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The Death of His Majesty King George V

THE death of His Majesty King George V has brought an intimate sense of personal loss to the heart of each and every one of his subjects. In the twenty-five years of his reign, twenty-five years which have brought ruin and disruption to many Royal Houses, the position of the Imperial throne of Britain has been strengthened by his character and personal influence. He transcended "the divinity that doth hedge a king", to which our loyalty was freely given at the beginning of his rule, to become the beloved leader of his people, taking his full share of the joys and the trials of a democracy.

King George's reign began in a time of political stress, demanding an urgent and momentous decision, such as would have taxed the judgment of a ruler old in statecraft. Crisis followed crisis with an insistence and of a magnitude never equalled in so short a period in the world's history. Throughout the Great War and no less in the pangs of the period of reconstruction after the peace, the nation and the empire felt that their Sovereign was at one with them in their efforts to grasp and solve their problems. The wise and unobtrusive support of their ruler, setting an example to the members of the Royal Family which they were not slow to follow with ready self-sacrifice, afforded a rallying point and a stabilising influence in which the personal element came to count for even more than the constitutional position of the Crown.

British sovereigns have not invariably been in sympathy with the spirit of their times. As King George advanced in years, he was, his subjects could feel, in harmony with those elements of modern civilisation which seem, in such light as is given us, to make for progress, while he and his Consort held fast to a sense of discipline and to those ideals of an older generation which a broad view of the history of mankind shows to lie at the root of a stable society. To this end he brought to bear two supreme qualities—he knew men and their lands and he had an appreciation of the applications of science, and more particularly of mechanical science, to the amelioration of the conditions of life. His interest in and knowledge of technical detail often surprised those with whom he came into contact on his visits to industrial and other undertakings. It is not always remembered that his rank in the Navy was more than a ceremonial compliment to a member of the Royal House. From his early years, when he toured the world with his elder brother in the *Bacchante*, he was devoted to the sea; and it was only the untimely death of the Duke of Clarence, which brought him at twenty-seven years of age directly into the line of succession, that put an end to a career of high promise, in which he had already won rapid promotion.

The knowledge of peoples and individuals of all classes and ranks which King George thus acquired, in the various quarters of the world in which he was stationed, was further extended when as Duke of York and Prince of Wales he visited colonies and dependencies which were to be part of his Empire. As he showed at the opening of the Round Table Conference which deliberated on the future constitution of India, his visit to that country after his accession had inspired him with an understanding of its native rulers, its peoples and its problems, even though his visit was one of ceremonial, that had never been forgotten.

Thus King George was peculiarly fitted by temperament, by training and by experience to give to his people and their governors such guidance in a time of intense difficulty as our constitution

allows—good fortune for which we as a nation can never be sufficiently grateful. Each age is to itself an age of transition; but to the reign of King George, if we may anticipate the verdict of history, it would seem that this description will apply with more than subjective validity. By the Great War, tradition was broken. A new generation had grown up which knew not the training and precept of its immediate elders; and with a vastly augmented electorate it found opportunity—if not free and untrammelled, at least such as a younger generation had never had before—to secure a hearing for new ideals, new methods, new points of view.

Yet if we would compare the early years of King George's rule with those of its close, the strongest contrast is to be seen in the place of scientific research and the application of its results to the common surroundings of daily life in these later days. Speed in transport, the use of wireless, the variety and independence of season of our perishable foodstuffs, to name a few only of the most notable items, are now of the commonplaces of existence. In so far as evil can bring forth good, the Great War has profited mankind to this extent, that it has taught us the advantages of organised effort and of the systematic application of scientific method and research to the solution of the problems of modern civilisation and the amelioration of the conditions of modern life. No doubt, if we believe in human perfectibility, there is still a long road to travel, but in the history of science the reign of King George will stand out as a landmark in progress towards the knowledge and understanding of fact, which is of the essence of science, whether it be regarded as pure knowledge or in relation to man and his environment, considered as a specific factor of his existence.

Something of this was outlined in the issue of NATURE which marked the occasion of the late King's Silver Jubilee; but there was little opportunity there to stress the advance in those sciences which contribute even more directly to the knowledge of man and the advancement of his well-being—the social and humanistic sciences. Here progress has been no less marked than in the physical sciences, though the results are in themselves less spectacular. Their influence, however, is to be seen in the measures of social reform and improvement, the care for those feeble in mind or body and the progress of educational reform, slow though it may be, measures which His Majesty King George showed on many an occasion he had as nearly at heart as his subjects.

If the formation of the League of Nations, with its committees dealing with specific problems, be regarded as the salient fact since the War in the world at large affecting the development of the social sciences, changes within the Empire are of no less moment, and indeed, as the event has proved, have afforded a stimulus to the advancement of science as a whole. When King George came to the throne he received from his father, King Edward, an Empire which was a loose and somewhat indeterminate federation of dependencies and colonies, in which the chief bond was loyalty to the Crown and love for the Mother Country. This Empire passes to his successor as a Commonwealth of Nations having an assured statutory basis. The pride of nationality, however much we may deprecate some of its manifestations in certain quarters, it has to be admitted, has stimulated interest in educational and scientific institutions in all the Dominions, while in India notably, in Australia and in South Africa it has stimulated inquiry into the past history of the country and its races. In particular, the interest which is now beginning to be taken by the natives of India in the racial elements which constitute her peoples and in the story of the origin and growth of her culture, is not without its effect in the approach to the solution of the grave problems awaiting the application of the new organisation of government.

Mention of the races of the dependencies must serve to remind us of what perhaps has been the most fundamental movement of the last twenty-five years in Imperial relations. This is the change of attitude in the administration of the affairs of that large body of the Empire's members who conventionally are known as 'the backward peoples'. Not long after the late King's accession, Sir Richard Temple at the Birmingham meeting of the British Association in 1913, attacking once more on what the anthropologist had come to regard as almost a forlorn hope, urged upon the Government of the day the necessity for a training in anthropology as a necessary part of the equipment of the administrator. He advanced the argument, which now would be regarded as a commonplace, that a sympathetic understanding of native custom is a necessary condition of the successful control of those who follow that custom. It is unnecessary to follow the later history of the movement then set on foot, which indeed came

nearer success than any of those which had preceded it. But it is interesting to contrast the official attitude, which Sir Richard Temple was then attempting to overcome, with the spirit which now inspires, it may be said, the majority of the officers whose duty lies with 'native' races, and is accepted by authority as the first principle of administration.

The changed attitude towards native peoples and the administration of their territory is perhaps best manifested in the theory which underlies the mandated territories entrusted to the British Empire and other Powers under the League of Nations. Here the benefit of the natives is the first duty of the administering power. But the principle has also come to be recognised where it has no statutory foundation. In the last twenty-five years we have turned from exploitation to a sense of trusteeship.

King Edward VIII takes up the sceptre of Empire at a time of stress no less grave, if in some respects less acute, than that in which King George received it. In the developments which are clearly at hand, science will be called upon to play a part of no less moment than it has in the past. King Edward has personal knowledge of men and conditions in the Empire overseas, and he has emphasised more than once the importance of the co-ordination of research. In 1926 he presided over the meeting at Oxford of the British Association, and delivered a noteworthy address in the course of which he expressed the view that the future of civilisation "lies along a road the foundations of which have been laid by scientific thought and research". Incidentally, it may be remarked that this was the first occasion on which a member of the Royal Family has filled this office since 1859, when the Prince Consort was president, though King George himself, when Prince of Wales, would have accepted the presidency for the meeting in South Africa in 1905, if State duties had not called him to India at that time. By training and by precept our new ruler is clearly no less well-equipped than his father to meet the strain of a rapidly changing world ; and the sincere prayers of his subjects will ever be directed to the end that he may long be spared to give them his guidance.

Applied Psychology in Childhood

(1) Testing Children's Development from Birth to School Age

By Prof. Charlotte Buehler and Prof. Hildegard Hetzer. Translated from the first German edition by Prof. Henry Beaumont. Pp. 191+16 plates. (London : George Allen and Unwin, Ltd., 1935.) 12*s*. 6*d*. net.

(2) A Study of Imagination in Early Childhood and its Function in Mental Development

By Dr. Ruth Griffiths. Pp. xiv+367. (London : Kegan Paul and Co., Ltd., 1935.) 12*s*. 6*d*. net.

(3) Play in Childhood

By Margaret Lowenfeld. Pp. 345. (London : Victor Gollancz, Ltd., 1935.) 8*s*. 6*d*. net.

THE past seventy years has seen intensive study of the child from both physical and mental aspects, in health, abnormality and disease, and these years have witnessed not only the development of a national system of education but also a gradual tabulation of groups of children with an educational object in view, but largely on medical lines. In the Mental Deficiency Act, 1927, there is also defined the case of 'moral defective'. Social adaptability is the basal criterion of mental efficiency, and for certification as morally defective a child must be mentally defective. A morally defective child, if he exists, is very rare, and usually best classed as feeble-minded ; but there are many children with a social or anti-social tendencies who are not mentally defective. There are also many children who exhibit or suffer from a wide variety of 'nervous' symptoms, and, particularly since the War, the 'nervous child' has been a theme of interest and study for pedagogues, paediatrists and psychologists.

The rapidly developing science of psychology has sought, and is gaining, a new insight into child character, child temperament and personality, and is laying down the foundations of a new knowledge of children which bids fair to permit us to peer over the "wall around the town of Boyville".

(1) In their book on "Testing Children's Development from Birth to School Age", the authors have published a detailed series of tests which aim at disclosing the child's personality in all its fundamental dimensions. The tests are in six

categories which include all the fundamental dimensions of human behaviour, and cover the essential steps indispensable to the individual's development. They say :

"A knowledge of the fundamental categories of human behaviour was lacking. On the basis of experimental evidence and general observations we distinguish six such categories which should be reached by the tests. In the first place there are the two facts of sense stimulation and spontaneous movements. We call these (1) *sense reception*, and (2) *bodily movements*. We group under the latter also all those very characteristic movements which serve to increase bodily control.

"The contact with other human beings is to be regarded as specific and fundamental. This is category (3)—*social behaviour*. Two further fundamental facts are the ability of behaviour to change on the basis of experience and the activity of the individual by which he changes his environment. These facts are : (4) *learning*, and (5) *manipulation of materials*.

"Finally, the basic fact of the creation of and striving towards goals is to be called (6) *mental productivity*. All thought processes are included in this category, except that the thoughtful understanding of a situation which manifests itself in conversation is to be classified under 'social behaviour' with the sub-title 'language'. Finally, 'imitation' is to be classified under 'learning'."

Part 1 of the book is concerned with the technique of testing, the construction of tests and the evaluation of results, while Part 2 describes the various tests in detail. These tests largely form the basis for Dr. Bühler's book "From Birth to Maturity", and this latter book confirms the practical utility of the scheme and the procedure.

Thus not only do we find that results obtained bear out recognised or suspected relationships or significations, but also new relationships are exposed and a clearer, brighter picture developed.

(2) In "Imagination in Early Childhood" the difficult questions are put : "Is phantasy, as many have thought, due to the mere need of a weak and inexperienced mentality to turn from the unbearable hardness and coldness of an external world of reality ? Is it a temporary retreat, a denial of development, a regression ; or does the phantasy play any serious part in the adaptation of the individual to the conditions of his life ?"

To answer such questions it was first necessary to develop a new technique of examination and observation. The technique elaborated consisted in examining children of mental ages from 3 ; 4/12 years to 6 ; 9/12 years (chronological age 5–5½ years) in the following manner. A suitable quiet placid environment having been obtained, the child at ease and unhurried, he is allowed to talk and all he says is written down. When he falls silent he is offered a sheet of brown drawing paper and coloured pastels and it is suggested he should draw. If he does not care to, they are left beside him and he is encouraged to draw later. He probably continues to talk, and all he says is taken down. He is then shown a series of ink blots and asked "What does this look like ?" He is then asked to tell a story, and is also asked if he remembers any dreams. He is then told to cover his eyes with his hands until it is quite dark and tell what he can see.

It is claimed that "the tests attempt to investigate the imagination from several different lines of approach, whilst the background of conversation into which they are set yields further supplementary information often of a significant nature". Each child was tested on twenty occasions, and it was found in assessing the development actually occurring in each case :

"(1) There is first the effect of the gradual lifting of inhibitions to *reveal* what is already accomplished.

"(2) There is the effect of an improving command of the *tools* of expression, which enable the content to become manifest.

"(3) There is the actual growth within the subjective content that is taking place."

The author concludes :

"(1) Phantasy or imagination provides the normal means for the solution of problems of development in early childhood. (2) The problem is attacked indirectly, is often disguised by symbolism, and the subject is only vaguely aware of the end towards which he is striving. (3) The problem develops by means of a series of successively imagined solutions, which constitute a piecemeal and gradual resolution of the problem. (4) The result of the process is found both in an acquisition of information by the subject, and also in the more prominent feature of a change of mental attitude. (5) The change of attitude is usually from a personal and subjective point of view to a more socialized and objective one.

"Psychological development in early childhood involves the resolution on the part of the child of *three types of problem*. There is, primarily, the satisfaction of the fundamental physiological needs, such as hunger, thirst, movement. Secondly, there are certain emotional needs relevant to the growth of personality, and the problem of the adjustment of the individual to other personalities. Thirdly, there are those problems that are more strictly classifiable as intellectual."

(3) As phantasy is the manner of thinking natural in childhood, so is play the child's

characteristic mode of behaviour. This last point is the subject of the work "Play in Childhood" by Margaret Lowenfeld. Her observations are based largely on the method of Bühler, and her book is largely occupied by a very detailed description of methods of observation and a copious bibliography. She concludes :

"Play is to a child, therefore, work, thought, art, and relaxation, and cannot be pressed into any single formula. It expresses a child's relation to himself and his environment, and, without adequate opportunity for play, normal and satisfactory emotional development is not possible."

A. D. F.

Chain Reactions and Explosions

Chemical Kinetics and Chain Reactions
By N. Semenoff. (International Series of Monographs on Physics.) Pp. xii+480. (Oxford : Clarendon Press ; London : Oxford University Press, 1935.) 35*s*. net

THE mechanism of the 'chain reaction' was devised by Bodenstein in 1913 in order to account for the fact that, although Einstein had postulated that each quantum of light absorbed in a photochemical process would decompose *one* molecule of the absorbing medium, the action of one quantum of light on a mixture of hydrogen and chlorine gave rise to 10^5–10^6 molecules of hydrogen chloride. It was therefore clear that the primary decomposition initiated by irradiation was propagated almost indefinitely by some other mechanism.

The details of this mechanism have been the subject of much discussion, but it is now generally believed that the light decomposes the chlorine molecules into *atoms of chlorine*, that these atoms of chlorine act upon molecules of hydrogen and liberate *atoms of hydrogen*, which in turn attack molecules of chlorine and reproduce *atoms of chlorine* once again.

$$Cl_2 = 2Cl\ ;\ Cl + H_2 = HCl + H\ ;$$
$$H + Cl_2 = HCl + Cl,\ \text{etc.}$$

In this way, a reaction chain is set up, which can be propagated indefinitely, until *two atoms* happen to collide and so bring to an end the two chains for the propagation of which they have become responsible. Even so, it is generally recognised that a collision of atoms will only be effective in breaking the chains if it occurs in presence of a third body (for example, a gaseous molecule or the walls of the containing vessel), which can take away their energy of combination, and thus prevent them from dissociating again immediately into atoms.

The author of the present volume is well-known for his work on *branched chains* and for the application of this conception to reactions which lead to inflammation and explosion. He supposes that the oxidation of phosphorus is initiated by stray atoms of oxygen, which start a chain of primary reaction :

$$O + P_4 = P_4O\ ;\ P_4O + O_2 = P_4O_2 + O\ ;$$
$$O + P_4 = P_4O,\ \text{etc.}$$

The final product is an excited molecule $P_4O_{10}^*$, which is assumed to possess so much energy that it can decompose a molecule of oxygen into two atoms :

$$P_4O_{10}^* + O_2 = P_4O_{10} + O + O.$$

Whenever this occurs, the chain, which started with a single atom of oxygen, now develops into *two* ; and it is clear that, if the probability of branching is at all high, the quiet propagation of the primary chain may be replaced by an uncontrolled mechanism, leading to inflammation or explosion.

The effectiveness of the branching mechanism may be measured by a factor α, which represents the probability that a primary reaction will give rise to a second reaction of the same type. Thus, for an ordinary chain mechanism, which is not interrupted, $\alpha = 1$; but if a certain proportion of chains are broken, then $\alpha < 1$. If the chain were to branch at each stage of propagation, we should find $\alpha = 2$, but this factor would also be reduced by the breaking of the chain. It is evidently of critical importance whether α is less than or greater than 1, since in the former case the number of chains can only be maintained by some initiating mechanism, whereas in the latter case they tend to increase automatically. Since this critical increase from $\alpha < 1$ to $\alpha > 1$ may be produced by a very small change in the experimental conditions, a well-controlled oxidation ($\alpha < 1$) can pass with great abruptness into a flame or an explosion ($\alpha > 1$). In this way it is possible to account for the fact that a mixture of hydrogen and oxygen only explodes if the proportion of oxygen lies between 4 and 96 per cent.

In the same way, phosphorus is only oxidised when the pressure of oxygen is greater than about

0·001 mm., or less than about an atmosphere. The lower limit, however, depends on the diameter of the containing vessel; and addition of argon to a vessel containing phosphorus and oxygen provokes inflammation by lowering the critical concentration of oxygen. On the other hand, combustion at the upper limit of pressure is impeded by foreign gases, with the result that the combustion of phosphorus in air becomes impossible when the partial pressure of oxygen is less than that of pure oxygen. The vapour pressure of phosphorus also has a profound influence on the limits of pressure (of oxygen) within which combination can occur. Thus, as the vapour pressure of phosphorus is decreased, the limits of pressure within which combustion can occur are narrowed; and when this pressure is less than 10^{-4} mm., inflammation is impossible irrespective of the pressure of the oxygen. Conversely, the addition of immeasurably small amounts of ozone widens the limits of inflammation very greatly, with the result that the upper limit of combustion is extended and the mixture becomes liable to explosion.

The author points out that the application of chain mechanisms to reactions which lead to inflammation and explosion was followed by a renewed interest in this branch of reaction kinetics, which resulted in the course of four years in the appearance of some three hundred papers connected with the chain theory. It is not necessary for the purpose of a review to make any attempt to summarise these papers. It will therefore suffice to direct the attention of physical chemists and others, including those who are not already specialists in the theory of chain reactions, to the fact that in the present volume this extensive literature is presented in a convenient and readable form, by an author who is perhaps more competent than any other to give an account of the developments which he himself did so much to initiate.

Experimental Study of Living Cells

Handbuch der biologischen Arbeitsmethoden
Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 433. Abt. 2: Physikalische Methoden, Teil 3, Heft 5. Die Methoden der Fluoreszenzmikroskopie, von Max Haitinger; Elektrokapillarität, von Marie Wreschner. Pp. 3307–3400. (Berlin und Wien: Urban und Schwarzenberg, 1934.) 5.60 gold marks.

IMMENSE knowledge has been accumulated about the minute structure of organisms after death, while relatively little is known about the organisation of cells and their inclusions in the living state. It is a matter of great importance to distinguish appearances in dead tissues which are merely artefacts resulting from necessary chemical procedures and staining reactions. It becomes necessary to examine tissues in the living state, a matter of great technical difficulty.

When examined in ordinary daylight, living tissues are fairly transparent, possessing as they do a refractive index not very different from that of the saline nutritive fluid bathing them. Any device, therefore, which reveals the organisation of structure in living tissues is a boon to the biologist.

The examination of tissues in radiations outside the visible range of wave-lengths can be accomplished without damage to certain living tissues. Haitinger is one of the pioneers in the utilisation of ultra-violet radiations for this purpose and for which he has designed a special microscope. He presents in methodical form in the first part of the work under notice the technique to be applied to various tissues, and fairly represents the limitations of the methods. The use of sensitising dyes increases the scope of the method. The account he gives will prove of real practical value to workers in biology and bacteriology.

The second part of this volume is occupied with a masterly account of electro-capillary phenomena. Unfortunately, however, the capillary electrometer has in recent years been superseded by more rapid instruments. This is probably a good thing, since its use involves an enormous waste of time in calibration of recorded curves. Their calibration, nevertheless, is fully described here. Where precision is not required and calibration can be dispensed with, the mercury capillary electrometer still has its uses. Certainly, it is cheap and is easy to construct, and students will find in Wreschner's excellent account full details for purification of mercury and the assembly of a capillary electrometer. The account also includes several related phenomena of electrical and biological interest.

James Watt

James Watt: Craftsman and Engineer

By H. W. Dickinson. Pp. xvi+207+17 plates. (Cambridge: At the University Press, 1936.) 10*s*. 6*d*. net.

