society, manifests a liberality and courtesy highly honourable to himself, and entitled to imitation by other noble and eminent persons who are advanced to similar stations by the members of their respective societies. Occasionally, during the winter season, his Royal Highness invites some of the leading members of the Royal Society to dine with him at Kensington Palace, and, on the same evening receives a large assembly of visitors from 9 to 12 o'clock. On these occasions, many of the first nobility and gentry of the country thereby meet some of the most eminent men of science, professors of the fine Arts, and literary characters. . . .

"The presidents of the Astronomical Society, Mr Baily—of the Geological, Mr. Greenough, are in the habit of having frequent dinner and evening parties of the members of their respective societies, and thereby contribute very materially to promote science and a friendly intercourse amongst its lovers and patrons. These gentlemen are rarely ever absent from their presidential duties, and thus manifest a laudable zeal and a positive attachment to that science over which they are elected as professional guardians.

"Two of the Duke of Sussex's meetings have taken place since Christmas and two others named on the invitation cards. For the purpose of gratifying the company, and furnishing matter for conversation, various objects of art, science, vertu, literature, etc., are placed on the tables and the choice treasures of the library are accessible through the obliging attentions of Mr. Pettigrew, his Royal Highness's librarian. The unrivalled collection of Bibles is a source of great interest to many persons. Among other objects exhibited have been a series of marbles of different countries and qualities, on which Mr. C. H. Smith has lectured; a model of a machine for polishing lenses; a very curious model of the Great Pyramid of Egypt, made by Mr. Davidson; and a series of drawings illustrating the architectural antiquities of different ages and different countries, being part of Mr. Britton's extensive series for his lectures." (*Gentleman's Magazine*, May 1834).

London Horticultural Society and Garden

"The Anniversary Meeting took place, when a report on the affairs of the Society was read, and officers elected. It appears that there has been a surplus of income over expenditure for the year ending March 31, 1834, of 1574l. 18s. 7d. Out of

this sum the Society have paid off two bonds amounting to 920l., leaving the gross amount of the debt at 17,602l. 11s. 9d.; which, there can be no doubt, they will soon be able to discharge. The Show at the Gardens on May 10 was the best that has yet taken place. The first striking object on entering was the *Wistaria Consequana*, covered with some thousands of bunches of flowers; most of which were expanded to the point of their greatest beauty, and but a few so far have begun to drop their corollas." (*Gardener's Magazine*, May 1834).

Societies and Academies

PARIS

Academy of Sciences, March 19 (*C.R.*, 198, 1089–1192). The president announced the deaths of Camille Matignon, D. H. Scott and W. M. Davis. E. FICHOT: Poincaré waves of the second species. J. COSTANTIN: Exteriorisation of degenerations by the action of altitude. Discussion of the effects of growth at high altitudes on plant diseases. A. GOSSET, JOSEPH MAGROU and A. TCHAKIRIAN: The action of various elements on the bacterial tumours of *Pelargonium*. Of various elements introduced, only salts of germanium showed a selective action on the tumours, and the effect was not permanent. GABRIEL BERTRAND and PIERRE SERBESCA: Does the daily injection of small quantities of aluminium favour cancer? The author's experiments on rabbits lend no support to the view that aluminium is toxic and predisposes to cancer. M. HAIMOVICI: The general spaces which correspond point by point with conservation of the parallelism of Cartan. SERGE ROSSINSKI: A transformation of minimal surfaces. ALFRED ROSENBLATT: A bi-harmonic non-linear equation with two independent variables in a general domain. G. VRANCEANU: A classification of the equations of a Pfaff system. B. DE KERÉKJARTÓ: The regularity of the transformations of a simply transitive continued group. N. LUSIN: A new property of measurable B ensembles. MLE. H. SZMUSZKOWICZOWNA: A theorem on polynomials and its application to the theory of quasi-analytical functions. E. VESSIOT: The refraction and reflection of waves. FLORIN VASILESCO: A manner of considering the study of plane movements with ridges independently of the theory of functions with complex variables. ANTOINE APPERT: Some remarks on the Poisson stability in the Poincaré sense. CRESTIN and CAMPREDON: Study of the deformations and of the distribution of the internal forces in a piece of wood by means of an adherent film. Description of a method applicable to material to which, on account of non-isotropic properties, photoelastic methods are inapplicable. LOUIS BESSON: Total radiation measured by the Bellani lucimeter. L. DUNOYER: The expansion of fused silica. A negative coefficient of expansion of fused silica over a certain range of temperature has been proved. ANDRÉ EGAL: Thermoelectric meter compensated for all fluids. An instrument for measuring the rate of flow of fluids is described and illustrated. RENÉ REULOS: The deduction of the laws of electro-dynamics starting from certain solutions of the equation of electric waves. MLE. M. QUINTIN and A. LEBETTRE: Study of the chain: lead, lead sulphate, copper sulphate, copper. A. PORTEVIN, E. PRETET and H. JOLIVET: Displacement of the