THE appearance of this book is most opportune. Some such comparatively brief study of Watt has long been needed, for the large memorial volume on "James Watt and the Steam Engine", due to the collaboration of Mr. Rhys Jenkins and Mr. Dickinson, was never likely to be widely read, while the older work by Smiles, valuable as it still is, is out of date. Since Smiles wrote, a great mass of material connected with Watt and also with the famous firm of Boulton and Watt has become available, and this has led to a much closer study of a very important chapter in industrial history. A good deal of this material has found its way into the collections at the Science Museum, and as keeper of the Engineering Division Mr. Dickinson had the congenial task of studying and arranging the Watt exhibits there. His knowledge of the subject is therefore probably unique.

The particular aspect in which Watt is here shown is mainly that as a craftsman. "He was a craftsman at the outset of his career, craftsmanship helped him throughout his working life as inventor and engineer, and craftsmanship was the solace of his old age". If, however, this view of Watt is emphasised, it is not at the expense of his fundamental work on the steam engine. Watt may be said to have started life as an instrument maker and then, after practising for a time as a civil engineer, become a mechanical engineer through his genius for invention and the sheer force of circumstance. His inventive faculty drove him along a steep and rugged path, and one which by temperament he was ill-fitted to climb, but one which, nevertheless, thanks largely to the vision, resolution, support and business capacity of Boulton, led him to a contented old age in which he was free to give rein to his ingenuity without the vexatious contacts with rival inventors, blundering workmen and recalcitrant clients who were as thorns in his flesh.

Many-sided as were Watt's activities, undoubtedly the greatest interest in his life belongs to the twenty years 1765–1785, years of extraordinary difficulties. It was in this period that he transformed the crude, wasteful and often unreliable atmospheric engine of Newcomen into an engine applicable to many purposes, and so solved the urgent problem of power supply in industry. From his patents of 1769, 1781, 1782 and 1784 came the double-acting rotatory engine which to some of his generation appeared likely to be the standard engine for all time. Each step in the development of the engine is clearly dealt with by Mr. Dickinson, whose story shows that an inventor may be a great benefactor, but often those who reap a harvest from his labours prove the hardest task-masters.

Mr. Dickinson begins his book with a short sketch of the industrial conditions and the position of craftsmen in Great Britain in Watt's early days, and some readers may regret that he does not conclude with a corresponding view of the country when Watt's work was done. The influence of Watt on the progress of industry was enormous. His contemporaries were in no doubt of this, and Lord Jeffrey remarked that it would be difficult to estimate the value which his inventions had conferred upon the country. Moreover, the Watt engine, he said, had "laid a sure foundation for all those future miracles of mechanical power which are to aid and reward the labours of after generations". This is one of the reasons why the pioneering work of Watt will remain of lasting interest.

Africa Dances:

a Book about West African Negroes. By Geoffrey Gorer. Pp. xv+363+32 plates. (London: Faber and Faber, Ltd., 1935.) 15*s*. net.

MR. GORER has written a bright and entertaining account of a tour through all the French colonies of West Africa in the unconventional style which is fast becoming a convention. His object was to obtain a record of genuine native dances; and for this the companionship of a West African dancer, whom he met in Paris, gave him exceptional facilities. His descriptions of dances are full, though, of course, not technically adequate nor intended to serve for reproduction. A secondary interest, which some perhaps will think primary, is that as his intimate contacts were with the native rather than the official, his view of French methods of administration is taken at an unusual angle. His verdict is not flattering; and although he is not impressed favourably by the British, whom indeed he cordially dislikes, he contrasts the bearing and character of the Gold Coast native under British administration with that of the population of the French colonies very much to the advantage of the former. He attributes the difference almost entirely to the divergence in spirit and method of the two systems.

The Annual of the British School at Athens

No. 33, Session 1932–1933. Pp. viii+262+35 plates. (London: Macmillan and Co., Ltd., 1935.) 63*s*. net.

THE thirty-third number of the Annual of the British School of Archæology at Athens contains the report of the Committee of Management—of which Prof. J. L. Myres is now chairman in succession to Mr. George Macmillan, whose retirement is recorded with great regret—on the operations of the school up to the close of the session 1932–33. In this period excavations were conducted at the Heraeum at Perachora by the director (Mr. H. G. C. Payne), in Mytilene by Miss W. Lamb, at the Isthmian Sanctuary by Mr. R. J. H. Jenkins, and at Knossos by the director and Mr. H. A. Blakeway. The results obtained at each are briefly summarised.

Of the papers by members of the School, which are included in the volume, first place is given to the excavations at Ithaca. Lord Rennell of Rodd discusses "The Ithaca of the Odyssey", and Messrs. W. A. Heurtley and H. S. Lorimer describe the excavation of the site which has been selected as in all probability the most profitable for the investigation. Among the remaining papers may be mentioned an account of journeys or archæological exploration in Crete by Messrs. J. D. S. Pendlebury, E. Eccles and M. B. Money-Coutts, in which the existence of thirty-five new archæological sites is recorded, bringing the number now known in the island up to well over six hundred; while a valuable "Prolegomena to the Study of Greek Commerce in Italy, Sicily and France in the Eighth and Seventh Centuries B.C.", by Mr. H. A. Blakeway, is based on the concrete, but much neglected, evidence of Greek geometric pottery and its imitations of a date older than the oldest colonial burials at Syracuse, which have been found at no less than twenty-eight different sites in Italy, Sicily and France from Apulia to Marseilles. Archæologists will echo the author's expression of surprise at the neglect of this important body of evidence by historians.

Limnology

By Prof. Paul S. Welch. (McGraw-Hill Publications in the Zoölogical Sciences.) Pp. xiv+471. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30*s*. net.

THIS is the first book written in English which deals at all comprehensively with inland waters, and, as such, it is greatly to be welcomed. In it Prof. Welch has correlated in easily available fashion information which has been gained by investigators in America and elsewhere. Naturally the author knows the work of his own countrymen best, and the result is of special advantage to English and European limnologists. A great many facts are included in the book, and the presentation of them is necessarily condensed. Consequently, the work is one rather of reference than of an introductory nature suitable for students just beginning the study of fresh water.

Most of the book is occupied with information about lakes and other standing-water environments. Only thirty pages are devoted to running water, and of these thirty pages, ten are given over to a consideration of the plankton, which, if not accidental, is at least incidental. The author has as his unifying principle "the biological productivity of inland waters . . . with all the causal influences which determine it". In England, interest is concentrated on the correlation between the physiology of organisms living in fresh water, and the environment in which they are found. This aspect of limnological problems is not specially emphasised, but full references are given to original papers about the effects of physical and chemical conditions in the environment on living organisms.

The Angler's Week-end Book

By Eric Taverner and John Moore. Pp. 512. (London: Seeley, Service and Co., Ltd., n.d.) 8*s*. 6*d*. net.

THE "Compleat Angler" has long been accorded the rank of a 'classic', though there have been some who will only allow that it is good in parts. But these dissentients, at any rate, will accord a wholehearted welcome to the present small volume. Moreover, it will appeal not only to the angler, but also to all who have a kindly feeling for our undisturbed water-ways, and their inhabitants, other than human. For these delightful pages afford entertainment for every mood, made up, as they are, of 'fishermen's tales' told with unusual skill, selections from the writers of the past, from Chaucer onwards, in prose and poem, ancient recipes for the gourmet for cooking fish, as well as observations on fish and their habits, record weights of fish, and a store of information on fishing, flies and tackle.

It is a book for the fire-side, a book to be dipped into, again and again, and always with relish. A number of quaint wood-cuts add not a little to its charm.

Many will agree that even the splendours of old Isaac Walton pale beside it. For the reiterated eulogies of "the good bishop Dubravius", Gesner and Pliny, are apt to grow tiresome. It may not be said, with truth, that the "Compleat Angler" is now superseded, but at least it has a formidable rival in this volume. W. P. P.

Le pansoma et la géométrie de l'énergie

Par Dr. A. C. Léemann. Pp. viii+257. (Genève: Georg et Cie, 1935.) 15 francs.

THIS book attempts to show that the conception of the three dimensional extension of the quantum of energy is sufficient to provide a complete description of Nature (p. 4). A quantum is supposed in its normal form to occupy a cube (p. 18) the edges of which are quantised in terms of the diameter of a proton (p. 10). The quotient of the quantum by the quantised edge is the available energy (p. 13). The faces of the cubes are in tension, and neighbouring quanta exert pressure on each other (p. 19). For the reasons for many fundamental statements of this kind the reader is referred to later pages, and there appear to be serious gaps and inconsistencies in the argument which will require to be removed before the author's ideas can be clearly understood.

The Watt Bicentenary Celebrations

THE bicentenary of the birth of James Watt is being commemorated in many ways and in many places, and on a scale worthy of a great international figure. "Science," Lord Playfair once said, "has no country though its investigators have birthplaces"; and the commemorations of Watt in places so far apart as America and Japan show that he is recognised as a world benefactor. In recent years, numerous centenary tributes have been paid to inventors and engineers such as Maudslay, Symington, Bell, Matthew Murray, Crompton, Trevithick and Telford—to mention only those of British birth—but the earliest and most notable of such recognitions in the present century was that at Birmingham in 1919, on the occasion of the centenary of Watt's death. The Birmingham gatherings had very valuable results. They led to the founding of a James Watt fellowship in the University, the writing of the monumental work of Mr. Rhys Jenkins and Mr. H. W. Dickinson on "James Watt and the Steam Engine", and they also led to the founding of the Newcomen Society for the Study of the History of Engineering and Technology which has, among other things, helped to stimulate, both at home and abroad, an interest in the lives and achievements of the pioneers of the past.

While it was appropriate that the centenary commemoration of the death of Watt should be held in Birmingham, where with Matthew Boulton as his constant guide and philosopher, Watt did the principal work of his life, it is natural that in the present celebrations of the bicentenary of his birth, Greenock, where he was born on January 19, 1736, should take the leading part. On Monday, January 13, therefore, Greenock began a week's celebrations with the opening of an exhibition in the Watt Institution, which was very largely the gift of James Watt, jun. Watt himself was a generous contributor to the library there, for in 1816 he gave £100 for the purchase of books for the youth of Greenock. The foundation stone of the Institution was laid just a century ago by Sir Michael Shaw-Stewart, Bt., the grandfather of Sir Hugh Shaw-Stewart, who on Monday opened the exhibition, and in doing so recalled the words used by his grandfather in 1836: "We narrow the reputation of Mr. Watt if we consider him only as a great practical mechanic; I believe him to be a profound philosopher and subtle chemist".

The opening of the exhibition was followed on Wednesday and Thursday by a pageant in the Greenock Town Hall by pupils of the High School, and on Friday, January 17, Lord Rutherford delivered the Watt Anniversary Lecture to the Greenock Philosophical Society, taking for his subject "The Transformation of Energy". Previous Watt lecturers have included Parsons, Ramsay, Preece, Bramwell, Balfour Stewart, Tait, Maxwell and Kelvin, the first of all being Joule, who in 1865 took as the title for his lecture, "On some facts in the Science of Heat developed since the time of Watt". The conservation of energy, radioactive energy, radiation and matter, and matter and energy are all included in the list of Watt lectures of the past, while so recently as 1930, Prof. C. G. Darwin spoke on "The New Conceptions of Matter". Lord Rutherford's lecture therefore may be considered as the latest in a valuable series of closely related discourses spread over the last seventy years.

In the opening passages of his lecture, Lord Rutherford spoke at some length of the association of Watt with Black, and the influence this had on the work of Watt on the Newcomen steam engine and the invention of the separate condenser; he then turned to review the work of Rumford, Mayer, Joule, Helmholtz, Carnot, Clausius and Kelvin, the enunciation of the laws of thermodynamics, the development of the principle of the conservation of energy and the possible efficiency of heat engines, touching also upon the use of high-pressure steam and the development of the mercury boiler and turbine due to Emmet in America. In speaking of the conservation of energy, Lord Rutherford said: "It must be borne in mind that 'energy', which is generally defined as 'the capacity for doing work', is an abstract conception, for energy can neither be seen nor measured directly. Its evaluation depends on the measurement of other quantities, and these are different for each type of energy involved. While it is an act of faith to believe that the conservation of energy does apply to all physical systems, yet we know it is difficult in many cases to obtain a direct experimental proof of its validity. Each case of transformation has to be examined with great care to be sure that energy has not disappeared in some unrecognised form." Lord Rutherford then went on to deal with the further important extensions to our ideas of energy and its transformations which belong to the present century, and exert to-day a profound

influence on the progress of atomic physics. This portion of his address is printed elsewhere in this issue.

The committee which arranged the Greenock celebrations, of which Mr. H. Ferrier is the chairman and Mr. H. Henderson the honorary secretary, appealed for funds for three objects. One of these was to found a prize fund for engineering students, another to complete the Watt Cairn in the Greenock Cemetery, and the third to place a plaque in the vestibule of the Watt Memorial Engineering and Navigation School which stands on the site of Watt's birthplace. The Cairn dates from 1854 and consists of stones brought from different parts of the world to form an international memorial. These stones at present are in an irregular heap, and it is now proposed to build them into a simple finished design. The plaque, however, has been erected, and at noon on Saturday, January 18, was unveiled by Sir Godfrey Collins, M.P. for Greenock and Secretary of State for Scotland. The inauguration of this memorial was followed on Sunday, January 19—the actual anniversary of Watt's birth—by a commemoration service in Greenock Town Hall, the address being given by Dr. C. L. Ward, Dean of the Thistle and Chapel Royal. The service was broadcast by the British Broadcasting Corporation from its Scottish station.

As already mentioned in our columns, a Watt Bicentenary Exhibition has been arranged in the Science Museum and will be on view until April 19. The Museum already possesses a valuable and varied collection of documents, apparatus, models and engines illustrating Watt's work, and also his garret workshop with all its contents. This was given to the Museum in 1924 shortly before his house, Heathfield Hall, Handsworth, was pulled down. A catalogue of the exhibition has been prepared by Mr. A. Stowers, and it includes many notes on objects lent for the occasion by various institutions and individuals.

On Friday, January 17, the members of the Institution of Mechanical Engineers made an official visit to the Science Museum to inspect the Watt exhibits and to hear a lecture on the life and work of Watt by Sir Thomas Hudson Beare. The lecture was given in the Lecture Theatre and was listened to by a large audience. Though Sir Hudson confined himself closely to his subject and attempted no review of the effect of the work of Watt and his fellows on the progress of the Industrial Revolution, he brought out clearly the influence of his surroundings on Watt, his standing among his scientific contemporaries and his originality of mind. The president of the Institution, Colonel A. E. Davidson, was in the chair, and at the close of the proceedings said that a bequest had been made to the Institution, and it had been decided with it to found a Watt Medal.

The London celebrations were continued on Sunday, January 19, when many representatives of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, the Newcomen Society and other bodies attended evensong in Westminster Abbey. The service was conducted by the Rev. Canon F. R. Barry, while the preacher was the Bishop of Knaresborough, Dr. P. F. D. de Labilliere. The sermon, which was based on the text Matthew, xvi, 26, is printed on other pages of this issue. At the close of the service, a small procession proceeded to St. Paul's Chapel, where three wreaths were placed upon the Watt monument; one of these was from the Institution of Mechanical Engineers, another from the Institution of Naval Architects, while that placed in position by the president of the Institution of Civil Engineers was deposited on behalf of all the other institutions represented at the service. This monument to Watt bears Brougham's famous inscription beginning: "Not to perpetuate a name which must endure while the peaceful arts flourish, but to show that mankind has learnt to honour those who best deserve their gratitude . . .", an inscription of which Dean Stanley said that "in its vigorous style and scientific enthusiasm, it is not unworthy of the omnigenous knowledge of him who wrote it, or of the powerful intellect and vast discovery which it is intended to describe". Finally, a few of those present were conducted by the Dean of Westminster, the Very Rev. W. Foxley Norris, to the Vestry, where they signed the Preachers' Register.

It was shortly after the conclusion of this service that Colonel A. E. Davidson and Mr. H. W. Dickinson, by the permission of the Director of the Science Museum and arrangements made by the Columbia Broadcasting Corporation, gave short addresses at the Museum which were broadcast in America, where the celebrations arranged by the Lehigh University, the Franklin Institute, the American Society of Mechanical Engineers and the American Section of the Newcomen Society were just being inaugurated in the Franklin Institute. The proceedings in America extended over Sunday, Monday and Tuesday, and were of a notable character.

On Monday, January 20, at 8.30, the British Broadcasting Corporation included in its National programme an item entitled "The Romance of Steam Power" and on the following Wednesday, the Newcomen Society held a meeting in the Science Museum to receive a series of short papers. One of these was by Prof. P. Labarinsky, of the

Academy of Sciences of the U.S.S.R., Leningrad, its subject being the "Earliest News of Watt's Steam Engine to Reach Russia". Another paper by Mr. Rhys Jenkins was entitled "The Note Book of Roger North and the Work of Sir. S. Morland in the Steam Engine". Roger North (1653–1734), a lawyer, was the brother of Francis North, Lord Guildford. In the British Museum is a note-book of his containing some leaves devoted to mechanical subjects. Some of the sketches were of what Mr. Jenkins referred to as "a two-cylinder, single-acting, high-pressure condensing engine with automatic valve gear". Was it an engine of Savery's, Newcomen's, Papin's or Morland's? Morland in 1673 asked for a patent for "An engine capable of raising water to any height by the help of steam", and in 1682 showed an engine to the King. But in the seventeenth century many men were at work on the steam engine. Some were concerned with the philosophical aspect of the subject, others had in view applications in practice. It is quite possible, indeed likely, that there were other workers in the field of whom we have no knowledge. In historical research from time to time buried material comes to light, necessitating a revision of our conclusions, and it may yet be possible to discover the inventor of the engine as described by Roger North.

Watt Commemoration in Westminster Abbey

SERMON BY THE RIGHT REV. P. F. D. DE LABILLIERE, BISHOP OF KNARESBOROUGH

What is a man profited, if he shall gain the whole world, and lose his own soul?
S. Matt. xvi. 26.

WE are celebrating to-day (January 19) the two hundredth anniversary of the birth of James Watt—"the improver of the steam engine"—whose gigantic statue yonder in the Chapel of St. Paul, with its inscription from the pen of Lord Brougham, testifies to the high honour in which he was held by the men of his generation.

The basic principles of the steam-engine, it would appear, were already known when Watt embarked upon his investigations—but its use had been confined almost entirely to providing a satisfactory method of draining water from the newly-opened coal-mines—"a giant with one idea" as Coleridge called it. It was James Watt who improved this steam pumping engine and made it available for driving other types of machinery, so that when he died in 1819, the "giant with one idea" was capable of being used for an almost infinite variety of purposes.

Thanks to Watt's inventive genius, man had successfully harnessed the power of steam to his triumphal chariot, and the stage was set for the inauguration of the Mechanical Age, which made Britain for nearly a century the workshop of the world.

Speaking of the erection of James Watt's monument in the Abbey, Dean Stanley writes:

"Well may the ancient pavement of the Church have cracked and yawned, as the enormous monster moved into its place, and disclosed to the eyes of the astonished workmen, rows upon rows of gilded coffins in the vaults beneath. . . . Well might the standard-bearer of Agincourt, and the worthies of the courts of Elizabeth and James, have started from their tombs in S. Paul's Chapel, if they could have seen this colossal champion of a new plebeian art enter their aristocratic resting-place. . . .

"Yet when we consider what this vast figure represents, what class of interests before unknown, what revolutions in the whole actual framework of society, equal to any that the Abbey walls have yet commemorated, there is surely a fitness even in its very incongruity."

We may truly, then, regard James Watt as one of the foremost pioneers of the Machine Age, and on this bicentenary of his birth concentrate our thoughts upon some of the ways in which mechanical invention has affected human life and thought.

Think for a moment of the extent to which the man of to-day lives his ordinary life under the domination of the machine. In our homes we rely upon electric light, vacuum cleaners, sewing-machines and consider them only half-furnished unless we have also a telephone, a wireless set and perhaps a gramophone as well. Small wonder that an eminent modern architect (de Courbousier) has defined a house as "a machine for living in". Our offices are equipped with typewriters, calculating-machines and cash-registers, if not with dictaphones.

We go out into our streets and count on being able to use electric trams or motor buses or

underground tubes—and a growing number of daring folk are unhappy unless they can fly in the air.

There is no need to prolong the wondrous story. To tell it in detail would require volumes. The outstanding fact is obvious—the life of mankind to-day is controlled by mechanical devices as never before.

Now in some quarters this increasing mechanisation of life is viewed with frank dismay. Indeed, as Prof. Lecky pointed out ("Rationalism", 2, 349), "every step of the progress of machines was met by fierce opposition, directed at one time by the ablest statesmen, and long afterwards sustained by the lower classes". There are some still living who, apparently, could witness the absolute destruction of the 'machine' without shedding a tear.