Curie point with concentration in iron-nickel-tungsten (or molybdenum) austenites. PIERRE CHEVENARD: The thermomagnetic study of the heterogeneity of an iron-nickel-carbon-chromium austenite after precipitation of the carbide after annealing. EMILE HENRIOT: The couples exerted by circularly polarised light. GILBERT CAHEN: A method of calculation for thick glass projector mirrors. G. SANNIÉ: A recording photoelectric photomicrometer with neither slit nor amplification. GUY EMSCHWILLER: The chemical action of light on the diiodo-derivatives of hydrocarbons: the diiodoethenes. P. MONDAIN-MONVAL and RENÉ PARIS: The thermometric study of the formation of inorganic complex compounds. Results of a calorimetric study of the formation of mercury potassium iodide, and of the double cyanides of nickel, zinc and cobalt. E. ROUYER: The cryoscopic determination of the total hydration of the ions of strontium chloride. PAUL RENAUD: A new compound of phosphorus, nitrogen, oxygen and hydrogen. The hydrolysis of the compound PN, obtained as a product of the reaction between phosphorus trichloride and ammonia, gives a new compound, H_2NO_2P , the properties of which are recorded. H. MURAOUR and W. SCHUMACHER: The combustion of compressed mercury fulminate in a vacuum. JACQUES DE LAPPARENT: The deposition and geological position of the bauxites of Greece. PIERRE COMTE: The layers intermediate between the Silurian and Devonian in Asturia. LEFÈVRE: The division and elongation of the cells in the genus *Closterium*. RAYMOND-HAMET: The presence of entirely woody supernumerary bundles in the cortical parenchyma of *Echeveria*: HENRI PRAT: Remarks on the epidermal characters of the American species of the genus *Agropyrum*. MARC SIMONET: The regularity of the chromatic reduction and the perfect pollen constitution of a hybrid between species with unequal numbers and aneuploids of chromosomes (*Iris autosyndetica*). M. M. JANOT: The action of the female crystallised hormones on the development of some plants. Equiline, equilenine, folliculine and dihydrofolliculine force the growth of hyacinths and lilies of the valley. AD. DAVY DE VIRVILLE: Observations and experiments on the variations of alkalinity in sea-water pools. JULES AMAR: Diuresis and metabolism. PAUL WINTREBERT: The laws of epigenesis in amphibians. MLE. IRÈNE GOLDBERG and JACQUES MONOD: The rôle of the symbiotic chlorellæ in the nutrition of *Paramecium bursaria*. LÉON BINET and GEORGES WELLER: A new method for the estimation of glutathione. The method is based on the insolubility of a compound of glutathione with cadmium. MLE. BERTHE DELAPORTE: The structure and process of sporulation of *Oscillospira Guillaermondi*. MAURICE DOLADILHE: Some physical properties of blood serum.

CRACOW

Polish Academy of Science and Letters, February 5. M. PETROVITCH: A class of algebraic differential equations of the second order. A. JABLONSKI: The polarisation of the fluorescence of colouring materials as a function of the wave-length of the exciting light. For the dyes studied the amount of polarisation generally decreased with the wave-length of the exciting light, and the effect appears to be due to the fluorescent molecule and not to the medium supporting it. These phenomena cannot be accounted for by any current theories (see also NATURE, 133,

140, Jan. 27, 1934). MLE. M. MORACZEWSKA: The distribution of the intensities in the resonance line Hg 2537 Å. emitted in different directions. W. SWIETOSLAWSKI and MLE. E. BARTOSZEWICZ: Abnormal thermal effects produced by certain minerals and certain chemical substances. Experiments made with the adiabatic calorimeter. W. SWIETOSLAWSKI: Some improvements of the adiabatic calorimeter used for the measurement of minute thermal effects. The alterations remove the possibility of errors arising from bad working of the thermo-electric battery. I. ZLOTOWSKI: Studies of the cathodic polarisation of metallic electrodes by means of the Heyrovsky and Shikata polarigraph. The author deals with the cathodic polarisation of solid metallic electrodes, the phenomena of overvoltage of metals and the theory of the overvoltage of hydrogen. W. JACEK: The velocity of solution of marble in acids (4). K. SMOLENSKI and W. KOZLOWSKI: The influence of sucrose on the pH of alkaline solutions. The authors conclude that the lowering of the pH by sucrose is an effect caused by the acid character of the sugar. The dissociation constant is calculated as $K = 1.5 \times 10^{-13}$. K. SMOLENSKI and A. ZELAZNY: The velocity of crystallisation of sucrose. Cz. KUZNIAR: The Stebnik glaseritic rocks. MLE. H. WYSOCKA: Remarks on the ecology and sociology of the sphagnophilous Desmidiæ of the neighbourhood of Warsaw. J. TUR: The undulating parablact. J. GALLERA: Experiments on the action of sub-blastodermic pressure on the embryos of birds. E. LOTH: Cinematography considered as a new method of research in macroscopic anatomy. W. GAJEWSKI: Monographic study of the association of *Avenetum desertorum*.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 1-92, Jan. 15, 1934). WILLIAM K. GREGORY: Polyisomerism and anisomerism in cranial and dental evolution among vertebrates. Polyisomerism is defined as a state in which many homologous parts, or polyisomers, are arranged along any primary or secondary axis, whether curved or straight; anisomerism is the state in which one or more parts are emphasised at the expense of the rest, while the original number of parts is usually reduced by fusion or elimination. The forces producing these states are extended in time, are repeated and are subject to rhythmic acceleration and retardation. Adaptive radiation results from the summation along divergent lines of the results of secular polyisomerism and its opposites, anisomerism and hyperpolyisomerism. HANS ZINSSER and M. RUIZ CASTANEDA: Active and passive immunisation in typhus fever. It has proved possible to prepare a serum, from a horse treated with killed vaccines of Mexican typhus, which gave immunity to the European form of the disease in experimental animals. It is suggested that the two forms of typhus are due to organisms of the same group, with fractional antigenic differences caused by passage through different animal and insect vectors. G. LEMAÎTRE: Evolution of the expanding universe. Applying the law of gravitation to a region of extremely low density, and allowing for fluctuations of density and velocity about the mean value, it is concluded that the system includes collapsing regions distributed in the generally expanding space and occasionally equilibrium regions. The collapsing regions are identified with the extragalactic nebulae and the equilibrium regions with the clusters of nebulae. (See also NATURE, April 28,