Some thinkers even to-day refuse to admit that there is in it anything which is not wholly vile—still less that it contains any promise of good for the future. What Rupert Brooke called "the keen impassioned beauty of a great machine" is not for them. They are only able to see a hideous and well-nigh invincible giant—hard, glittering and inhuman—that dwarfs human personality, and both compels and symbolises a life of mad and unbroken monotony. Mr. Gandhi, for example, with his passionate concern for the spiritual welfare of India, would seem to desire a return to life on its old, simple terms—and he has, at times, spoken strange words in denunciation of railways and modern methods of manufacture.

That, however, is an attitude of intransigence which, I imagine, few of us would be proposed seriously to adopt. Some very deep instinct always asserts itself when we are tempted to condemn or belittle any large field of human activity. When we think calmly about it, surely it becomes plain that this vast advance of man in the control of Nature belongs to the line of his true evolution. We feel that God must have meant it—if God is indeed behind the whole evolutionary process, as we believe Him to be.

We see that what is really happening is that, by learning to harness the forces of Nature to his will, man is bringing nearer the day when human drudgery shall cease to be the lot of any man, and the spirit of man shall be released for higher ends.

We cannot but rejoice in the triumphant exercise of human brains which lies behind all this mechanical advance, and some of us at least believe that ultimately the perfect control of matter will be found to subserve spiritual ends. No—we are certainly not going to deplore or to denounce all this mechanical advance—but on the other hand, if we are wise, we are not going to be blind to its attendant dangers.

It is obvious that these two hundred years of scientific progress have brought us face to face with the question whether mechanical science is to be our master or our slave—whether she is to be used as the servant of man's spirit, or is to bring the spirit of man beneath the tyranny of the machine.

A recent writer has pointed out, for example, that the War was a clear instance of the triumph of man's inventive intellect over his powers of spiritual control, and that is a charge which it would be difficult indeed to refute. He points out that of all attempts to depict the soul of the war, and of the society that made it and endured it, that of the painter comes nearest to the truth. Speaking of an exhibition of War pictures, he affirms that the subject treated by the artists is not man, but his handiwork—not soldiers but the 'things' which soldiers use. Reduced to form, they appear as vast intricacies of girders or spans—in white sheets of flame from roaring furnaces—in colossal hammers—in the bulk of huge transports—in the rush of destroyers through rough seas—in the mouths of monster guns pointing skywards.

The next effort of the artist is to show what these 'things' produce. And here again men scarcely appear. All that is seen is wreckage—the splinters of trees, or the huge dents of shell-holes on the earth's surface. The human agents, soldiers or workers, look like ants in an ants' colony, or figures from a child's storehouse of toys. They are minders or tenders of machines—creators in the first instance, but pre-eminently and finally creatures (victims) of what they have made.

No one can deny the truth of that grim description, and it shows how far civilisation has gone astray. If life were what it ought to be, the figure of man would dominate the picture, and all that he has created or invented would appear as mere tools to promote the well-being and happiness of the race.

It is a bad sign when our inventive genius threatens to outstrip our powers of spiritual control. If man is to progress, and civilisation is to survive, spirit must reign supreme over machinery, and all the wondrous discoveries of the intellect must be brought into the service of the soul. No one can wisely suggest the turning back of the clock. We cannot, if we would, return to the stage-coach, the spinning-wheel and the tallow candle. We must win through by the aid of the machine we ourselves have created, not court defeat by its destruction; but if we are to do that, what is required is that our moral and spiritual 'lag' must be abolished.

As we look into our own hearts, or survey the world at large, there can be little doubt that our

moral and spiritual powers have failed to keep pace with our new inventions. Ever since James Watt made his steam engine, and the era of scientific inventiveness got well under way, we have been absorbing ourselves in the creation, accumulation, elaboration of the means of living; but when we turn our thoughts from the means by which we live to the end for which we live, are we so sure that we are on a correspondingly higher moral level than our fathers? Are we not driven to confess that the splendid new powers with which science has furnished us are still too largely in the hands of the old selfishness, the old greed, the old ambition? And increasing material powers simply are not safe except with proportionately improving character.

A drunken man afoot is dangerous enough, but the danger is multiplied tenfold if the drunken man is allowed to drive a car. An angry man can work damage with his two bare fists, but his damage becomes dire calamity if you place him in a bombing aeroplane.

Enlarged powers spell enlarged peril if the soul does not grow. I suppose society could endure for a time without further new inventions. The question is, How long can it endure without a better spirit, a spirit capable of handling aright those enlarged powers which modern discovery has placed within our reach?

So the final challenge presents itself: How is our spiritual 'lag' to be compensated? Where are we to find that larger vision, that clearer insight, that new unselfishness which the modern situation so urgently demands?

If the question is urgent, the answer, for those of us who are Christians, is abundantly plain. "If any man be in Christ he is a new creation." Jesus Christ came to save the soul of the world, to produce a new type of man who shall be equal to the demands of each new age. He told us not to fear those who kill the body, but those who kill the soul; and no one can be blind to the mighty forces within us and around us which threaten the destruction of the soul.

The message of the Christian Gospel is that in the power of God, which is ours through Christ, we can overcome them all. Let us strive so to live that we may vindicate the supremacy of the soul, for what profit is there in anything that science can do without the soul. What does it profit individual, or nation, or civilisation to gain the whole world and lose the soul?

The Transformation of Energy*

By The Right Hon. Lord Rutherford, O.M., F.R.S.

Equivalence of Mass and Energy

ONE of the great advances of the last century was the recognition of the relation between heat and energy; to the present century belongs the recognition of a fundamental relation between mass and energy. The existence of such a relation was first discussed by Hasenöhrl in a study of the properties of radiation; but the general formulation of the principle we owe to Einstein in 1905 as a consequence of the theory of relativity. On this principle, mass and energy are equivalent, and mass is to be regarded in a sense as a concentrated source of energy. The energy E, whether in potential or kinetic form, resident in a mass m, is given by $E = mc^2$, where c is the velocity of light. If the energy of a system is increased, its mass is increased; if the energy decreases, the mass diminishes. For example, the mass of a rifle bullet in flight is slightly greater than at rest because of its additional kinetic energy. The mass of a body increases when it is heated because its content of energy is increased.

In these cases, when we are dealing with matter in bulk, the changes of mass brought about by realisable changes of energy are exceedingly minute and quite beyond the possibilities of measurement. For this reason, it might be thought that the effect of the change in mass is on such a small scale that it may be disregarded. This is not so, for we shall see that the position is very different when we deal with flying particles like electrons and protons, which can be given speeds comparable with the velocity of light. At slow speeds, the mass of the electron is only 1/1,840 of the mass of our lightest atom, hydrogen; but its mass increases rapidly with speed as we approach the velocity of light. Even for the fast electrons that are spontaneously liberated from the radioactive bodies, the mass of the electron is five or six times greater than for slow speeds. This change of mass is much greater when we examine the very energetic electrons which appear in the cosmic rays.

* From the Watt Lecture delivered before the Greenock Philosophical Society on January 17.

Some of these have a mass greater than that of the hydrogen atom, and still more energetic and consequently more massive electrons are believed to be present.

The conclusion that the destruction of mass involves the appearance of a corresponding amount of energy has been experimentally verified in a number of cases and is brought out with great clearness in investigations on the transformations of atomic nuclei. In discussing the changes of energy involved, it is customary to employ as a unit of energy the electron-volt; thus the energy acquired by an electron in passing freely in a vacuum between two points differing in potential by 1 million volts is said to be 1 million electron-volts, or for brevity, 1 million volts. On this unit, the energy equivalent to the rest mass of the electron is about 500,000 volts, and for the proton about 930 million volts. It is convenient to remember that the energy corresponding to mass 1 on the atomic scale is 930 million volts, so that 0·001 difference in mass corresponds to slightly less than 1 million volts.

If, as the consequence of a nuclear transformation, the resulting masses of the particles are less than before, then, if the conservation of energy is to hold, the liberation of energy whether in the form of kinetic energy of the particles or in the form of radiation must be equivalent to the change of mass. Consider, for example, the transformation which occurs when the lithium isotope of mass 7 is bombarded by a stream of fast protons. Occasionally, as the result of a close collision, the proton enters the lithium nucleus and is captured by it. The new nucleus formed is unstable and breaks up with explosive violence into two α-particles (helium nuclei) each of mass 4, which escape with high speed in nearly opposite directions. The transformation is schematically shown below:

$$ {}_3Li^7 + {}_1H^1 \rightarrow {}_2He^4 + {}_2He^4, $$

where the subscripts represent the charges on the nuclei. From a measurement of the speed of the particles and allowing for the kinetic energy of the bombarding proton, it is found that the total kinetic energy liberated in this reaction is 17·1 million volts, equivalent to a loss of mass of the system of 0·0181 units. The relative masses of the atoms involved have all been carefully measured by Aston and by Bainbridge by means of the mass-spectrograph, and are found to be H = 1·0078, He = 4·00216, Li = 7·0146*. The difference in the sum of the masses on the two sides of the equation, namely, 8·0224 and 8·0043, is 0·0181. This, as we have seen, is in complete accord with the mass equivalent of the kinetic energy released.

* Recent work indicates that these masses are too low, but the mass differences on which the energy depends remain the same.

It is thus clear that the conservation of energy, taking into account changes of mass, holds for this nuclear reaction within the limit of the experimental errors. Incidentally, it should be mentioned that the conservation of momentum and also of nuclear charges equally hold in the transformation.

Similarly, when heavy hydrogen ions of mass 2 (deuterons) are used to bombard the isotope of lithium of mass 6, the following transformation occurs:

$$ {}_3Li^6 + {}_1H^2 \rightarrow {}_2He^4 + {}_2He^4. $$

Again two α-particles are shot out in opposite directions and with still greater speed than in the first case. The kinetic energy liberated is 22·5 million volts, and again this is found to correspond to the decrease of the mass of the system.

In these reactions, the released energy appears in the kinetic form, and it is of interest to refer to another type of transformation, of Li^7 bombarded by protons, in which the greater part of the energy is liberated not in the kinetic form but as a quantum of high energy $h\nu$, namely:

$$ {}_3Li^7 + {}_1H^1 \rightarrow {}_4Be^8 + h\nu, $$

or

$$ \rightarrow {}_2He^4 + {}_2He^4 + h\nu. $$

It is not quite certain which of these reactions occurs. The mass of the Be^8 isotope is known from other reactions, and the quantum energy of the γ-radiation is found to be very great, namely, 16 million volts—about the value to be expected on the conservation of energy. While it appears that, in general, the energy released in a reaction is mainly in the kinetic form, it is of great interest to find such a clear case where the greater part of the energy can be released in the form of electromagnetic radiation of high quantum energy.

It is also found in general that every type of reaction takes place which is consistent with the conservation of energy. This is well illustrated by the many different types of transformations observed in the isotopes of lithium when bombarded by protons or deuterons.

While the conservation of energy appears to hold in all cases where the energy is associated with massive particles, it is by no means so certain that the law holds when light particles like positive or negative electrons are liberated in transformations. It is to be expected that the electrons should ordinarily be expelled with identical speed, but in all cases examined they are found to be released with a wide range of velocity. This peculiarity was first observed in the β-rays from the radioactive bodies, and cannot be explained by supposing that part of the energy of the electrons is converted into γ-rays. So far as our information has gone, it appears that the conservation of energy

applies if the energy of the fastest electrons is taken as a measure of the energy lost by all the nuclei involved. Either the conservation of energy does not hold with such light particles as electrons, or part of the energy is carried off in some unknown form. For this purpose, a new particle called the 'neutrino' has been invented. This particle, which has no charge and small mass, is supposed to be emitted with the electron and share part of the momentum and energy, but we have no direct evidence of any kind of the existence of this hypothetical particle. This apparent breakdown of the law of conservation of energy is of very great interest and may prove of fundamental importance.

Production and Disappearance of Matter

A very remarkable case of the conversion of the whole mass of a particle into radiation has been recently observed. A few years ago, the positive electron of small mass was discovered, and is now known to appear in certain transformations and to arise also in the passage of high-energy γ-radiation through matter. These positive electrons have a very short life and disappear, apparently due to their coalescence with a negative electron in their path. In such a case, the mass represented by both a positive and negative electron, corresponding to 1 million volts, disappears in a blaze of radiation. If at the moment of disappearance, the electrons have slow speeds, the energy of the radiation should correspond to the combined rest energy, namely, 1 million volts; but it is to be expected that, in order to conserve momentum, two quanta of radiation should be emitted, each of 500,000 volts in opposite directions. Actually a radiation of this energy is observed in such cases, and in addition experimental evidence has been obtained that two quanta of this energy are simultaneously emitted.

Still another striking observation has been made, the inverse of the former, for under certain conditions pairs of electrons, positive and negative, are produced by the action of high-frequency γ-rays. Since the combined energy of formation of two electrons is 1 million volts, the quantum energy of the radiation must be greater than this to be effective. Apparently the production of such electron pairs is due to the interaction of the high-energy radiation with the electric field outside a nucleus, and is specially marked for heavy nuclei.

This is the first time that evidence has been obtained that matter, or at any rate individual massive entities, can be produced by the action of radiation. There is also some indication that this materialisation can be effected also by high-energy electrons. Under certain restricted conditions, it thus appears that mass and energy are mutually convertible. So far no evidence has been obtained that the mass of the proton can vanish into radiation. If this process can occur, the total energy of the radiation emitted should be nearly 1,000 million volts. It appears in general that the conversion of mass into energy or the conversion of energy into mass are most likely to take place when we are dealing with very concentrated sources of energy such as occur in the energetic particles present in the cosmic rays. Some of these are of far greater energy than we can hope to produce in the laboratory, so a close study of the effects produced by the cosmic rays may give us further information on this most fascinating and fundamental problem.

Energy Liberated in Transformations

It has long been known that the atoms of the natural radioactive bodies break up with the emission of a large amount of energy, generally in the form of a fast α- or β-particle. Some of the atoms which are broken up artificially by bombardment with protons or deuterons emit even more energy than the atoms of the radioactive elements. In the case of artificial transmutations, we can, however, compare the kinetic energy of the bombarding particle with the amount of energy released in the transformation. The efficiency of bombarding particles in producing transformations in general increases rapidly with the kinetic energy of the particles. For example, the transformation of lithium by protons, of energy say 1 million volts, is on a very marked scale, but is still detectable with protons of energy so low as 20,000 volts. Since the energy liberated in the transformation of each atom is about 17 million volts, the energy released is about 850 times the energy communicated to the atom. On the other hand, we must bear in mind that only 1 proton in 10^8 is effective, so that on the whole far more energy is supplied than is gained.

While the over-all efficiency of the process rises with increase of energy of the bombarding particles, there seems to be little hope of gaining useful energy from the atoms by such methods. On the other hand, the recent discovery of the neutron and the proof of its extraordinary effectiveness in producing transformations at very low velocities opens up new possibilities, if only a method could be found of producing slow neutrons in quantity with little expenditure of energy. At the moment, however, the natural radioactive bodies are the only known sources for gaining energy from atomic nuclei, but this is on far too small a scale to be useful for technical purposes.

Obituary

Sir Richard Glazebrook, K.C.B., K.C.V.O., F.R.S.

RICHARD TETLEY GLAZEBROOK, whose death took place at his home at Limpsfield, Surrey, on Sunday, December 15 last, was born at West Derby, Liverpool, on September 18, 1854. He came of two well-known Liverpool families, members of both of which have attained distinction, being the eldest son of Nicholas Smith Glazebrook, of West Derby, Liverpool, and of Sarah, daughter of Richard Tetley, of Liverpool. He was educated at Dulwich College and, later, at Liverpool College, whence, in 1872, he gained a scholarship at Trinity College, Cambridge. He took his degree as fifth wrangler in 1876, was made a fellow of his College in the following year, and for twenty-two years, until 1898, was engaged in active work in Cambridge. He became a College and University lecturer in mathematics and natural science, assistant tutor at Trinity, and in 1895 was made Senior Bursar. Immediately after taking his degree he studied in the Cavendish Laboratory, where he became a demonstrator under Lord Rayleigh in 1880, and in 1891 was made assistant director.

In considering Glazebrook's science work in Cambridge, it is necessary to bear in mind the position of science teaching there at the time. Clerk Maxwell had been appointed the first professor of experimental physics in March, 1871, and gave his earlier lectures in the lecture room of Liveing, the professor of chemistry. The new building for experimental physics, the Cavendish Laboratory, was not completed until 1874. The students attending Maxwell's lectures in the early days were mainly men who, like Glazebrook, had already taken a high place in the mathematical tripos. When Glazebrook began experimental work in 1876, he turned his attention at first to optical questions, and his first important paper, "An Experimental Determination of the Values of the Velocities of Normal Propagation of Plane Waves in different directions in a Biaxial Crystal, and a Comparison of the Results with Theory" was published in the *Phil. Trans.* in 1878. A second paper, on "Double Refraction and Dispersion in Iceland Spar" appeared, also in the *Phil. Trans.*, in 1880, and a third in 1882, in which year he was elected F.R.S. But under Maxwell his attention had also been given to electrical questions, which more and more occupied his time during the professorship of Lord Rayleigh (1880–84) and after.

When, in 1880, Glazebrook was made a demonstrator, the number of students was still small, but soon tended to increase, and it was necessary to give attention to the organisation of the 'demonstrations'. Then began that co-operation with Napier Shaw which had so great an effect for many years on science teaching both in colleges and schools. It is not necessary here to go into details; Glazebrook was from the first fully alive to the disadvantages as well as the advantages of any such plan, but some system of the kind soon was clearly essential in dealing with the greatly increased numbers of students requiring to gain experience in experimental work, and the scheme adopted in Cambridge found wide approval among teachers elsewhere.

During Lord Rayleigh's tenure of the Cavendish professorship, much time was given to a redetermination of the electrical units. The British Association Committee on Standards of Electrical Resistance, appointed in 1861, after doing much valuable work, had been dissolved in 1870. The unit of resistance adopted by that Committee, as represented by a number of practical standards constructed and issued by the Committee, came to be known as the B.A. unit. This purported to represent the absolute unit, but by 1880 it was realised that its value was appreciably in error, and the re-appointment of the Committee and a redetermination of the unit were generally called for. During the years 1880–84, three redeterminations of the B.A. unit, in terms of the absolute unit, were made under Lord Rayleigh in Cambridge, one of them by Glazebrook in 1882, as a result of which the value of the B.A. unit in terms of the absolute unit was found to be 0·9867. An important result of the work was that the B.A. Committee undertook to arrange for the systematic testing of resistance coils, and for this testing Glazebrook, who had been appointed secretary of the Committee, became responsible. During his later years at Cambridge, it occupied much of his time, and impressed upon him the need of a public institution which should undertake this and similar work of national importance. As secretary of the B.A. Committee, he had charge also of the B.A. condensers constructed by the Cambridge Scientific Instrument Co. to the design of Dr. Muirhead. He continued to act as secretary of the Committee until its dissolution in 1912.

During Lord Rayleigh's professorship, the numbers working in the Cavendish Laboratory steadily increased, and the increase continued under his successor, the present Master of Trinity. Additional demonstrators and assistant demonstrators had to be appointed, and the system of organisation of the laboratory teaching introduced by Glazebrook and Shaw was extended, with appropriate modifications, to the more advanced classes. A plan of co-operative research by the members of such classes gave valuable results, an illustration of which is furnished by the paper by Glazebrook and Skinner on "The Clark Cell as a Standard of E.M.F." published in 1892 in the *Phil. Trans.*

In 1898, after twenty-two years' work at Cambridge from the date of his graduation, Glazebrook accepted the post of principal of University College, Liverpool. His tenure of this position was, however, brief, for in July, 1899, he was asked, and agreed, to

become the first director of the National Physical Laboratory. He had in 1897, as secretary of the Electrical Standards Committee of the British Association, given evidence before the Treasury Committee, of which Lord Rayleigh acted as chairman, which in July, 1898, recommended the establishment of the Laboratory, to be under the control of the Royal Society. His formal appointment was dated January 1, 1900, but already in the summer of 1899 he was actively helping in the preliminary work and negotiations involved before the necessary new buildings could be provided. The proposal of the Treasury Committee was that the institution should be established by extending the Kew Observatory, and the original intention was to build in the Old Deer Park, Richmond, but difficulties arose, and in 1901 Bushy House, Teddington, was offered as an alternative, and accepted. Kew Observatory remained part of the new institution as the Observatory Department. Once this decision was reached, rapid progress was made with the alterations and additions necessary to adapt Bushy House for the purpose, and on March 19, 1902, the Laboratory was formally opened by the Prince and Princess of Wales, their Majesties the present King and Queen. From that time onwards the success of the new institution was rapid. Glazebrook quickly gained the entire confidence of the influential body of men who consented to act as the governing body—the General Board and Executive Committee—of the Laboratory. He showed, too, his judgment of men in the early recruits he found for the staff: T. E. Stanton, F. E. Smith, H. C. H. Carpenter, W. Rosenhain, H. H. Jeffcott are early names on a list which might be greatly extended.

The funds provided by Government were meagre, but with every year the friends of the Laboratory grew and were ready to give practical form to the enthusiasm which was fostered by the success of the new institution. The first new building was that for electrotechnics and photometry, and others rapidly followed, for metrology, for chemistry and metallurgy, while the engineering building had more than once to be extended to accommodate the increasing work. The Director's first care was the provision of suitable units and standards of measurement, determined with ever-increasing accuracy as need arose and knowledge grew, including the fundamental standards of length, mass and time; the electrical units and standards including those of capacity and inductance; temperature standards, over a continually extending range of temperature, as demanded by modern science and practice; standards for pressure measurement; photometric standards and special standards for specific purposes. Much of this work, for example, the accurate measurement of high temperatures, involved extensive research, and among other typical researches undertaken in the early days may be mentioned the investigations into wind pressure on structures and into the strength of materials when subjected to varying and repeated stresses.

It was in 1908 that the building of the tank for experiments on ship models was commenced, the funds for which were provided through the generosity of Sir Alfred Yarrow. In May, 1909, the Advisory Committee for Aeronautics was appointed by Lord Haldane, with Lord Rayleigh as president and Glazebrook as chairman, to advise upon flight problems, and to control research to be undertaken at the N.P.L. by means of models, and at Farnborough on the full scale. Thus began Glazebrook's long connexion with aeronautical research. As is well known, rapid progress was made with the experimental work, and the success achieved was of great importance to Great Britain during the Great War.

In a somewhat similar manner the question of research in wireless telegraphy arose at the beginning of 1913. The Postmaster-General appointed a committee, with Lord Parker as chairman, of which Glazebrook was a member, to report as to existing systems of wireless telegraphy, and as to what provision the State should make for research on the subject; and in 1914 the committee obtained approval of a scheme involving the provision of buildings and equipment at the N.P.L. The carrying into effect of this scheme was stopped by the Great War.

By 1913 also the testing work previously done at Kew had been transferred to Teddington, and Kew Observatory had become the research station of the Meteorological Office. An administration building had been provided at Teddington to meet the need of increased accommodation. Additions to the buildings had, of course, also been necessary for the aeronautical researches.

In 1914, therefore, under Glazebrook's energetic administration, the success of the Laboratory was fully established and its great value as a national institution made clear. Its scope had become even wider than was originally contemplated by its promoters and there was ample evidence that its usefulness had by no means reached its limit.

Its further development was, however, greatly affected by the War. The proposed wireless researches were, no doubt unfortunately, not begun, and the staff who remained, after a number had gone on active service, had to devote much attention to routine work connected with munitions supply. The aeronautical work, of course, became at once of extreme importance, and for that increased provision had to be made; and a number of other special problems were referred to the Laboratory for investigation. When the Ministry of Munitions was formed, Glazebrook became a member of its staff, and was able in many ways to render personal service. Valuable work was done by the Metrology Department of the Laboratory as a result of the experience already gained in accurate measurement, and for this work temporary staff had to be provided in somewhat large numbers. Towards the end of the War, it became clear that the Royal Society could no longer continue to be financially responsible for the N.P.L.; but Glazebrook was able to secure that the scientific control of the work by the Society under the pre-existing scheme should continue. In September, 1919, he retired from the directorship, on reaching the age limit.

Glazebrook returned at first to Cambridge, where, of course, he still had many friends. He planned the

production of a "Dictionary of Applied Physics", which, with the co-operation of many expert contributors, was issued in 1922, and has been widely used. But he soon found that the many calls upon his time rendered necessary a return to the neighbourhood of London. For a time he lived actually in London : later he built himself a house at Limpsfield, where he could enjoy the country and his garden, without being involved in too much travelling. He still continued to act as chairman of the Aeronautical Research Committee, as it was now called, which, with a number of sub-committees, already found necessary during the War for special sections of the work in dealing with design and production, had become a most valuable organisation for promoting advance in the science of aeronautics and in aircraft design. The reconstituted committee had the duty of initiating and supervising research and experimental work, and also of advising on the scientific and technical problems connected with the design and construction of aircraft. It was given responsibility for the investigation of air navigation problems and of accidents, and with the aid of the Air Ministry expert staff, assisted greatly in the attainment of safety in flying. In this connexion the reports made by the Committee on the disaster to *R.* 101, and on the accident which gave rise to a prolonged investigation into the causes of 'flutter', may be instanced as illustrating the importance of the work for which Glazebrook was specially responsible. He secured very close co-operation with the American Advisory Committee, and, through its president, Joseph Ames, principal of the Johns Hopkins University, maintained the friendliest relations with those engaged in aeronautical research in the States. From 1920 until 1923 he was Zaharoff professor of aviation and director of the Department of Aeronautics in the Imperial College of Science and Technology. For the prolonged and highly valuable services he thus rendered to aviation in Great Britain he was, in 1933, awarded the Gold Medal of the Royal Aeronautical Society.

Brief mention only can here be made of other public services rendered by Glazebrook during the time when he was director of the N.P.L. and after. He was for many years an active supporter of the Engineering Standards Association, now the British Standards Institution. In 1911 he became a member of the Royal Commission for the Exhibition of 1851, and Mr. Evelyn Shaw has written of the valuable services he rendered as chairman of the Science Scholarship and Industrial Bursary Committees, and of the personal interest he took in the subsequent achievements of the scholars. He was a member also of the Commissions for the Brussels and Turin Exhibitions. He became a member, in 1924, of the Statutory Commission for the University of Cambridge. In 1927 he was appointed a member of the Royal Commission on National Museums and Galleries which presented its report in the years 1929–30 : he was made a member also of the Libraries Sub-Committee, and took especial interest in the proposals for improved facilities at the Science Museum. He was at various times president of the Physical Society, of the Optical Society and of the Institution of Electrical Engineers, and member or honorary member of the Institutions of Civil and Mechanical Engineers, and other technical institutions. He maintained, after his retirement, the closest connexion with the work of the N.P.L., and served on its main research committee and technical committees, as well as on the Executive Committee and the General Board. His friendship with the present director, formed when they served together on the Advisory Committee for Aeronautics from 1909 onwards, has proved of enduring value to the Laboratory.

Glazebrook was made K.C.B. in 1920, shortly after his retirement from the Laboratory, and K.C.V.O. in 1934. He was the recipient of honorary degrees from the Universities of Oxford, Edinburgh, Victoria and Heidelberg. He was Hughes medallist of the Royal Society in 1909, Royal medallist in 1931, and from 1926 until 1929 acted as foreign secretary and vice-president. In 1934 he was a member of the National Committee for Physics of the Royal Society, and a delegate to the International Union of Physics ; and he took a foremost part in the organisation of the International Physics Congress held in London and Cambridge during October of that year. It is interesting to note that he was then again very active in promoting international agreement on the subject of electrical units, a matter which had continued to occupy his mind since the time when he worked under Clerk Maxwell and Lord Rayleigh at Cambridge. Only a few days before his death he wrote a letter on the meaning of certain constants in physics, which appeared in NATURE of December 21.

Glazebrook married in 1883 Frances Gertrude, daughter of the late J. W. Atkinson, of Leeds, who survives him, with their son and three daughters. Their golden wedding was celebrated in June, 1933. Any survey of his life and work would be incomplete which did not call to mind the care and devotion which watched over him throughout all those years.

WE regret to announce the following deaths :

Dr. H. Bolton, formerly curator and director of the Bristol Museum and Art Gallery, president of the Museums Association in 1923–24, on January 18, aged seventy-two years.

Prof. W. E. Byerly, emeritus professor of mathematics in Harvard University, on December 20, aged eighty-six years.

Captain S. R. Douglas, F.R.S., deputy director of the National Institute for Medical Research, and director of the Department of Experimental Pathology, an authority on virus diseases, on January 20, aged sixty-four years.

Prof. T. L. Hankinson, professor of zoology in the Michigan State Normal College, known for his work on animal ecology and on ichthyology, on December 3, aged fifty-nine years.

Dr. Josef Petřik, professor of physiology in the Masaryk University of Brno since 1931, on January 11, aged forty-one years.

News and Views

Broadcast Announcement of King George's Death

ON the occasion of the death of His Majesty King George V on the night of January 20, the organisation of the British Broadcasting Corporation was utilised in communicating the official bulletins to the whole of the British Empire. From 9.30 p.m. onwards, the ordinary broadcasting programmes were stopped, and all the stations of the B.B.C., including those conducting the short-wave Empire service, were linked together, but were kept silent except for the transmission of the official bulletin at 15 minute intervals. At 10 o'clock, a short service of recollection and prayer for the King was broadcast, after which the silent watch between bulletins was resumed. The final announcement of the peaceful death of the King came shortly after midnight. In this way was the great organisation of British broadcasting used in the manner of a gigantic public address system, with literally millions of listeners in all parts of the world constituting the audience. Thus were listeners able to share with the Royal Family the tense anxiety of the last few hours, and to receive simultaneously the news of the passing of our Sovereign. Never before in the history of the world has it been possible for the whole human race to unite in sympathetic response to the messages thus conveyed from Sandringham to listeners everywhere. Truly, "Their sound is gone out into all lands, and their words unto the ends of the world", and the heart of man cannot fail to be touched by this great achievement of science. The imagination of a poet like the late Mr. Rudyard Kipling might well have been stirred by this theme of waves of emotion encompassing the earth to trace the changes which history has seen in methods of proclaiming to the nation the loss of its beloved King.

The Mount Everest Expedition, 1936

WE are glad that Lord Conway, in a letter which appears in our correspondence columns this week, expresses concern that not a single scientific member is included in the personnel of the new expedition to Mount Everest. It is greatly to be regretted that the leader of the expedition has made no provision for carrying on, or continuing, the scientific work of previous expeditions, especially as this could be done without hampering, or impeding in any way, the actual climbing party. The stratigraphy of the neighbouring portions of the Tibetan plateau was worked out by Dr. A. M. Heron in 1921, and the complicated structure of the immediate environs of Everest was studied by Mr. N. E. Odell in 1924 and by Mr. L. R. Wager in 1933. There are, however, many problems of stratigraphy and structure yet awaiting solution in this very important section of the main Himalayan chain. Also, there is much yet to investigate as regards the glaciers, which, on account of the prevailing conditions of high altitude and low temperature, show many unusual features, and exhibit characters that are more 'arctic' than 'temperate' in affinity. Moreover, the researches of the late Mr. A. F. R. Wollaston and Mr. R. W. G. Hingston in the natural history and ecology deserve to be followed up.

WE are strongly of the opinion that an expedition organised with the support of the Royal Geographical Society ought to undertake as a part of its activity some work in an area to which access can only be obtained under special conditions, an area nevertheless of the greatest geological interest. If the climbing expedition is successful, any defects on the scientific side will very probably be overlooked. If, however, the expedition is unsuccessful, criticism will no doubt be very freely levelled against it on the ground that it has achieved nothing. If, however, provision is made for scientific work, that, at any rate, would be achieved even if the main expedition does not realise its object. The conquest of Everest by a climbing party has a certain amount of human interest, but it should not become a newspaper 'stunt' and it should be associated with a desire to increase knowledge if it is to have any scientific value.

Bicentenary of Lagrange, 1736-1813

As stated in our issue of January 4, on January 25 occurs the bicentenary of the birth of the celebrated French mathematician Joseph-Louis Lagrange, a senator of France, a grand officer of the Legion of Honour and a count of the Empire. A born student, Lagrange was gentle and timid in manner, reserved in society, detested controversy, and for the greater part of his life was never in really robust health. Yet by the methodical use of his time and the exercise of his genius, he accomplished an amount of work, seldom, if ever, exceeded by any individual, while his "Mécanique Analytique" has been called one of the most remarkable monuments of human genius. To Sir William Rowan Hamilton, the "Mécanique Analytique" was "a scientific poem". The first thirty years of the life of Lagrange were passed in Turin, his birthplace; the next twenty years in Berlin and the last twenty-seven in Paris. As a young man he set out to visit London, but his journey was interrupted by sickness. He was the correspondent or associate of many of the greatest Continental men of science, such as Euler, D'Alembert, Clairaut, Legendre, Laplace, Borda, Berthollet and de Morveau, and it was the last who, when in October 1793 a decree banished all persons not born in France, secured special exemption for Lagrange so that he might complete some calculations on the theory of projectiles.

IN 1794 Lagrange was given chairs in the Ecole Normale and the Ecole Polytechnique, and his name was the first in the list of members of the Bureau

des Longitudes. He was twice married, his second wife, whom he married in 1792, being the daughter of the astronomer Lemonnier. To this union Lagrange owed much of the happiness of his later years. At the age of seventy-seven years, in the spring of 1813, he was attacked by fainting fits. On April 8 he had a last conversation with Lacépède, Monge and Chaptal, and two days later he passed away. At his funeral in the Panthéon, orations were delivered by Lacépède, then Chancellor of the Legion of Honour, and Laplace. His life was written by Delambre. In 1877 his statue was placed in the hall of the Bureau des Longitudes, and between 1866 and 1892 his works, edited by Serret and Darboux, were published in fourteen volumes.

Prof. Wilhelm Schmidt

AT the annual meeting of the Royal Meteorological Society on January 15, the Symons Gold Medal was presented to Prof. Wilhelm Schmidt, director of the Zentralanstalt für Meteorologie und Geodynamik at Vienna. In presenting the Medal, the president, Lieut.-Col. E. Gold, said that Prof. Schmidt has written important papers in many branches of meteorology. In 1925 he published his book "Der Massenaustausch in freier Luft und verwandte Erscheinungen" which dealt comprehensively with the mechanics of the exchange of air, especially the part played by turbulence, and did much to open up a new chapter in meteorology. In recent years he has devoted great attention to the new subject of 'micro-climatology', which deals with the finer details of climatology, and is especially important for agriculture. In 1934 he lectured on this subject before the Royal Meteorological Society, choosing as his title "Observations on Local Climatology in Austrian Mountains". He has also carried out detailed investigations on the distribution of temperature in Alpine lakes. In 1935 Prof. Schmidt succeeded the late Prof. A. Wallen as president of the International Commission for Agricultural Meteorology, a subject which he has done much to foster. Prof. Schmidt was unable to be present to receive the Medal in person, and Herr von Blass, of the Austrian Embassy, attended on his behalf.

U.S. Stratosphere Balloon *Explorer II*

THE *National Geographic Magazine* of January contains a graphic account together with many interesting photographs of the stratosphere flight of November 11, 1935, of *Explorer II* piloted by Capts. A. W. Stevens and O. A. Anderson. The height achieved was 72,395 ft., corresponding to a pressure of 29·5 mm. The duration of the flight was 8 hr. 13 min., commencing at 7.01 a.m. Mountain Standard Time from Stratobowl near Rapid City in South Dakota and finishing at 3.14 p.m. 12 miles south of White Lake. The flight was completely successful in all its objectives, and we are promised in a future issue of the magazine a detailed account of the scientific results obtained. Capt. Stevens makes mention of practically all the instruments that were referred to in the previous account given of the balloon in NATURE of June 22, 1935; but omits any reference to the Wilson expansion chamber. We hope that this omission is purely accidental, because it is felt that so much could be learned of cosmic rays from observation of tracks made at these high altitudes.

REMARKABLY little went wrong with the arrangements; the fliers had the same experience as M. Max Cosyns. They were discomfited by the fact that the balloon refused to turn, which resulted in uncomfortable temperature conditions within the gondola. We are told that the thermometer placed within the envelope and viewed by binoculars during the flight of the balloon functioned properly, and proved most valuable in enabling the travellers to estimate exactly how much ballast to retain in order to prevent too precipitate a descent. The higher the internal temperature of the gas—helium in this case—the more is spilled at the top of the flight and the less will be the buoyancy during the descent. Stevens says that for him the most exciting moment during the flight was when at a height of 65,000 ft. the balloon became fully spherical and the central appendix opened giving a full view within the mighty sphere above them. One other point interesting to readers of NATURE is an account of the reality of the inversion of the temperature gradient. Actual data for the external temperature are not yet available, but the interior of the gondola rose from 21° F. at a medium height to 43° F. at the top of the flight. Very diverse air currents were met. At the start, the travel was to the south-east, in rising near the top a little north of east and on the descent first due south and then due north. Doubtless many volumes will be filled when all the data available have been worked up. A remarkable feature of the event was the diversity and number of individuals and of public bodies mentioned by Capt. Stevens as having taken an active part in this great experiment. The whole was a triumph of co-operation.

Mr. Ellsworth's Antarctic Flight

IT was on November 23 last year that Mr. Lincoln Ellsworth and his pilot, Mr. H. H. Kenyon, left Dundee Island off Graham Land in their attempt to reach the Bay of Whales in the Ross Sea in a trans-antarctic flight of more than two thousand miles. Their last radio message was received eight hours after their departure. In the hope that the fliers had succeeded in reaching their destination, the R.R.S. *Discovery II* was diverted from her work to make her way to the Bay of Whales, where she arrived on January 16 and found the two airmen alive and well at the camp known as Little America, where Admiral Byrd had left petrol, stores and huts two years ago. Mr. Ellsworth's own ship *Wyatt Earp* was also making for the Bay of Whales after visiting Charcot Land and other places according to prearranged orders. It appears that the American aeroplane descended twenty miles short of Little America owing to lack of fuel. The men sledged to safety, for the plane carried a small sledge. Their wireless set failed, and

Recent Scientific and Technical Books

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics: Mechanics: Physics

Anderson, Oskar. Einführung in die mathematische Statistik. Roy. 8vo. Pp. 314. (Wien und Berlin: Julius Springer, 1935.) 22 gold marks.

Bouligand, G.; Brunold, Ch.; Grumbach, A.; Morand, M.; Sergescu, P.; Taboury, M., et **Turpain, A.** L'évolution des sciences physiques et mathématiques. (Bibliothèque de Philosophie scientifique.) 8vo. Pp. 267. (Paris: Ernest Flammarion, 1935.) 12 francs.

Clements, Guy Roger, and **Wilson, Levi Thomas.** Analytical and Applied Mechanics. Med. 8vo. Pp. ix +420. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 21*s.* net.*

Doczekal, Rudolf. Absolute thermische Daten und Gleichgewichtskonstante: Anleitung, Tabellen und Nomogramme zur praktischen Durchführung von Berechnungen. Unter Mitarbeit von Heinrich Pitsch. Roy. 8vo. Pp. iv +69 +3 plates. (Wien und Berlin: Julius Springer, 1935.) 6.60 gold marks.

Eggert, J., und Schiebold, E., Herausgegeben von. Anwendungen der Durchstrahlungsverfahren in der Technik. (Ergebnisse der technischen Röntgenkunde, Band 5.) Pp. viii +118. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 13.50 gold marks.

Fues, E. Einführung in die Quantenmechanik. (Sonderausgabe aus Handbuch der Experimentalphysik, Ergänzungswerk 2.) Pp. viii +224. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 14 gold marks.

Fues, E. Beugungsversuche mit Materiewellen: Einführung in die Quantenmechanik. (Handbuch der Experimentalphysik, Ergänzungswerk, Band 2.) Pp. xiv + 351. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 28 gold marks.

Holzer, Wolfgang, and **Weissenberg, Eugen.** Foundations of Short Wave Therapy: Physics—Technics—Indications; an Introduction to the Physico-Technical Principles and Medical Applications of Short Electric Waves, for Physicians and Biologists. Physics and Technics, by Wolfgang Holzer; Medical Applications, by Eugen Weissenberg. Translated by Justina Wilson and Charles M. Dowse. Demy 8vo. Pp. 228. (London: Hutchinson's Scientific and Technical Publications, 1935.) 12*s.* 6*d.* net.*

Knowlton, A. A., and **O'Day, Marcus.** Laboratory Manual in Physics. Second edition. Med. 8vo. Pp. xi + 137. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 7*s.* 6*d.* net.*

Laue, M. v. Die Interferenzen von Röntgen- und Elektronenstrahlen: Fünf Vorträge. Demy 8vo. Pp. 46. (Berlin: Julius Springer, 1935.) 3.60 gold marks.*

Leroy, Florentin. Cours d'algèbre et d'analyse: Essai d'enseignement intuitif et concret. Tome 1: Algèbre. 8vo. Pp. 201. (Paris: Libr. Vuibert, 1936.) 24 francs.

Krönert, Josef. Messbrücken und Kompensatoren. Band 1: Theoretische Grundlagen. Roy. 8vo. Pp. 275. (München und Berlin: R. Oldenbourg, 1935.) 13.80 gold marks.

Mandelbrojt, S. Séries de Fourier et classes quasi analytiques de fonctions. (Leçons professées à l'Institut Henri-Poincaré et à la Faculté des Sciences de Clermont-Ferrand.) (Collection de monographies sur la théorie des fonctions.) 8vo. Pp. 157. (Paris: Gauthier-Villars, 1935.) 35 francs.

Richmond, Donald E. The Dilemma of Modern Physics: Waves or Particles? 8vo. Pp. 120. (New York and London: Putnam and Co., Ltd., 1935.) 7*s.* 6*d.* net.