p. 654.) WILLIAM HOVGGAARD: An investigation of the stresses in longitudinal welds. A theoretical discussion based on experimental work on partially welded girders. W. H. INGRAM: On the dynamical theory of electrical commutator machines. CYRUS H. FISKE: The nature of the depressor substance of the blood. A method used for the separation of adenosine triphosphate from protein-free muscle filtrates, used at a temperature of 0° C., gives with fresh rabbit blood a substance which is indistinguishable from adenosine triphosphate. M. DEMEREC: Effect of X-rays on the rate of change in the unstable miniature-3 gene of *Drosophila virilis*. No significant change was observed with 600–1,800 r units of radiation. Regarding the gene as a complex organic molecule, which may be stable or unstable, the system of genes is like a balanced action. The effect of X-rays is to change the position of balance; this may account for the slight changes observed. C. W. METZ: Evidence indicating that in *Sciara* the sperm regularly transmits two sister sex chromosomes. CURT STERN: On the occurrence of translocations and autosomal non-disjunction in *Drosophila melanogaster*. No translocations between chromosomes I, II and III were found. Non-disjunction of the autosomes in males was frequent. DONALD F. JONES: Unisexual maize plants and their relation to dioecism in other organisms. Dioecious maize has been produced from normal plants by combining two recessive genes located on different chromosomes. R. L. MOORE: Concerning compact continua which contain no continuum that separates the plane. MARSTON MORSE: Does instability imply transitivity? E. K. HAVILAND: On distribution functions and their Laplace-Fourier transforms. AUREL WINTNER: On the asymptotic formulæ of Riemann and of Laplace. H. BATEMAN: Functions orthogonal in the Hermitian sense: a new application of basic numbers. PAUL S. EPSTEIN: The expansion of the universe and the intensity of cosmic rays. Zwicky has pointed out that the distance a light quantum can travel may be limited by the operation of the astronomical red shift. Linear extrapolation of the red shift leads to a very short time scale for the universe, namely, 1.8×10^9 years. The high observed intensity of cosmic rays requires the introduction of Einstein's cosmological constant. The types of expansion of the universe and their time scales are discussed. ARTHUR H. COMPTON: Scientific work in the *Century of Progress* stratosphere balloon. The balloon rose from Akron on Nov. 20, 1933, to a height of 18,665 metres and descended eight hours later near Bridgeton, N.J. Skylight at 90° from the sun was completely polarised. Above the highest layer of haze, the colour of the sky shaded through green to a deep blue, deficient of any purple hue. Radio signals were well transmitted on a wave-length of 19.7 metres. The temperature of the top of the balloon rose to -2° C., but the air temperature was about -55° C. During the descent, the gondola was opened at 8.1 kilometres, without any bad effects on the observers, due apparently to the short exposure to the very low pressure or high concentration of oxygen in the gondola. Cosmic ray observations were made successfully, but an unexpected rapid rotation of the balloon prevented the completion of the directional experiments. G. H. SHORTLEY and G. E. KIMBALL: Analysis of non-commuting vectors with application to quantum mechanics and vector calculus. OSWALD VELEN and A. H. TAUB: Projective differentiation of spinors.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Tuesday, May 22

UNIVERSITY OF LONDON, at 5.15.—(at University College).—Prof. W. Vogt: "Experimental Vertebrate Anatomy" (succeeding lectures on May 24 and 25).*

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. David Katz: "Some Problems of Perception in Modern Psychology" (succeeding lectures on May 23 and 24).*

Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1564 (S. and C. 466): Further Experiments on a Model Fairey IIIIF Seaplane. By A. S. Batson and A. G. Gadd. Pp. 6 + 8 plates. 6d. net. No. 1565 (Strut. 140): Elastic Instability of a Thin Curved Panel. By S. C. Redshaw. Pp. 15. 9d. net. No. 1568 (T. 3437): Calculation of Critical Reversal Speeds of Wings. By D. M. Hirst. Pp. 24 + 3 plates. 1s. 3d. net. No. 1569 (T. 3433): The N. P. L. Open Jet Wind Tunnel. By A. R. Collar. Pp. 17 + 10 plates. 1s. net. No. 1572 (T. 3466): An Improved Multiflute Tilting Manometer. By Dr. R. Warden. Pp. 6 + 2 plates. 6d. net. (London: H.M. Stationery Office.)