Rothe, R. Höhere Mathematik für Mathematiker, Physiker und Ingenieure, Teil 3. (Teubners mathematische Leitfäden, Band 23.) 8vo. Pp. 238. (Leipzig und Berlin: B. G. Teubner, 1935.) 6.60 gold marks.

Saha, M. N., and **Srivastava, B. N.** A Treatise on Heat (including Kinetic Theory of Gases, Thermodynamics and Recent Advances in Statistical Thermodynamics): being the second and revised edition of "A Text Book of Heat". Second edition. Sup. Roy. 8vo. Pp. xii +815 +2 plates. (Allahabad and Calcutta: The Indian Press, Ltd., 1935.) 27*s.**

Sengupta, U., assisted by **Sengupta, Abaniranjan,** and **Dasgupta, Haralal.** Geometry, treated as a Science. Cr. 8vo. Pp. vii +105. (Calcutta: Abaniranjan Sengupta, 1935.) 1.4 rupees.*

Stephenson, R. J. Exploring in Physics: a New Outlook on Problems in Physics. Roy. 8vo. Pp. xiv +206. (Chicago: University of Chicago Press; London: Cambridge University Press, 1935.) 7*s.* net.

Van Deuren, Pierre. Leçons sur le calcul des probabilités. Tome 2: Les applications des probabilités. 4to. Pp. 572. (Paris: Gauthier-Villars, 1935.) 100 francs.

Walsh, J. L. Interpolation and Approximation by Rational Functions in the Complex Domain. (American Mathematical Society: Colloquium Publications, Vol. 20.) Sup. Roy. 8vo. Pp. ix +382. (New York: American Mathematical Society; Cambridge: Bowes and Bowes, 1935.) 5 dollars.*

Watson, Floyd Rowe. Sound: an Elementary Textbook on the Science of Sound and the Phenomena of Hearing. Med. 8vo. Pp. ix +219. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 12*s.* 6*d.* net.*

Engineering

Agg, Thomas R., and **Foster, Walter L.** The Preparation of Engineering Reports. Cr. 8vo. Pp. 192. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 10*s.* 6*d.* net.

Avery, Alfred H. Small Alternating Current Motors. Cr. 8vo. Pp. 51. (London: Percival Marshall and Co., Ltd., 1935.) 1*s.* 6*d.* net.

Beck, E. G., Edited by. Practical Engineer Mechanical Pocket Book and Diary, 1936. (48th year.) 18mo. (London: Oxford University Press, 1935.) 2*s.* 6*d.* net.

Bergtold, F. Hilfsbuch für Rundfunk- und Verstärkertechnik. 8vo. Pp. 136. (Berlin: Weidmann Verlag, 1935.) 6 gold marks.

Bolz, G., Moeller, F., und **Werr, Th.** Elektrotechnik: ein Leitfaden für Studium und Praxis. Band 2, Teil 3–4. Roy. 8vo. Pp. 80 +125. (Berlin und Leipzig: B. G. Teubner, 1935.) 10 gold marks.

Bolz, G., Moeller, F., und **Werr, Th.** Leitfaden der Elektrotechnik, Teil 4. (Teubners H.T.L.-Bücherei, Band 107.) Roy. 8vo. Pp. 130. (Berlin und Leipzig: B. G. Teubner, 1935.) 4.60 gold marks.

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Dock, H. Aufnahmearbeiten in der terrestrischen Stereophotogrammetrie. (Terrestrischen Stereophotogrammetrie, Band 1.) Roy. 8vo. Pp. 110. (Wien und Leipzig: Carl Gerolds Sohn, 1935.) 7 gold marks.

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Guillemin, Ernst A. Communication Networks. Vol. 2: The Classical Theory of Long Lines, Filters and related Networks. Med. 8vo. Pp. vii +587. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 37*s.* 6*d.* net.*

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Jenkins, John G. Psychology in Business and Industry: an Introduction to Psychotechnology. Ex. Cr. 8vo. Pp. xii +388. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 12*s.* 6*d.* net.*

Joseph, H. W. B. Essays in Ancient and Modern Philosophy. Demy 8vo. Pp. 340. (London: Oxford University Press, 1935.) 15*s.* net.

Maier, N. R. F., and **Schneirla, T. C.** Principles of Animal Psychology. Med. 8vo. Pp. 543. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 24*s.* net.

Phillips, R. P. Modern Thomistic Philosophy. Vol. 2: Metaphysics. Demy 8vo. Pp. 412. (London: Burns, Oates and Washbourne, Ltd., 1935.) 9*s.* net.

Quarto di Palo, A. Sintesi di un sistema filosofico. 8vo. Pp. 252. (Roma: P. Maglione, 1935.) 12 lire.

Sondergeld, W. Affektive Erregbarkeit und Objektionsfähigkeit: ein Beitrag zur Typenlehre. (Untersuchungen zur Psychologie, Philosophie und Pädagogik, Neue Folge, Band 10, Heft 2.) Roy. 8vo. Pp. 66. (Göttingen: Akademische Buchhandlung Calvör, 1935.) 3 gold marks.

Spiller, G. The Origin and Nature of Man: an Enquiry into Fundamentals. Second edition. Med. 8vo. Pp. 397. (London: Williams and Norgate, Ltd., 1935.) 7*s.* 6*d.* net.

Stovin, Harold. Totem: the Exploitation of Youth. Cr. 8vo. Pp. vii +237. (London: Methuen and Co., Ltd., 1935.) 5*s.* net.

Taylor, H. M. Life's Unknown Ruler: an Exposition of the Teaching of Georg Groddeck, M.D. Cr. 8vo. Pp. 80. (London: The C. W. Daniel Co., Ltd., 1935.) 2*s.* 6*d.* net.*

Wells, H. G. What are we to do with our Lives? (Thinker's Library, No. 55.) Fcap. 8vo. Pp. vi +150. (London: Watts and Co., 1935.) 1*s.* net.

Whitwell, J. R. Gleanings from Plato. Cr. 8vo. Pp. 95. (London: Gerald Duckworth and Co., Ltd.. 1935.) 3*s.* 6*d.* net.

Wulf, Maurice de. History of Mediæval Philosophy. Translated by Ernest C. Messenger. Vol. 1: From the Beginnings to the End of the Twelfth Century. Third English edition based on the sixth French edition. Demy 8vo. Pp. xiv +317. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 12*s.* 6*d.* net.

Bacteriology: Hygiene

Diehl, Harold. Healthful Living. Demy 8vo. Pp. 363. (New York and London: McGraw-Hill Book Co. Inc., 1935.) 12*s.* 6*d.* net.

Havens, Leon C. The Bacteriology of Typhoid, Salmonella and Dysentery Infections and Carrier States. Edited by Kenneth F. Maxcy. Med. 8vo. Pp. xiii +158. (New York: The Commonwealth Fund; London: Oxford University Press, 1935.) 7*s.* 6*d.* net.*

Hoder, Friedrich. Der Verkehr des praktischen Ärztes mit der bakteriologischen Untersuchungsstation. Roy. 8vo. Pp. vii +126. (Jena: Gustav Fischer, 1935.) 5 gold marks.

Medical Research Council. Special Report Series, No. 205: The Source of Infection in Puerperal Fever due to Hæmolytic Streptococci. By Dora C. Colebrook. Roy. 8vo. Pp. ii +99. (London: H.M. Stationery Office, 1935.) 1*s.* 6*d.* net.*

Müller, Reimer. Lehrbuch der Hygiene für Ärzte und Biologen. (Lehmanns mediz. Lehrbücher, Band 14.) Sup. Roy. 8vo. Pp. 305. (München: J. F. Lehmann, 1935.) 6.80 gold marks.

Miscellany

Allcott, A. The Young Observers: a Simple Science Series for Reading and Study. Imp. 16mo. Book 5. Pp. 192. Book 6. Pp. 192. Book 7. Pp. 192. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1935.) 2*s.* 3*d.* each.

Andrews, P. E., and **Lambert, H. G.** An Introduction to Science. (Longmans' Introductory Books on Science.) New and enlarged edition. Cr. 8vo. Pp. x +166. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 2*s.* 6*d.*

Cohen, Henry. New Pathways in Medicine: a Public Inaugural Lecture delivered in the University of Liverpool. Cr. 4to. Pp. 19. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1935.) 1*s.* net.*

Darlison, J. J. The New Art of Healing, Osteopathy: Some Popular Questions Answered. Med. 8vo. Pp. xii + 50 +9 plates. (London: W. H. Smith and Son, Ltd., 1935.) 1*s.*

Hartog, Sir Philip, and **Rhodes, E.C.** An Examination of Examinations: being a Summary of Investigations on the Comparison of Marks allotted to Examination Scripts by Independent Examiners and Boards of Examiners, together with a Section on a Viva Voce Examination. Med. 8vo. Pp. 81. (London: Macmillan and Co., Ltd., 1935.) 1*s.*

Hathaway, Esse V. Partners in Progress. Med. 8vo. Pp. vii +303 (12 plates). (New York and London: McGraw-Hill Book Co., Inc., 1935.) 15*s.* net.*

Hodgman, Charles D., Editor-in-Chief. Handbook of Chemistry and Physics: a Ready-Reference Book of Chemical and Physical Data. Twentieth edition. Fcap. 8vo. Pp. xiv +1951. (Cleveland, Ohio: Chemical Rubber Publishing Co.; London: A. Harvey, 1935.) 6 dollars; 25*s.*

Jacot, B. L., and **Collier, D. M. B.** Marconi—Master of Space. Roy. 8vo. Pp. 287. (London: Hutchinson and Co., Ltd., 1935.) 18*s.* net.

Jaffe, Bernard. Outposts of Science: a Journey to the Workshops of our Leading Men of Science. Roy 8vo. Pp. xxvi +547 +32 plates. (New York: Simon and Schuster, Inc., 1935.) 3.75 dollars.*

Mahaffy, R. P. Highway and Road-Traffic Law. (The Roadmakers' Library, Vol. 4.) Med. 8vo. Pp. viii +202. (London: Edward Arnold and Co., 1935.) 15*s.* net.*

Marett, R. R. Tylor. (Modern Sociologists.) Cr. 8vo. Pp. 220. (London: Chapman and Hall, Ltd., 1936.) 6*s.* net.*

Oppenheimer, C., und **Pincussen, L.,** Herausgegeben von. Tabulæ Biologicæ Periodicæ. Band 5, Nr. 3 (=Tabulæ Biologicæ, Band 11, Nr. 3). Sup. Roy. 8vo. Pp. 225-320. (Den Haag: W. Junk, 1935.) Band 5, complete, 58 gold marks.*

Parker, Arthur C. A Manual for History Museums. (New York State Historical Association Series, No. 3.) Med. 8vo. Pp. xvii +204 +22 plates. (New York: Columbia University Press; London: Oxford University Press, 1935.) 15*s.* net.*

Roche, Alex. E. Medical and other Verses. Cr. 8vo. Pp. x +92. (London: H. K. Lewis and Co., Ltd., 1935.) 3*s.* 6*d.* net.*

Ryle, John A. The Aims and Methods of Medical Science: an Inaugural Lecture. Cr. 8vo. Pp. 44. (Cambridge: At the University Press, 1935.) 2*s.* net.*

Schleich, Carl Ludwig. Those Were Good Days! Reminiscences. Translated by Bernard Miall. Demy 8vo. Pg. 280 +9 plates. (London: George Allen and Unwin, Ltd., 1935.) 12*s.* 6*d.* net.*

Science Masters' Book. Series 2. Part 1: Physics; being Experiments selected from the *School Science Review* by a Committee of the Science Masters' Association. Edited and arranged by G. H. J. Adlam. Demy 8vo. Pp. xvi +273 +xv. Part 2: Biology, Chemistry, Experiments for Receptions; being Experiments selected from the *School Science Review* by a Committee of the Science Masters' Association. Edited and arranged by G. H. J. Adlam. Demy 8vo. Pp. xvi +252 +xv. (London: John Murray, 1936.) 7*s.* 6*d.* net each Part.*

Scientific and Learned Societies. The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland; with a Record of Publications issued during Session 1934-1935. Compiled from Official Sources. Fifty-second Annual Issue. Demy 8vo. Pp. vii +169. (London: Charles Griffin and Co., Ltd., 1935.) 10*s.*

hence the many weeks of anxiety as to their fate. Details of the flight are awaited with interest, since the route was across the unexplored Hearst Land and presumably over the unknown extension of the Queen Maud Ranges.

Jubilee of the Aga Khan

IN the celebration of the jubilee of the Aga Khan on January 19 and four succeeding days in Bombay, one of the most striking incidents, perhaps for its incongruity, has been the assessment of the tribute from his followers to mark the occasion by the ceremonial of weighing His Highness against bars of gold in a huge balance. This is the usual method by which the contributions to his personal expenditure are determined annually; but, on this occasion, the £25,125 representing the value of the weight of gold at which he 'tipped the balance' is to be devoted by his decision to the benefit of his community. By his activities in Europe the Aga Khan has become so intimately known to the public that the significance of his position in India is sometimes overlooked. Without territory, as hereditary Imam of the Ismailia sect, he is spiritual head and virtual dictator to a body variously estimated at from four to twenty millions, and distributed over north and east Africa, Central Asia, India and Burma. Although the Ismailia sect is regarded as heretical by both Sunni and Shiah, from the latter of whom it originally derived, in India the Aga Khan by his personal qualities, his influence and his services, has come to be regarded as in some sort the representative of the Moslem community. His hereditary position and influence are derived not so much from his descent from the Prophet, as from the fact that he is of the line of the "Old Man of the Mountains", the legendary figure of the Middle Ages, by whom the Ismailia sect was founded, and whose fanatical followers, the Assassins, were said to be devoted to his service through the use of hashish, whence their name. The leaders of the Ismailia dominated Syria in the twelfth century until overcome by the Mongols. They then settled in Persia, the grandfather of the Aga Khan going to Bombay in 1845.

Cave Exploration in South Australia

A REMARKABLE series of discoveries made in the course of cave exploration in South Australia is described by the Adelaide correspondent of *The Times* in the issue of January 16. The caves are situated in the Nullarbour Plain, which itself is not the least remarkable feature in the geography of South Australia. It is a treeless expanse of some 38,000 square miles in extent, which has made a deep impression even on the imagination of the aborigines; for it figures prominently in their legendary lore, one belief being that it is the home of an immense serpent, which devours human beings who enter its province. At different times a number of attempts have been made to explore the caves of the Plain, but without marked success. The present expedition was carried out by a party of nine, of whom the leader was Capt. Maitland Thompson of Port Lincoln. It started from Ceduna in November last. A number of caves were examined, of which the most impressive was the Koonalda Cave, situated sixty miles from Eucla. The entrance was in an almost vertical shaft and was reached by ladder. Passing through a chamber eight hundred feet in circumference, the exploring party penetrated for more than half a mile to a narrow passage leading to a subterranean well fifty feet in diameter; while another tunnel was followed to a distance of 2,400 ft. from the entrance until the passage forked and further progress was blocked by water. An interesting piece of evidence of previous penetration was found near the well in the form of an impression in the sand of the foot of an aboriginal.

IN the Weebubble Cave, a canoe, which the party had brought with them, came into use and after effecting an entry to a circular entrance hole three hundred feet across in the face of an eighty foot cliff, a tunnel was followed until a vast room, of which the back wall was four hundred yards from the entrance, was reached. Here the water, 320 ft. below the surface, was at the level of the sea fourteen miles away. The lake was found to have a depth of twenty feet at the edge and more than two hundred feet at the centre. An interesting piece of evidence of the attitude of the aborigines towards these remarkable caves was found at the Murrawidginnie Cave, where at the entrance were a number of imprints of the human hand (usually the left) in red on the surface of the rock, which was also daubed or stained with red ochre. The practice of the Australian aboriginal of leaving the imprint of his hand on a rock surface has been recorded from numerous districts on the continent and is a custom which he shares with the Bushman and palæolithic man of Europe. Frequently the fingers show mutilations. Various explanations of the custom have been offered, and it may be that in the present instance it is correctly interpreted as a taboo sign, especially as it is believed that the cave may have been used as a store-house for the churingas and other emblems which were used in tribal ceremonial. Among other caves explored was the Abrakurrie Cave, where a drop of 250 ft. led to a cavern 1,200 ft. long, 160 ft. wide and 150 ft. high. It is proposed to follow this very successful exploration with further investigations, the next immediate objective being a search for the caverns known as "The Catacombs", of which the situation, frequently sought, appears to have been established by a recent aerial reconnaissance.

Association of British Zoologists

THE annual meeting of the Association of British Zoologists was held in the rooms of the Zoological Society on Saturday, January 4, Prof. J. S. Huxley being in the chair. At the previous meeting the Association had appointed a committee to inquire into any means which could be devised to lessen the confusion at present caused by frequent changes in the scientific names of animals, and especially of the common species used in schools and universities as

types for teaching and experiment. Mr. H. R. Hewer, secretary of the Association, read the report of this committee. A list of the names accepted at present as correct for a large number of animals has been prepared, and it is hoped to publish this list in the near future. Prof. J. W. Munro, of the Imperial College of Science, opened a discussion on the extent of the opportunities which are at present available to junior members of the staffs of the universities for carrying on individual research. Dr. B. Dawes, Mr. C. C. Hentschell, Dr. E. B. Worthington and others spoke on this subject. It was the general view that, so long as promotion in the universities is made to depend, as it so often is at present, on the results of research, the members of the staffs should be given more opportunities for carrying out this research. Either increase in the number of the staffs, or provision of research grants for members of the teaching staff by which they could be released from teaching duties in whole or in part for short periods, would ease the position. A third discussion was held on the conditions under which consultant work in zoology is being carried on. Such work has considerably increased in recent years in spite of the existence of several institutions provided by the Government for the study of problems in economic zoology. Dr. J. C. F. Fryer of the Ministry of Agriculture, Dr. R. C. Fisher of the Forest Products Research Laboratory, Princes Risborough, and Mr. H. R. Hewer spoke in this discussion, and the Council of the Association was asked to make inquiries whether it would be possible to prepare a list of recognised zoologists qualified to give advice on these matters.

Science and Values

In his retiring presidential address to the American Association for the Advancement of Science delivered at St. Louis on December 30, Prof. E. L. Thorndike, under the title "Science and Values", discussed the psychology of values in its relation to the competence of science to improve the judgments of value and esteem which rule men, and the possible contribution of scientific methods in the treatment of moral questions. Pointing out that the discussion of questions of value by philosophic thinkers has made little advance since the time of Aristotle in spite of the general advance of knowledge, Prof. Thorndike asserted that judgments of value or worth are simply a special sort of judgments of fact or existence, distinguished by being concerned with consequences, and with consequences to the wants of sentient beings. Values, positive or negative, reside in the satisfaction or annoyance felt by animals, persons or deities, and while competent students judge the existence of things by observations, they judge the values of things by observations of their consequences. Creating and enjoying truth or beauty are examples of the class of satisfiers which involve positive satisfaction for some without subtraction from, and often with addition to, those of others. Where satisfactions and annoyances lie within the natural world of men or animals, they are amenable to scientific study. Sometimes indeed it is necessary to judge the value of things, events and relations indirectly by their affiliations, for which a special technique is required.

Although, therefore, values are difficult to determine, they are not banished entirely from the realm of science but are amenable to scientific methods. The work of a science of values, a realistic ethics, is to learn what men do want and how to improve their wants, and to trace the consequences of acts, events, ideas, attitudes, etc. So far, science has tended to leave values alone; but it is not wise to leave decisions about consequences entirely to the humanists. We should regard nothing as outside the scope of science, and every regularity or law that science can discover in the consequences of events is a step towards the only freedom that is of use to man and an aid in the good life. If values do not reside in the orderly world of Nature but depend on chance and caprice, it would be in vain to try to increase them. The world needs not only the vision and valuation of great sages, and the practical psychology of men of affairs, but also scientific methods to test the worth of the prophets' dreams, and scientific humanists to inform and advise its men of affairs, not only about what is, but also about what is right and good.

New Type of Aircraft Structure

Messrs. Vickers (Aviation) Ltd. have commenced work upon a production order of 'Wellesley' military aeroplanes, introducing a type of construction with an estimated saving of 35–40 per cent in structure weight, which can be used for increasing either useful carrying capacity or extra fuel, giving greater range. It is known as the 'geodetic' principle, and has been developed by Mr. B. N. Wallis, from a similar method used by him in the construction of the British airship *R.100*. The general principle is that the stresses in the structure are taken by a skin which follows a path between any two points taken by the surface of a cylinder or sphere. The skin is built up by a large number of small members, placed criss-cross, disposed of in such a way, and of the correct size, to take the local loading most advantageously. Thus the advantage of a skin construction, in that the interior of the wing or body is left clear, is obtained, with the added gain that local damage, as from gun fire, is confined to the actual parts broken, and does not spread catastrophically, as in the case of a very thin continuous skin. Stressed skin construction has many advantages. The higher loading with increased speeds can be taken with a proportionately smaller increase in weight than with the more conventional structures. The absence of interior bracing simplifies the questions of storage of the carried load. The problem of producing a wing of variable area to suit varying flight conditions becomes feasible, by making the outer wing portions telescopic, which is almost an impossibility with an interior stressed structure.

Collared Peccaries

ALL interested in the breeding of wild animals in captivity will welcome the announcement that two collared peccaries have just been born in the Gardens of the Zoological Society of London, for it is many years since a like event took place there. Though 'pigs' in the general sense of the term, the peccaries, of which there are two species, are found only in North and South America. They differ from the pigs of the Old World in many particulars. In the matter of their dentition they have fewer teeth than the true swine, and the upper tusks turn downwards, not outwards and upwards, as in, say, the wild-boar. They have small ears, and no more than a vestige of a tail; and only three instead of four hind-toes. Further, no more than two are produced at a birth, and these are never striped as are so many wild swine of the Old World. They display yet another peculiarity in having a large scent-gland in the middle of the back, producing a most evil-smelling exudation. If this gland is not removed immediately after death, the whole flesh becomes tainted and uneatable. The collared peccary, which ranges from Texas to Patagonia, is a harmless animal; but its larger relative, the white-tipped peccary, has a bad reputation on account of its ferocity. It has, however, a more restricted geographical distribution, extending northwards no farther than Honduras, while its southward limit is Paraguay. But it roams in large herds, unlike its smaller relative which lives in small communities. Both species haunt dense forests, feeding on roots and fruits, hence, in the neighbourhood of inhabited areas they do great damage to crops.

Birth of a Chimpanzee

"WEDNESDAY", a chimpanzee in the Scottish National Zoological Park at Edinburgh, gave birth to a 'baby' on January 17. The only other records of chimpanzee births in Great Britain are "Adam", born in Clifton (Bristol) in May 1934, and "Jubilee" (a female) born in the London Zoo last February. "Wednesday" is of gentle disposition, and her temper has been quiet throughout gestation; she has fed well, and been normal in every way. The birth is a month earlier than was expected, but the 'baby' was born without trouble, and seems to be fully developed and quite fit in every way. "Wednesday" was brought up from an early age by Mr. Wm. Galloway of Glasgow and Accra, and was presented to the Zoological Park in July 1934, when she was about eight years old.

Operation of the Lucerne Plan in Broadcasting

THE broadcasting stations of Europe have now been working for two years in accordance with the Lucerne plan, by which a redistribution of wavelengths was put into operation on the night of January 14–15, 1934 (see NATURE of December 2, 1933, and January 20, 1934). A review of the working of this arrangement during the past two years is given in *World Radio* of January 17. The Lucerne plan has been more nearly applied than its predecessors of Geneva, Brussels and Prague, but the recommendations of the plan have not been fully adopted even by some of the countries which signed it. This failure is chiefly confined to the long-wave broadcast band, in which portions of three separate international arrangements now co-exist. On the medium waves, the position is much clearer and, generally speaking, the broadcasting stations are in their allotted places. The exceptions are chiefly confined to cases in which frequencies were allotted in the plan to stations not yet built, and these are now being used temporarily by other stations. A noteworthy development which has resulted from the application of the Lucerne plan is in the increased stability of frequency of broadcast transmitters which has taken place. The plan recommended a tolerance of ± 50 cycles per second for stations using exclusive waves, and of ± 10 cycles per second for stations using shared waves. A table of observations given in the article referred to above shows that in November 1935, 107 stations had attained the first limit, while 67 stations came within the smaller tolerance. Actually 12 stations showed a maximum deviation from their normal frequencies of 1 cycle per second or less. On the whole, it may be said that the results of international co-operation on the technical aspects of broadcasting in Europe have been fairly satisfactory; for some 230 stations in thirty-five different countries are now working relatively free of interference.

Electricity Production in North America and Great Britain

AN interesting comparison is made by Mr. H. E. M. Kensit in *World Power* of November of the comparative progress made in electricity production by Great Britain, Canada and the United States. The diagrams of electricity production during the past ten years prove that while both the United States and Canada show actual retrogression in consumption during the period 1929–32 of the world-wide depression in industry, Britain made continuous progress throughout it. The average annual progress of Britain over the last ten years has been greater than in either of the other countries. In total production also, Britain is gaining. The conditions affecting the comparison in the three countries are not quite the same. The United States includes in its records of consumption a considerable amount of power generated in Canada and imported. It also includes that portion of the power generated by private manufacturers which is sold by them. Corresponding amounts do not appear in the British items. For the last ten years the average progress in Britain is 10 per cent, in Canada 8·5 and in the United States 4·5. The total outputs in 1934 for the three countries are 17,000, 21,000 and 91,000 million kilowatt hours respectively. The good showing on the British side is attributed by the Americans to British Government enterprise and to the energy and able administration of the Electricity Commissioners. In Canada, owing to the abundance of cheap water-power, about 30 per cent of the total power is exported or used for operating steam electric boilers in connexion with pulp and paper mills.

The 1934 Locust Invasions

IN the report of the Committee on Locust Control prepared by Dr. B. P. Uvarov and published by the Economic Advisory Council in 1935, a detailed account is given of the locust outbreak in Africa and western Asia in 1934. The present survey of the situation is the fourth of its kind, its predecessors covering the years 1925–32. These series of publications make it possible to trace the outbreak of each species of locust from its earliest stage, and it is evident that the present invasion is already in its tenth year and still continuing. Altogether, four species of locusts are involved, and the data respecting them supply convincing proof that the usual idea that locusts are serious but transient pests is fallacious, at any rate, in so far as Africa is concerned. With a sequence of four different species, it appears that a period when no swarms of any of these will be present in the whole continent will be long in coming. It appears even probable that there are no such periods, and that danger from locusts is permanent and not intermittent. An encouraging outcome of the work embodied in this report is the fact that a clear understanding of the origin and course of the outbreak of each locust species is gradually developing and replacing the fragmentary knowledge previously available.

Viscount Grey Memorial

AN appeal has recently been issued to erect a memorial to Lord Grey of Fallodon. Apart from his fame as a statesman, Lord Grey will be remembered as a lover of Nature. In writings that combine the poetry and the science of bird observation, he has taught many to find the purest and most lasting joys of mind and heart. It is proposed to erect a threefold memorial: (1) To set up a statue or bust in a central spot in London; (2) To acquire and make over to the National Trust 'Ross Castle', the small hill-top crowned by an ancient earthwork which adjoins Chillingham Park in Northumberland, a favourite view-point of Lord Grey's, which he often visited from Fallodon; (3) To develop (by further endowment and otherwise) the existing scheme of research maintained by the British Trust for Ornithology at Oxford, of which University he was an undergraduate and in later years the Chancellor, to form a permanent Institute of Bird Studies, to which his name would be attached. Further information can be obtained from the Secretary, The Viscount Grey Memorial, 7 Buckingham Palace Gardens, London, S.W.1.

Polar Year Book

THE great activity of Norwegians in polar exploration and economic development finds expression in the well-illustrated *Polar-årboken*, of which the 1935 issue has recently been published. In addition to a great deal of polar news, in which Spitsbergen is prominent, there are various articles, some in a lighter vein, but most of a serious nature. Mr. O. Sund gives a useful account of the distribution of food fishes in west Greenland waters, and Mr. A. Lidtveit discusses plant growth and possibilities of agriculture in the same land. Dr. A. Hoel has some interesting notes on the use of ice-breakers in Spitsbergen in relation to the export of coal. The book is published by Gyldendal Norsk Forlag at Oslo.

Cracking of Potato Tubers

A SHORT article by Messrs. A. Powell Jones and H. I. Moore, in the *Gardeners' Chronicle* of December 21, directs the attention of farmers and gardeners to the possibility of lifting potatoes in a turgid condition. The slightest damage to the skins of tubers in such a state will produce unsightly cracks which reduce the culinary value and so lower the financial returns from the crop. Turgidity may be induced naturally, as when copious rain follows drought or severe frost, or it may occur if the foliage is killed by spray chemicals. The turgid condition passes after a day or two, and the tubers can then be harvested with safety.

Botanical Society of America

THE Botanical Society of America at its thirtieth annual meeting held on December 31, 1935–January 2, 1936, in St. Louis, Missouri, elected the following botanists to corresponding membership: Prof. N. E. Svedelius, professor of botany and director of the Botanic Gardens of the University of Uppsala; Dr. A. B. Rendle, lately keeper of botany in the British Museum (Natural History); Prof. Fritz von Wettstein, director of the Botanical Institutes and professor of botany in the University of Münich; and Prof. N. A. Maximov, professor in the Union Institute for Grain Husbandry, Saratov, U.S.S.R. Officers elected at the same meeting were: *President*, Dr. C. Stuart Gager, director of the Brooklyn Botanic Garden, Brooklyn, New York; *Vice-President*, Dr. H. A. Gleason, curator and assistant director of the New York Botanical Garden, New York City.

Awards of the Geological Society

THE following awards of the Geological Society of London have recently been made: Wollaston Medal to Prof. G. A. F. Molengraaff, of Delft, in recognition of "his researches concerning the mineral structure of the earth", in many widely separated areas, and especially in the Dutch East Indies and South Africa; Murchison Medal to Mr. E. E. L. Dixon, of H.M. Geological Survey, in recognition of the value of his geological researches, especially in South Wales and the north of England; a Lyell Medal to Mrs. Eleanor Mary Reid, in recognition of her researches on the fossil floras of the Tertiary and Pleistocene rocks; another Lyell Medal to Prof. L. J. Wills, of the University of Birmingham, for his work on the palæontology and stratigraphy of the Midlands; the balance of the proceeds of the Wollaston Donation Fund to Dr. G. H. Mitchell, for his work on the succession and structure of the Lake District; the balance of the proceeds of the Murchison Fund to Dr. Emily Dix, in recognition of her studies on the sequence of fossil plants in the Coal Measures of England and Wales; the balance of the proceeds of

the Lyell Geological Fund to Dr. S. W. Wooldridge, for his researches on the geology and geomorphology of southern England, and especially of the London Basin.

Announcements

DR. C. V. DRYSDALE, director of scientific research, Admiralty, in 1929–34, has been awarded the thirteenth Duddell Medal of the Physical Society for his outstanding work in connexion with electrical and optical instruments.

THE council of the Institution of Electrical Engineers has made the fourteenth award of the Faraday Medal to Sir William H. Bragg. The Faraday Medal is awarded by the Council of the Institution not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution. It is also announced that Sir John F. C. Snell has been elected an honorary member of the Institution.

MR. R. W. DANA was entertained at dinner at the Royal Societies Club on January 16 by the president, honorary vice-presidents, vice-presidents and members of council of the Institution of Naval Architects, to mark his retirement from the position of secretary to the Institution, which he has held for more than thirty-four years. Presentations were made to Mr. Dana, including the diploma of honorary membership of the Institution.

MESSRS. EDWARD ARNOLD AND CO. inform us that, owing, probably, to the return in error of an incorrect proof to the printers, Prof. L. W. Collet's "Structure of the Alps" (new edition) appears in the advertisements of NATURE of January 18 with the price 16*s*. net; the price of the new edition is, in fact, 20*s*. net.

AT the meeting of the Quekett Microscopical Club held on January 14, Sir David Prain was elected an honorary member of the Club. Sir David was director of the Botanical Survey of India and superintendent of the Royal Botanic Gardens, Calcutta, 1898–1905, and director of the Royal Botanic Gardens, Kew, in 1905–1922.

THE Huxley Lecture of the University of Birmingham is to be delivered on February 25, at 5.30 p.m., by Sir Joseph Barcroft, professor of physiology in the University of Cambridge, who has chosen as his subject "The Influence of Chemical Conditions on Mental States".

MR. T. W. HILL, secretary of the Athenæum Club, is resigning his office on May 11 next at the annual general meeting of the club. The committee has appointed as his successor Mr. N. R. Udal, at present bursar of Clifton College, and formerly of the Sudan Civil Service, where he was latterly warden of the Gordon College, Khartoum.

THE Japan Society for Investigation of Cancer has awarded its annual prize for 1935 to Dr. P. Yoshida of the Sasaki Institute for his successful production of tumours in the livers of white rats.

AT the meeting of the Royal Meteorological Society on January 15, the following officers were elected: *President:* Dr. F. J. W. Whipple; *Vice-Presidents:* Mrs. Charles J. P. Cave, Lieut.-Col. Ernest Gold, Capt. W. N. McClean, W. M. Witchell; *Treasurer:* R. A. Watson Watt; *Secretaries:* Dr. J. Glasspoole, E. L. Hawke, M. McCullum Fairgrieve; *Foreign Secretary:* Capt. C. J. P. Cave; *New Members of Council:* Dr. C. E. P. Brooks, A. H. R. Goldie, W. G. Kendrew, J. F. Shipley.

THE *Journal of Industrial Hygiene*, edited at the Harvard School of Public Health, Boston (U.S.A.), announces that it will be known in future as the *Journal of Industrial Hygiene and Toxicology*, and issues will appear ten times a year instead of six times.

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

A junior research assistant in the Potato Virus Research Station, Cambridge—The Secretary, School of Agriculture, Cambridge (Feb. 5).

A technical officer (Feb. 5) and assistants (Grade III) (Feb. 8) in the Meteorological Office—The Secretary (S.2.e.), Air Ministry, Adastral House, Kingsway, W.C.2.

A junior lecturer in bacteriology in the University of Cape-Town—The High Commissioner for the Union of South Africa, Trafalgar Square, London (Feb. 12).

A keeper of the Department of Invertebrate Zoology in the public museums of the City of Liverpool—The Town Clerk, Municipal Buildings, Dale Street, Liverpool, 2 (Feb. 13).

A curator in the Museum of the Georgetown Public Free Library, British Guiana—The Secretary, The Museums Association, Chaucer House, Malet Place, London, W.C.1 (Feb. 20).

A University professor of mathematics in King's College, London—The Academic Registrar, University of London, S.W.7 (Feb. 24).

A director of the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, London, S.W.7 (Feb. 29).

A regius professor of civil engineering and mechanics in the University of Glasgow—The Private Secretary, Scottish Office, Whitehall, London, S.W.1 (March 16).

A lecturer in electrical engineering in the Burmah Oil Company's College of Mining and Engineering, University College, Rangoon—The Secretary, Universities Bureau, 88a, Gower Street, W.C.1.

A teacher of engineering subjects in the Batley Technical College—The Director of Education, Education Office, Batley.

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 154.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Estimation of Vitamin A

IN June of 1934 the second International Conference on Vitamin Standardisation was held in London, called under the auspices of the Permanent Commission on Biological Standardisation of the Health Organisation of the League of Nations. This Conference made certain recommendations, of which many, particularly those concerned with vitamin assay, were held to be of a provisional nature. It is a little difficult to know at exactly what point these recommendations became something more, and were to be regarded as "officially" adopted by the nations represented on the Health Organisation. It is, however, generally assumed that this recognition dates from the appearance of the Report of the Conference in the *Quarterly Bulletin of the Health Organisation*; this publication occurred towards the end of 1934 as Extract No. 15 of vol. III of the *Bulletin*.

Shortly afterwards, the National Institute for Medical Research, acting in this matter as central laboratory on behalf of the Health Organisation, issued small samples of the International Standard Preparation of β-carotene, with certain instructions and suggestions for its use. It thus became permissible in Great Britain to use one of three methods in estimating the vitamin A content of food and medicinal substances.

(1) A direct comparison, by means of animal assay, could be made against the International Standard Preparation of carotene, either with the standard put forward by the first Vitamin Conference, which was a preparation of solid carotene, largely β-carotene, or with the new standard, a sample of pure β-carotene dissolved in coco-nut oil.

(2) An indirect comparison could be made with the International Standard Preparation either by means of a secondary standard, prepared by the assayist himself (on lines analogous with those put forward for the standardisation of digitalis), or by means of a Subsidiary Standard to be officially sanctioned, nationally or internationally. It was announced that the reference oil of the United States Pharmacopœia Commission was considered to be a useful oil for this purpose, and that arrangements were being put in hand to make it available to workers in Great Britain. This has since been done. It is, of course, perfectly clear, both from the Conference Report and from the instructions issued nationally, that any individual secondary standard *must* be prepared by biological assay.

(3) It would be permitted, for liver oils and concentrates, to use a spectroscopic method and to convert the absorption coefficient of such preparations to international units per gram by simple multiplication with a factor, to which the value 1,600 was assigned by the Conference. There is no question of using a standard, either primary or secondary, in the spectroscopic method. A factor has been provisionally recommended for practical use—and is in this sense fixed until officially revised—and the determination of absorption coefficient is, of course, absolute. For that reason the use of certain 'simplified' spectroscopic apparatus, except for purposes of routine comparison, is to be regarded as unsatisfactory in the actual assay of vitamin A, unless the instrument has been accurately calibrated. Even then, the use of such an instrument cannot possibly give results as accurate as those obtained with adequate apparatus.

As a result of nearly one year's experience of these three methods, it has regrettedly to be reported that the three official recommendations will, in many, if not in all, instances, give three different results. It is not disputed that the first method, direct biological comparison with the International Standard, must still be regarded as fundamental to the other two. It is, therefore, rather unfortunate that quantities of the revised International Standard Preparation have only quite recently become available on a sufficiently large scale to enable assayists, especially those engaged in routine commercial standardisation, to make use of it. It must also be emphasised that the experimental errors of this method of assay, even when relatively large numbers of animals are used, have been variously put at 20 to 100 per cent.

The method of using a sub-standard has grave disadvantages, both in general and in this specific instance. It can be shown that if two workers obtain results having a certain degree of concordance, these same workers, working against independently prepared secondary standards, will obtain results with a considerably lower probability of agreement. If, however, both work with the same subsidiary standard, their results should have the same order of agreement as if they had both worked against the International Standard Preparation. In those circumstances, everything will turn upon accurate standardisation of the Subsidiary Standard.

In the testing of vitamin A against the Subsidiary Standard (the U.S.P. reference oil), we are faced with the unfortunate fact that its vitamin A content has undoubtedly diminished since it was assessed at 3,000 international units per gram some two years ago. The loss in vitamin A content is proved not only by a fall in the absorption coefficient and the 'blue value', but also by actual biological tests, as shown by one of us with the late Dr. R. S. Morgan and Mr. J. R. Edisbury[1]. There is therefore no doubt that the assay of any material against the Subsidiary Standard would, if this were taken to contain 3,000 international units per gram, give results higher than

the truth. It is much to be desired that any Subsidiary Standard issued in future should be accompanied by a statement of the date at which its biological activity has been directly determined, and by the value of its absorption coefficient at that date.

It is, of course, realised that the bio-assayist finds himself here in a vicious circle. If he is to be permitted to check the deterioration of his secondary standard by means of a spectroscope, there seems to be no argument against his using the spectroscope for determining the vitamin A content of the unknown, except where this is not a liver oil or concentrate.

The factor of 1,600, to be used in converting absorption coefficient to international units per gram, was based upon a large number of biological determinations in different laboratories on a limited number of oils and concentrates for which the spectrographic constants were known with some precision. The actual values for this factor obtained in the different laboratories varied very considerably, though possibly not more so than would have been expected on account of the errors of biological assay. Subsequent work[1] in a number of laboratories has confirmed the view that application of the factor 1,600 to rich oils and concentrates will give values for its vitamin A content higher than those obtained by direct biological comparison with the international standard preparation.

One of us (A.L.B.) has found in his own laboratory that various concentrates, tested against the first International Standard Preparation of carotene, gave results indicating a factor between 1,000 and 1,200, with one exception which showed a very much lower figure, probably owing to deterioration of one of the solutions used. He has also reason to believe (private communications) that similar results have been obtained in at least two other laboratories, and it is to be noted that Culhane Lathbury has put forward the view that the factor 1,600 is too high, not only for rich oils and concentrates, but also for cod liver oil[2]. There is other evidence, particularly that based upon an examination of the Subsidiary Standard cod-liver oil, that the factor is too low, and some recent American work, of which only the outlines have so far been published, bears out this view.

We are of opinion that the present position is unsatisfactory for two main reasons. In the first place, it makes it almost impossible for workers in different laboratories to compare vitamin A estimations, unless they are using practically identical methods, and makes the attempt on the part of reputable manufacturers to market products of known, constant and stated vitamin A content extremely difficult to carry out. In the second place, the confusion tends to bring discredit upon the use of the International Units and International Standard Preparations, a tendency that, in our opinion, cannot but be regarded as very grave by all who support, as we do, the attempts of the Permanent Commission to foster accurate biological standardisation.

Glaxo Laboratories, Ltd., Greenford. — A. L. BACHARACH.

University College, London. — J. C. DRUMMOND.

University of Liverpool. — R. A. MORTON.

[1] *Biochem. J.*, **29**, 1645 (1935).
[2] See also "The Standardisation and Estimation of Vitamin A", M.R.C., Special Report Series, No. 202 (1935).