The Academic Assistance Council. Annual Report, 1st May 1934. Pp. 14. (London: Academic Assistance Council.)

Report of the National Baby Week Council, 1933, presented and adopted at the Seventeenth Annual Meeting of the National Baby Week Council held in London on the 14th March 1934. Pp. 25. (London: National Baby Week Council.)

The Board of Greenkeeping Research. Report for 1933. Pp. 38. (Bingley: St. Ives Research Station.)

OTHER COUNTRIES

Canada: Department of Mines: Mines Branch. The Mineral Industries of Canada, 1933. Compiled by A. H. A. Robinson. (No. 738.) Pp. vii + 116 (34 plates). (Ottawa: King's Printer.) 25 cents. Institut de France: Académie des Sciences. Annuaire pour 1934. Pp. 405. (Paris: Gauthier-Villars et Cie.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service: Fisheries Research Directorate. Notes and Memoirs, No. 2: An Analysis of Arabian Seine Net Hauls on the Sea-coast near Ashtoum El Gameel, August 1928–May 1929. By R. S. Wimpenny. Pp. ii + 113. (Cairo: Government Press.)

Madras Fisheries Department. Administration Report for the Year 1932–33. By Dr. B. Sundara Raj. Pp. iii + 74. (Madras: Government Press.) 10 annas.

Year Book American Amaryllis Society. Vol. 1: In Memoriam Henry Nehrling 1853–1929. Pp. 110. (Winter Park, Fla.: W. Hayward, Secretary, 2240 Fairbanks Avenue.)

U.S. Department of the Interior: Geological Survey. Bulletin 844–E: Reconnaissance of the Northern Koyukuk Valley, Alaska. By Robert Marshall. (Mineral Resources of Alaska, 1931.) Pp. ii + 247–256 + plate 6. 5 cents. Bulletin 849–G: The Girdwood District, Alaska. By C. F. Park, Jr. (Investigations in Alaska Railroad Belt, 1931.) Pp. viii + 381–424 + plate 33. 25 cents. Circular 7: Gold-Quartz Veins south of Libby, Montana. By Russell Gibson. Pp. 24. Circular 8: Beach Placers of the Oregon Coast. By J. T. Pardee. Pp. 41. (Washington, D.C.: Government Printing Office.)

Survey of India. General Report 1933, from 1st October 1932 to 30th September 1933. Pp. vi + 75 + 11 plates. (Calcutta: Survey of India.) 1.8 rupees; 2s. 6d.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 104: On the Yield Points of Mild Steel Beams under Uniform Bending. By Fujio Nakanishi, Masaharu Itô and Kikuo Kitamura. Pp. 273–289. (Tôkyô: Koseikai Publishing House.) 20 sen.

Field Museum of Natural History. Report Series, Vol. 10, No. 1: Annual Report of the Director to the Board of Trustees for the Year 1933. (Publication 328.) Pp. 136 + 12 plates. (Chicago: Field Museum of Natural History.) 1 dollar.

Contributions from the Dudley Herbarium of Stanford University. Vol. 1, No. 5: New Plants from Baja California, by Ira L. Wiggins; New Western Erythroniums, by Elmer L. Applegate; Two New Species in *Heuchera* and *Cuphea*, by Rimo Bacigalupi. Pp. iv + 161–193 (plates 11–17). (Stanford University, Calif.: Stanford University Press.) 1 dollar.

Stanford University Publications: University Series. Biological Sciences, Vol. 2, No. 5: Contributions toward a Monograph of the Sucking Lice, Part 5. By Prof. Gordon Floyd Ferris. Pp. 143. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press.) 2 dollars.

CATALOGUES

Éditions Gauthier-Villars. Bulletin des Publications nouvelles (1er trimestre 1934). Pp. 26. (Paris: Gauthier-Villars.)

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