The Neutrino Theory of Radiation and the Emission of β-Rays

FOLLOWING a suggestion of de Broglie, a theory has been developed by Jordan[1] and myself[2] in which an attempt is made to reduce the field of radiation with light quanta, obeying the statistics of Bose and Einstein, to a field of particles with spin, obeying the statistics of Dirac and Fermi. These particles have been tentatively identified with the neutrinos, the occurrence of which must be postulated in radioactive β-disintegrations in order that energy and angular momentum may be conserved.

For a number of β-emitters, it is experimentally certain that there is practically no γ-radiation present in addition to the β-rays. Thus for radium *E* the γ-radiation has an energy amounting to about one per cent of the energy of the β-particles[3]. Moreover, this radiation is in part *K*-radiation, excited by the passage of the β-particles through the electronic shells of the element arising from the disintegration of radium *E*, while the rest probably is due to the retardation of the β-particles in the field of the nucleus from which they are expelled, so that all the γ-radiation is of secondary origin.

If the neutrino theory of radiation has a physical significance, the experimental result just mentioned calls for a very particular type of interaction between the heavy particles (protons and neutrons) of which the nucleus is built up and the light particles (electrons, positrons and neutrinos) created during the β-disintegration. In fact, the interaction energy must be such that the neutrino field excited by the disintegration process is of the radiationless type, the possibility of which I have recently demonstrated[2]. Without discussing here the exact nature of the interaction energy, it may be mentioned that the forms hitherto proposed for it[4] have not the character required above. It is to be hoped that the condition of the absence of radiation, together with the postulate of relativistic invariance, will limit sufficiently the choice of the interaction energy, so as to make the problem of its theoretical determination a more definite one.

R. DE L. KRONIG.

Natuurkundig Laboratorium
der Rijksuniversiteit,
Groningen.
Dec. 31.

[1] P. Jordan, *Z. Phys.*, **93**, 464 (1935).
[2] R. de L. Kronig, *Physica*, **2**, 491, 854, 968 (1935).
[3] S. Bramson, *Z. Phys.*, **66**, 721 (1930).
[4] E. Fermi, *Z. Phys.*, **88**, 161 (1934); E. J. Konopinski and G. E. Uhlenbeck, *Phys. Rev.*, **48**, 7, 107 (1935).

Selective Absorption of Neutrons by Gold

SIX small gold disks, 15 mm. in diameter and 0·5 mm. thick, were placed in a hole in a cadmium plate and irradiated by slow neutrons, by putting the whole arrangement in a cavity in a large block of paraffin wax, near a radon-beryllium source. On measuring the activities of the successive disks, it was discovered that the bottom of the lowest disk (which lay directly on the cadmium) was very much more active than the top of the same disk, and was indeed comparable in activity with the uppermost disk. All the disks decayed with the normal gold period ($2\frac{1}{2}$ days).

When a sheet of gold, 0·1 mm. thick, was placed below the cadmium, the effect disappeared. This shows

that there exists some group of neutrons, very strongly absorbed by gold, but transmitted through cadmium. The actual half-value thickness for the selectively absorbed neutrons was measured by replacing the bottom disk of the six by a number of very thin (0·01 mm.) disks. The result was about 0·02 mm., whereas the figure for neutrons not filtered through cadmium is 1–2 mm.

Replacement of the cadmium by boron (both elements are strong absorbers for slow neutrons) diminished, but did not eliminate the effect. In some rough experiments where the gold was replaced by other elements (copper, rhodium and silver) no marked effect was found. Alteration of the thickness of cadmium beneath the gold had little or no influence on the effect. The effect disappeared, and the total activity was very small, when the gold was activated without surrounding the source with paraffin wax.

An experiment was made in which the gold was completely surrounded by cadmium. It was found that, in addition to the activity of the top and bottom plates, there was a considerable activation of the inner plates. Thus the actual number of the strongly absorbed neutrons is only a small fraction of the total number of neutrons transmitted by cadmium; it is only because the activation produced by the selectively absorbed neutrons is concentrated in a very thin layer that it is so readily detected. This indicates that it is only a small velocity range that is so strongly absorbed.

Amaldi and Fermi[1] have recently discovered a similar phenomenon in the case of silver. They found that the initial part of the neutron absorption curve in silver is anomalously steep if silver is used as indicator, and that the initial steep fall becomes relatively more pronounced on filtering the incident neutrons through cadmium. Szilard[2] has found that indium behaves similarly.

O. R. FRISCH.
G. HEVESY.
H. A. C. MCKAY.

Institute of Theoretical Physics,
Copenhagen.

[1] *La Ricerca Scientifica*, Anno VI, 2, 9–10.
[2] NATURE, **136**, 950 (1935).

Formation of Negative Atomic Ions of Mercury

WITH the mass-spectrograph by means of which we established the formation of diatomic mercury molecules by electron impact[1], we have now made an investigation of negative ions. No trace of a stable negative molecular ion was detected, but negative atomic ions were found in considerable number.

The ions are formed at a point in the electric field close to the filament. The probability of electron attachment as a function of the energy of the electrons attains a maximum between 0 and 5 volts, then falls to almost zero for electron energies above about 5 volts.

In addition to these ions, which have 0–5 volts less energy than they would have if they had originated on the filament, a small number of fast negative ions, having energies up to 10 volts more than the total potential across the tube, have been detected.

The presence of fast ions suggests dissociating molecules. However, the ionisation potential of the mercury molecule is found by us to be 9·65 volts[1]. Consequently, if the whole electronic energy of an excited molecule were converted into kinetic energy of the constituent atoms, each atom could have at the most only 4·8 volts energy. The origin of these fast ions is now being investigated.

F. L. ARNOT.
J. C. MILLIGAN.

University,
St. Andrews.
Jan. 1.

[1] NATURE, **135**, 999 (1935). *Proc. Roy Soc.*, A, **153**, 359 (1936).

Continuous Spectra of Certain Types of Stars and Nebulæ

THE continuous spectrum of Nova 452.1934 Herculis has been showing a change in the spectral energy distribution which is hard to explain from the point of view of pure temperature radiation. Fig. 1, curve *a*, presents the continuous spectrum observed on December 31, 1934, by Barbier, Chalonge and Vasy[1], and curve *b* the spectrum on March 6, 1935. Intermediate curves between these extremes will be found in the same publication. (The dotted line has been added by me.) Nova Geminorum 2 showed, during 1912–13, a similar energy distribution curve with one or even two secondary maxima in the early stage, which gradually disappeared[2].

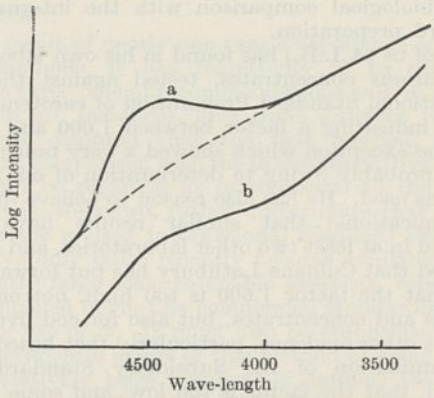

FIG. 1. Energy distribution curves of Nova 452.1934 Herculis. Proposed interpretation of curve *a*: black body radiation below, and continuous electron radiation above dotted line.

An interpretation of these energy distribution curves may be based on the assumption that *two different types of continuous emission spectra* are superimposed in the novæ, these being: (1) temperature radiation, according to the classical laws of black body radiation; and (2) continuous electron radiation, according to more recent results[3]. The conclusion to be drawn from the gradual disappearance of the secondary maxima in the spectra is that the state of a nova which results in the emission of the continuous electron radiation gradually disappears. The early stage of a nova seems to permit the generation of free electrons of high speed.

It remains to be seen whether or not similar secondary maxima exist in the continuous spectra of some early type stars and planetary and diffuse nebulæ. Such secondary maxima are to be explained again by a superposition of the two types of continuous radiations. It should be kept in mind that most energy distribution curves of early type stars and nebulæ have been obtained, so far, over a rather narrow range of wave-lengths, and it seems possible that only *parts* of their real black body

radiation and of their secondary maxima have been observed (see Fig. 2). According to our theory, the ultra-violet part F–G of curve c is significant for the black body radiation and not D–E as used at present. This is in agreement with the conclusion by Anger[4] that the ultra-violet colour index is more significant than the yellow one for certain B-type stars.

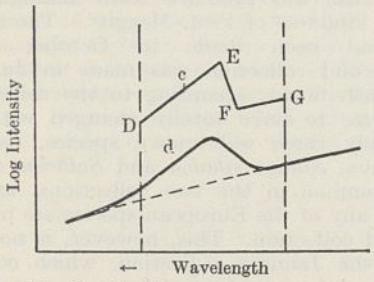

FIG. 2. Stellar energy curves. c = curve observed, d = complete curve.

Sudden changes in the spectra of a nova or a nebula may be interpreted by sudden changes in the continuous electron radiation (due to variations of the number and speed of free electrons, such as are actually observed in the emission from the sun), whereas the true temperature radiation of the nova or the nebula remains constant.

WILLI M. COHN.

Berkeley, California.
Nov. 8.

[1] D. Barbier, D. Chalonge, É. Vasy, *C.R.*, **201**, 128 (1935).
[2] W. H .Wright, Lick Obs. Publ., **14**, II. A. Brill, Publ. Astrophys. Obs. Potsdam, **23**, 70 (1914).
[3] W. M. Cohn, *Z. Phys.*, **75**, 544 (1932). *Astron. Nachr.*, **245**, 378 (1932). W. Finkelnburg, *Astrophys. J.*, **80**, 313 (1934).
[4] C. J. Anger, Harvard Coll. Obs. Bull., 882 (1931).

A Case of 50 per cent Crossing-over in the Male *Drosophila*

WHILE engaged in experiments on the possible effects of ultra-violet irradiation on crossing-over between black and vestigial in the second chromosome of *Drosophila melanogaster*, two stocks, *black-long* (*bbVV*) and *grey-vestigial* (*BBvv*) (obtained from Prof. Tammes, director of the Genetics Institute of the State University at Groningen), were crossed and the offspring allowed to interbreed in order to obtain double-recessives as from the F_3 onwards for back-cross purposes.

However, to my surprise, I noticed that all four classes were already represented in the F_2. Immediately more crosses were made, the F_1 allowed to interbreed, and the F_2 counted. The class frequencies were :

3175 *BV*, 1759 *bV*, 1193 *Bv*, 356 *bv*.

In the F_2 of every cross made, without exception all four phenotypes were represented. This naturally suggested crossing-over in the males involved in these crosses.

Assuming an equal crossing-over frequency for either sex, the crossing-over value must be calculated from the combination $(1\,BV + n\,bV + n\,Bv + 1\,bv)^2$. The phenotypes $\frac{BV + bv}{bV + Bv}$ would be represented by, $\frac{2n^2 + 4n + 4}{2(n^2 + 2n)}$. Let $\frac{BV + bv}{bV + Bv} = y$; then n would be $\sqrt{\frac{y+1}{y-1}} - 1$. From our data, $y = 3531/2952$, and therefore $n = 2{\cdot}346$. Hence the crossing-over value $100/(1 + n) = 29{\cdot}8$ per cent.

This value is radically different from the standard value of 17 per cent.

At this stage, double recessives were on hand, and I consequently back-crossed a few heterozygous F_1 males (*BbVv*) to double recessive females (*bbvv*). The following phenotypes were obtained : 40 *BV*, 38 *bV*, 43 *Bv*, 39 *bv*, the viability of the cultures being very bad. Clearly the crossing-over value in this case is 50 per cent approximately.

Again, but this time assuming 50 per cent crossing-over in the male, we calculated the data obtained after inbreeding the F_1. The zygotes in this case will result from the combination of $(1\,BV + n\,bV + n\,Bv + 1\,bv)$ eggs $\times$ $(z\,BV + z\,bV + z\,Bv + z\,bv)$ sperms. Evidently $2z = n + 1$.

$$\text{Now } \frac{BV + bv}{bV + Bv} \text{ phenotypes} = \frac{2n + 3}{2n + 1}$$

$$\text{that is, } \frac{3531}{2952} \text{ (our data)} = \frac{2n + 3}{2n + 1}$$

and $n = 4{\cdot}6$ approximately.

Hence the crossing-over value $100/(1 + n) = 17{\cdot}8$ per cent, which agrees fairly well with the standard value of 17 per cent. This, it will be noted, represents the crossing-over frequency in the female.

If we have interpreted our data correctly, we would like to state at the same time that this high frequency of crossing-over in the males involved in our crosses was not caused by ultra-violet irradiation, for not only the flies treated but also the controls and those allowed to interbreed under normal conditions showed the phenomenon in question. Some other explanation (for example, of chromosomal mutation) must be offered.

We may endorse the statement, made by Dr. Daigorô Moriwaki[1], that "The opinion that there is no crossing-over in the male of *Drosophila* has been losing ground in recent years".

G. ELOFF.

Department of Zoology,
University of the Witwatersrand,
Johannesburg.
Nov. 21.

[1] Daigorô Moriwaki, "Crossing-over in the Male of *Drosophila virilis* Induced by Heat and X-Rays", *Proc. Imp. Acad., Tôkyô*, **11**, 242.

The Organism of European Foul-brood of Bees

Streptococcus apis was first isolated and briefly described by Maassen[1]. This organism occurred in most of the cases of 'European foul-brood' (*Gutartige Faulbrut*) of bees which he studied. White[2] and Borchert[3], both of whom described this species, found that the cultures studied by them coagulated milk with subsequent digestion of the casein, and liquefied gelatin. Similar information with respect to this species is given by Bergy[4]. Curiously enough, no differences among various strains of this organism have been recorded.

During a number of experiments on the production of 'European foul-brood', I had occasion to study in detail ten strains of *Streptococcus apis* which were isolated by me from affected larvæ from a number of different cases of this disease[5,6]. It was found that these cultures could be divided into two groups, one of which caused the rapid and complete liquefaction of gelatin and coagulated and peptonised the casein

of milk, the other leaving these proteins apparently unchanged. Four of the strains examined fell into the first named group, and six into the other group.

In all other respects these strains were identical. Morphologically they were indistinguishable (Fig. 1), and all gave identical fermentation reactions. Thus, all formed acid from dextrin, sucrose, lactose, maltose, glucose, fructose, galactose, mannose, mannitol,

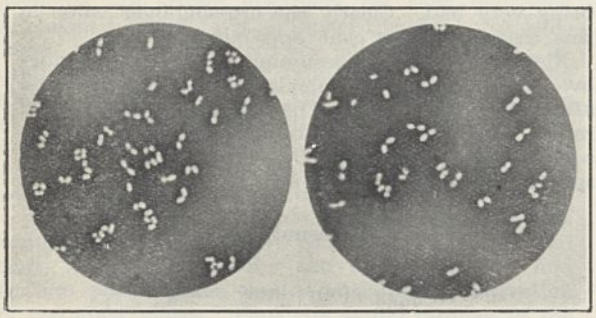

FIG. 1. Two strains of *Streptococcus apis* which differ solely in their power of liquefying gelatin and coagulating and peptonising milk casein.

glycerol and salicin, and none of them produced acid from starch, inulin, raffinose, arabinose, xylose, inositol, adonitol and erythritol under the experimental conditions. The cultural, morphological and biochemical characteristics of these organisms are being described in detail[6].

H. L. A. TARR.

Rothamsted Experimental Station,
Harpenden, Herts.
Jan. 6.

[1] Maassen, A., *Arb. Biol. Abt.* (Anst. Reichsanst.) Berlin, **6**, 53.
[2] White, G. F., *Bull. U.S. Dept. Agric.*, No. 810 (1920).
[3] Borchert, A., *Z. Bakt. Abt.*, (2), **92**, 179.
[4] Bergy, D. H., "Manual of Determinative Bacteriology", Fourth edition. Williams and Wilkins, Baltimore (1934).
[5] Tarr, H. L. A., *Bee Craft*, **17**, 310 (1935). *Archiv. Bienenkunde* (in press).
[6] Tarr, H. L. A., *Ann. Appl. Biol.* (submitted for publication, 1936).

European Species of Fish from the Tavoy Coast, Burma

EARLY in January 1934, the Zoological Survey of India received for determination an extensive collection of fish from Prof. F. J. Meggitt, of the University College, Rangoon. The major part of the collection was made at Maungmagan, a village on the Tavoy Coast, north-west of Tavoy, Burma. Among the 44 species of fish collected at Maungmagan, there are five forms, *Ammodoytes lanceolatus*, Le Sauvage, *Blennius pholis*, Linn., *Trachynus draco*, Linn., *Cottus bubalis*, Euphrasen, and *Lophius piscatorius*, Linn., the range of which is generally believed to be restricted to the Atlantic Ocean, and none of which had previously been recorded from the Indian waters. In passing, it may be mentioned that our specimens were sent to Mr. J. R. Norman of the British Museum (Nat. Hist.), who very kindly confirmed our identifications.

On inquiry, Prof. Meggitt assures us that he had no material of European fishes with him, and in the case of *Blennius* and *Cottus* he definitely recalls having collected them himself. The collections of the Zoological Survey of India in the Indian Museum, Calcutta, consist mainly of Indian animals, and there is, therefore, no possibility of any European material having been mixed up with the Burmese collection in our laboratories. Moreover, all the specimens appear freshly preserved. In view of the above, it seems tolerably certain that specimens of the species enumerated above, found in the collection from Maungmagan, were collected in Burmese waters.

With the view of verifying our results, a second collection of fish was procured from Maungmagan through the kindness of Prof. Meggitt. The earlier collection had been made in October 1933, while the second collection was made in January 1935. The fish fauna, according to the collections received, seems to have totally changed with the seasons. Only three well-known species, namely, *Terapon jarbua*, *Sillago sihama* and *Salarias dussumieri*, are common in the two collections, and no specimens of any of the European species are present in the second collection. This, however, is not surprising, for the January collection, which consists mainly of coral forms, apparently appears to have been made in coral-reef areas, while the earlier collection was made in sandy, rocky and estuarine pools and the open sea.

The present communication is published with the view of bringing to the notice of European ichthyologists the occurrence of certain Atlantic species in Indian waters; a full report on the fish material from Maungmagan will appear shortly in the *Records of the Indian Museum*, vol. 38.

SUNDER LAL HORA.
DEV DEV MUKERJI.

Zoological Survey of India,
Indian Museum, Calcutta.
Dec. 18.

Thermal Decomposition of Silver Oxalate

WORK has been in progress here for some years on the thermal decomposition of silver oxalate, and two papers on the subject are now practically ready for publication. In the meantime, a paper by Benton and Cunningham has appeared[1], dealing with the influence on this reaction of pre-exposure to light. As it will not be convenient to discuss this paper in our forthcoming publications, we propose to summarise here the points of agreement and difference.

In so far as the experimental results overlap, they are in as good agreement as can be expected from the nature of the reaction. Our conclusions, however, differ in some important respects. Benton and Cunningham, relying on the results obtained with specimens prepared with a slight excess of sodium oxalate, find that the reaction, when unaffected by pre-exposure to light, obeys the equation $dx/dt = kt^m$, where m is about 2·5. (We are here using the differential form of the equations which appear in their paper, as it affords an easier comparison.) We have shown, however, that the reagent which is in excess at precipitation has a profound influence on the subsequent decomposition, the stability of the specimen being roughly proportional to the logarithm of the nitrate ion concentration. The effect of altering the ionic concentration is illustrated in Fig. 1, which shows the plot of log dx/dt against log t for the decomposition of three specimens at 110°: G is precipitated with a 900 per cent excess of silver nitrate, B with the same excess of sodium oxalate, while D, prepared with exactly equivalent quantities, corresponds to the preparations on which Benton and Cunningham rely for their measurement of m.

It will be seen that the maximum slope of the curve increases with decrease in the nitrate ion concentration, that of specimen D being about 2, in agreement with Benton and Cunningham's results. Specimen G, however, exhibits a slope not much greater than 1, while the slope of B increases continually up to a value of about 6, and in fact the decomposition of this specimen follows an exponential equation of the type $dx/dt = qe^{pt}$. Thus two mechanisms appear to be concerned, one predominating in B and the other in G, while D is an intermediate case showing some of the characteristics of both. It is clear from these curves that there is no real evidence that the theoretical equation is $dx/dt = kt^3$.

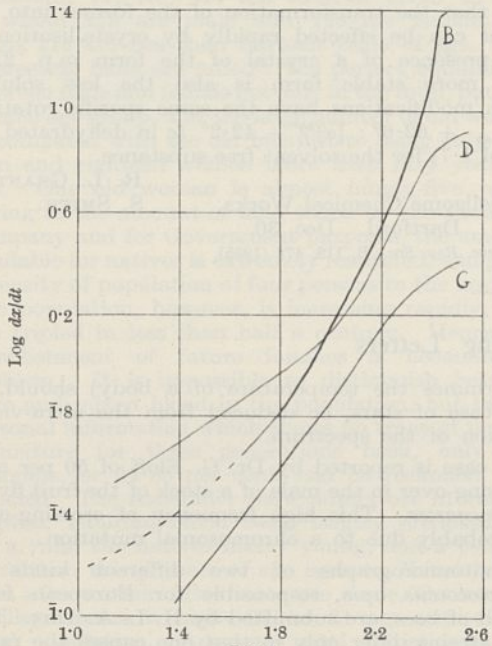

FIG. 1.

Further, Benton and Cunningham find that when the samples have been nucleated by preliminary exposure to light, the value of m decreases, figures so low as 0·4 being found. From this they conclude that the fundamental reaction in these circumstances is the growth of nuclei at approximately equal rates in the three dimensions of the crystal ($m = 2$). Our experiments are in substantial agreement, and we find that $m = 1·05$, as an average of twenty-one experiments in which either (*a*) nucleation was increased by light or (*b*) the process which predominates in specimen B was suppressed. From this we conclude that the fundamental process is the two-dimensional decomposition of nuclei along the planes of the crystal. With this mechanism, it is possible for branching to occur, and this explains the exponential term found in certain decompositions. Moreover, if the branching takes place preferentially on the surface of the crystal, then the effect of ionic adsorption becomes clear. The replacement of oxalate by nitrate ions will reduce the number of possible bridges by which the decomposition can spread from one layer to another.

So far as we can see, the only mechanism by which the three-dimensional decomposition of nuclei could lead to an exponential equation is for the reaction to spread from one crystal to its neighbours by contact infection. This hypothesis was disproved by dispersing the crystals in oil and in gelatin. The results were most striking, especially in the former case, when a curve with two maxima was obtained. The first acceleration, about 2 per cent of the whole decomposition, was identical with the decomposition of the same specimen *in vacuo*, and obeyed the equation $dx/dt = kt$, representing the decomposition of nuclei present at the start. The second acceleration followed the exponential law, but was very much slower than the corresponding portion of the vacuum decomposition, the time of half-reaction being about ten times as great.

J. Y. MACDONALD.

Department of Chemistry,
United College,
St. Andrews.
Dec. 7.

[1] *J. Amer. Chem. Soc.*, **57**, 2227.

Vibrations of Rods and Disks

IN an interesting paper[1] recently published, Dr. A. B. Wood gives some experimental results for the frequencies of free circular plates, vibrating with (*a*) two nodal diameters, and (*b*) one nodal circle. Disks with ratios (t/d) of thickness to diameter from 0·014 to 0·207 are considered, and it is shown that as this ratio increases, the theoretical and experimental values of the frequencies differ considerably. As some work on this subject which I did in 1932[2] seems to have escaped attention, it seems worth while to review here one or two of the results which were obtained at that time.

Disks and rods were used with ratios t/d from 0·046 to 6·4. It was found that the frequencies for each of the two types of vibration increased linearly with thickness of disk as predicted by theory when t/d was very small, but increased more slowly as t/d became larger, and finally approached asymptotically a constant value for t/d greater than about 1·5. The empirical expression, $f = A/a\ (1 - e^{-kt/a})$, where f = frequency, a = radius of disk, t = thickness, and A and k are constants, expresses the relation between frequency and disk dimensions over the whole range of t/d considered. When t/d is small, the formula is shown to reduce to Kirchhoff's and Poisson's formula, that is, $f = Kct/a^2$, where K is a constant, different for each mode of vibration.

In my paper the classical formulæ were wrongly quoted, the constant in each being given as about double its correct value. My experimental values for the constant K of 0·288 and 0·512 should be compared with the theoretical ones of 0·261 and 0·410, instead of 0·52 and 0·88. These experimental values were obtained by using $5·2 \times 10^5$ for the velocity of sound in duralumin. If a larger figure had been used, particularly in the case for one nodal circle (constant = 0·41), correspondingly better agreement between experiment and theory would have been obtained. In this connexion it may be noted that Dr. Wood, by assuming the theoretical constant to be correct, obtained larger values for the velocity of sound from observations on the vibration with one nodal circle than on the one with two nodal diameters.

GEO. S. FIELD.

National Research Laboratories,
Ottawa. Dec. 19.

[1] *Proc. Phys. Soc.*, **47**, 794–799 (1935).
[2] *Can. J. Res.*, **8**, 563–574 (1933).

The Mount Everest Expedition, 1936

MANY well-wishers of British exploration were rather more than surprised to see among the names of those announced in NATURE of December 21, p. 984, to take part in the fresh attempt to conquer Mount Everest none who is qualified to continue the valuable scientific investigations commenced by the earlier expeditions to this region. It is well known that the scientific researches, carried out often concurrently with the actual climbing operations by the four earlier expeditions, greatly increased our knowledge of the natural history, etc. of this ordinarily inaccessible and unique region. There is much yet to investigate as regards such features as the glaciers themselves, as well as the structure of this most important section of the main Himalayan chain, and it would be a pity if the opportunity were missed for continuing the work.

Moreover, it should surely be apparent to the sponsors of this expedition, and to its leader, that it has been a tradition on all primary British enterprises of this character to recognise the needs of scientific inquiry. Should the new attempt on the summit of Everest again fail in its object, then this expedition is in danger of returning empty-handed and with nothing of scientific value to cover its nakedness, while in the event of anticipated success the region is likely to be closed politically against all further investigation.

CONWAY OF ALLINGTON.

Dimorphism of Ergometrine

ERGOMETRINE as described by the late H. W. Dudley[1] is a white crystalline substance, which melts at 162°–163° (decomp.). During the process of preparing ergometrine, we have isolated in addition to this form a modification which crystallises from acetone in long needles, m.p. 212° (decomp.). We also find that the low melting point form tends to pass into the high melting point form on keeping, and that the transformation of the former into the latter can be effected rapidly by crystallisation in the presence of a crystal of the form m.p. 212°. The more stable form is also the less soluble. Both modifications have the same specific rotation, $[\alpha]_{5461}$ + 62·6° : $[\alpha]_D^{20°}$ + 42·2° (*c* in dehydrated alcohol 1·7) for the solvent free substance.

R. L. GRANT.
S. SMITH.

Wellcome Chemical Works,
Dartford. Dec. 30.

[1] *Proc. Roy. Soc.*, B, **118**, 478 (1935).

Points from Foregoing Letters

THE three approved methods of estimating vitamin A content give different results, according to A. L. Bacharach, Prof. J. C. Drummond and Dr. R. A. Morton. The values obtained by the spectroscopic method are at variance with those obtained by biological assay; the subsidiary standard (the U.S. Pharmacopœia reference oil) has deteriorated, as shown by both fall in absorption coefficient and by biological tests; even the direct biological comparison with the international standard preparation is apparently liable to variations of 20–100 per cent.

Dr. R. de L. Kronig states that the theory developed by Jordan and himself in connexion with the postulated production of neutrinos is the only one that explains the absence of γ-radiation in certain cases of β-ray (electron) emission by radioactive substances.

Experiments on the radioactivation of gold by neutrons slowed down by paraffin wax, using cadmium as filter, described by Dr. O. R. Frisch, Prof. G. Hevesy and H. A. C. McKay, indicate that there exists a group of neutrons very strongly absorbed by gold but transmitted through cadmium; this group has apparently a narrow velocity range and forms only a small fraction of the total number of neutrons transmitted by cadmium.

Dr. F. L. Arnot and J. C. Milligan, by means of their mass-spectrograph, have been able to detect negatively charged atoms of mercury (Hg^-), but not negatively charged molecules (Hg_2^-). They find that the atomic ions have energies higher than can be accounted for by the total potential across the tube or by the dissociation of excited molecules.

To explain the variation in the spectrum of the light emitted by Nova Herculis at different times, Dr. W. M. Cohn assumes that the radiation is made up of two parts, one due to heat radiation ('black body' type) and the other due to electron emission. He considers that the black body radiation (which determines the temperature of a body) should, in the case of stars, be deduced from the ultra-violet portion of the spectrum.

A case is reported by Dr. G. Eloff of 50 per cent crossing-over in the male of a stock of the fruit fly *D. melanogaster*. This high frequency of crossing-over is probably due to a chromosomal mutation.

Photomicrographs of two different kinds of *Streptococcus apis*, responsible for European foulbrood of bees, are submitted by H. L. A. Tarr. The two strains differ only in that one causes the rapid liquefaction of gelatin and coagulates and peptonises the casein of milk, while the other does not.

The presence in an Indian collection of fish, stated to have been caught off the coast of Burma in October 1933, of five species hitherto believed to be restricted to Atlantic waters, is reported by Dr. S. L. Hora and D. D. Mukerji. A later collection, in January 1935, in the same region but in different surroundings (coral-reef areas), yielded an entirely different fish fauna.

The rate at which the light-sensitive compound silver oxalate (obtained from silver nitrate and sodium oxalate) decomposes with increased temperature is found by Dr. J. Y. Macdonald to vary with concentration of the original solutions and with the relative amount of the reacting substances. The author considers the decomposition a complex mechanism, and disagrees with Benton and Cunningham, who have suggested for it a simple exponential equation.

Commenting upon a recent paper by Dr. A. B. Wood, G. S. Field directs attention to his investigation on the relation between the frequency of vibration excited in disks and the ratio of their thickness to diameter. He found that, as t/d increases, Kirchhoff and Poisson's formula no longer holds and has to be replaced by a more complex exponential formula.

Research Items

Demography of Easter Island

No trustworthy statistics of the population of Easter Island exist before those of the census of 1886 taken by A. A. Salmon, when 155 natives were grouped as follows: less than 15 years—males, 17, females, 27; adults—male, 68, female, 43. In a demographic survey made by Dr. I. Drapkin in 1934 (*Occasional Papers*, Bernice P. Bishop Museum, Honolulu, 11, No. 12) the total is given as 456, of whom 228 are male and 228 are female. Of these, 216 are less than thirteen years of age. Two interesting facts are noted: the perfect equilibrium between male and female not only in the total, but also in each age group, and the large number of old women as compared with the old men, there being only four men and eighteen women more than fifty years of age. One old woman is almost ninety-five years. Owing to the amount of land taken by the Products Company and for Government purposes, the amount available for natives is extremely restricted, and gives a density of population of four persons to the hectare. The population, however, is increasing rapidly, and has tripled in less than half a century. Hence the establishment of future families is becoming a problem. It is impossible to distinguish between pure and mixed blood in the population, but taking personal information which shows no trace of foreign admixture for three generations back, only 159 islanders, or 34·86 per cent, can be reckoned pure blooded. The remainder show admixture in various degrees, Tahitian blood being largely predominant. As a rule, the natives marry young, and a celibate more than thirty years of age is rare. Nevertheless, even after certain allowances are made, the number of illegitimates is high—96, or 21 per cent of the total population. Adequate vital statistics cannot be given, but in a period of seventeen years the percentage of births each year has been 10 male and 8 female, while the mortality has averaged 4 children and 6 adults.

Molar Teeth of Ungulates

Two weighty and elaborate monographs dealing with different aspects of the history of the molar teeth of Ungulates have appeared recently. The first forms vol. 14 of the collected works of Florentino Ameghino, published under the editorship of Alfredo J. Torcelli ("Investigaciones de Morfologia filogenetica en los Molares superiores de los Ungulados". Pp. 619. La Plata: Gobierno de la Provincia de Buenos Aires, 1933, received by NATURE in 1935). This work, printed page for page in Spanish and French, does not present a unified plan of Ameghino's researches, but contains a series of papers describing the molar teeth mainly of members of the rich Ungulate fauna of South America. But throughout, the author has had in view an examination of the theory of tritubercly, or of the derivation of quadrangular molars from triangular predecessors. The conclusion reached in these papers, as in his earlier works on the same subject, is the reverse of that generally accepted, for Ameghino's reading of the succession in fossil Ungulates is that the triangular type of molar is derived from the quadrangular. The second monograph, by Max Küpfer, is more limited in its field, but more intensive in its method. It is a very thorough investigation of the premolars and molars of the domestic ox (*Bos taurus*), following two main lines of exploration (*Mem. Soc. Helvetique Sci. Nat.*, 70, Mem. 1, 1935, pp. ix+218). The first elucidates the development of the teeth, as shown by X-ray photographs, by histological sections, and by the study of the morphological development of single teeth. The second line of study deals thoroughly and in a most interesting manner with the relative movements and interlocking of upper and lower molars in the bite of an ox, and shows the progressive changes which take place in the growing animal from three weeks to sixteen months of age. The monograph is copiously and beautifully illustrated.

Flora of South-eastern Polynesia

THE publication by F. B. H. Brown (Bernice P. Bishop Museum, *Bulletin* 130 (1935)) of the third and concluding part of his survey of the flora of the Marquesas, Tuamotu, Society and Austral Archipelagos, together with Rapa, Pitcairn, Henderson and Mangareva Islands, deals with the dicotyledons. The total indigenous vascular flora is made up of 453 species and varieties, of which 251 are dicotyledons. These belong to 62 families, the best represented being the Rubiaceæ, Euphorbiaceæ and Compositæ with twenty or more species, whilst of the other families only the Piperaceæ and Urticaceæ number more than ten species. Eighty-seven per cent of the indigenous dicotyledons are confined to Polynesia, whilst 153 species are confined to a single island or archipelago, representing a local endemism of 61 per cent. There is a general similarity of the dicotyledonous flora to that of Hawaii, where, however, the degree of endemism is considerably higher (85 per cent). It is suggested that not less than 82 per cent of the species are of American affinity, whilst 12 per cent and 6 per cent respectively show an Indo-Malayan and Australian affinity. The greatest number of species—approximately 50 per cent of the total—is found in the Marquesas Islands, whilst the Tuamotu Archipelago has a very meagre flora containing only 36 dicotyledons. Three new genera and many new species are described and well figured. It is improbable that further work will add many more plants.

The Hainaut Aerolite

A METEORIC stone, which is named and described as the Hainaut aerolite by Dr. M. Lecompte of the Brussels Museum (*Mém. Mus. Roy. Hist. Nat. Belgique*, No. 66, 1935), fell between 8 and 9 p.m. on November 26, 1934, near Roisin, fifteen miles south-west of Mons in Hainaut. It is claimed as a Belgian meteorite, but actually it reached the ground in French territory, only 60 metres east of the frontier line, in the commune of Bettrechies, Dep. Nord. The ancient country of Hainaut is now divided between Belgium and France, and meteorites have no respect for political boundaries. A fireball was

seen passing over Belgium, probably in a direction from E.N.E. to W.S.W., but it finally landed just in France, making a hole 60 cm. in depth and 80 cm. in diameter. Only five fragments with a total weight of 922 gm. were recovered; the whole mass weighed perhaps 15–20 kgm. The material of the stone is of the common type of grey chondrite showing a brecciated structure of lighter grey angular fragments in a darker grey ground. A chemical analysis shows 16·62 per cent of metallic nickel-iron and 7·02 per cent of troilite (FeS), the stony portion consisting mainly of olivine and enstatite. A second paper by Prof. R. Breckpot and Dr. M. Lecompte (*ibid.*, No. 69, 1935) gives the results of spectroscopic analysis made on different portions of the stone. Germanium (0·02 per cent) is present in the metallic portion, and traces of platinum, palladium, ruthenium, gold, tin, etc., were found. Belgium, with its relatively small area, has only three meteorites to its credit, these being all stones observed to fall: St. Denis-Westrem, near Ghent, fell June 7, 1855; Tourinnes-la-Grosse, near Tirelmont, fell December 7, 1863; and Lesves, near Namur, fell April 13, 1896. In the larger area of the British Isles the record is only sixteen genuine meteorites since 1795, but the number of odd-shaped objects often incorrectly thought to be meteorites is vastly greater.

Theory of Radio Communications

MR. R. A. WATSON WATT, in his address as chairman of the Wireless Section of the Institution of Electrical Engineers (*J. Inst. Elec. Eng.*, Jan.), entitled "A Pathologist Looks at Radio Communications", gives a rapid survey of the theory, looking at it from the point of view of a radio 'pathologist'. It is wrong for the pathologist to lecture on the anatomy of the ionosphere as if it were the simple 'Kennelly-Heaviside' layer. Not only must he take into account the Appleton region, but also a complex region of varying ionisation densities controlled by ultra-violet radiation from the sun. It is known that the Appleton region has two important subdivisions: F_2 is about 250 km. high, with a high ionisation density which attains its maximum late in the day and in the year; F_1 is a kind of undershelf at about 180 km. existing only during the day-time, and its maxima occur about noon and in midsummer. The Kennelly-Heaviside layer has been found to be no less complicated, with its E_2 subdivision at about 130 km. and its E_1 at 100 km. E_1 and F_1 are satisfactorily explained by ultra-violet light from the sun. Appleton has shown that the behaviour of F_2 requires the intervention of large thermal expansions in the atmosphere. The detailed structure and the variations in behaviour of E_1 show great complexities. For example, the base of the ionosphere is at a lower height during a magnetic storm. There is reason to hope that continued application of radio methods to the study of the ionosphere will elucidate the still obscure mechanism of the solar control of terrestrial magnetic storms.

Colouring Matter of Ebony

HITHERTO the black colour of ebony has been attributed to the presence of finely-divided carbon, since it is insoluble in all the usual solvents and could not be further characterised. Prof. E. Wedekind describes experiments in the December issue of the *Berichte der deutschen chemischen Gesellschaft* in which a wood-disintegration process, patented by himself and Schicke in 1933, has been successfully applied to ebony. An insoluble black pigment, resembling carbon in appearance, but containing only 66·6 per cent of carbon along with 3·8 per cent of hydrogen, has now been isolated. This composition corresponds with the empirical formula $C_9H_6O_3$, which differs from that assigned to lignin by six atoms of hydrogen. Attempts to convert lignin to the black pigment by direct oxidation with sulphur or selenium have so far been inconclusive, although black products were certainly obtained. The formation of hydrogen sulphide in these experiments was extraordinarily slow, and the reaction with selenium required a temperature high enough to produce carbonisation. The disintegration of the wood was effected by extracting at 100° C. a quantity of West African ebony sawdust with dioxan (diethylene dioxide), containing 1–2 per cent of concentrated hydrochloric acid. In this way the lignin is almost completely dissolved together with resins, hemicelluloses, etc., the residue consisting of a mixture of cellulose and pigment. As the latter appears to be particularly resistant to acids, its complete separation from the cellulose was brought about by hydrolysing the latter with 72 per cent sulphuric acid to soluble sugar. The residue contained only 64·6 per cent of carbon, but was found to contain some lignin held so firmly by sorption that it would not dissolve in dioxan. This lignin was ultimately removed by phenol, with which it combines very readily, and the pigment was then pure. Its amorphous character was confirmed by X-ray analysis.

Effect of Deuterium Oxide on Action of Some Enzymes

AT a recent meeting of the American Physical Society, a communication was made by David I. Macht and Hilah F. Bryan summarising a series of experiments in which they claim a considerable effect of very small concentrations of deuterium oxide on enzymatic action. Two kinds of oxidases and two kinds of catalases showed increased activity in dilute D_2O solutions, the greatest sensitivity to D_2O being observed in the case of the oxidative enzyme of fresh blood-free brain tissue from the cat. This enzyme decolorised a standard buffered solution of methylene blue *in vacuo* at a noticeably increased speed when 1 : 2,000 D_2O was added to the saline solution used for preparing the suspension. An oxidase from rat muscle showed an effect of the same order caused by the presence of 1 per cent of D_2O. Of the two catalases examined, one was from fresh rat muscle and another from *Lupinus albus* seeds. Two pairs of experiments with the latter enzyme were carried out in the following way: 1 c.c. of H_2O, 3 c.c. of H_2O_2 (3 per cent), 1 c.c. of KH_2PO_4 (0·2 molar) and 1 c.c. of Na_2HPO_4 (0·2 molar) were placed in a tube, and 0·5 c.c. of bean extract prepared with H_2O, or alternatively, 0·5 c.c. of bean extract prepared with 1 : 100 D_2O were added. The two experiments made in the presence of D_2O yielded an average of 5·55 c.c. of oxygen in fifteen minutes as against 3·3 c.c. of oxygen in the average of the experiments made in ordinary water. From the above data, the overall excess concentration of D_2O which proved to be effective in these experiments was 1 : 1,200. In some experiments, especially in concentrated D_2O solutions, the enzymes, compared with the controls, exhibited a diphasic activity. There was a primary retardation which was followed by a secondary and more marked acceleration.

Quantum Statistics and Internal Constitution of Planets

By D. S. KOTHARI and R. C. MAJUMDAR, Physics Department, University of Delhi

THIS note gives a preliminary account of work which has, in a straightforward way, led to a relation between the radii and masses of the planets and connects it with the theory of the white dwarf stars. The agreement between theory and observation is rather remarkable. The investigation owes its origin to the inspiring suggestion of Prof. H. N. Russell that "somewhere between stellar and planetary masses there must be a maximum radius for a cold body. This can be estimated at about 1/10th solar radius, a value about equal to the diameter of Jupiter"[1].

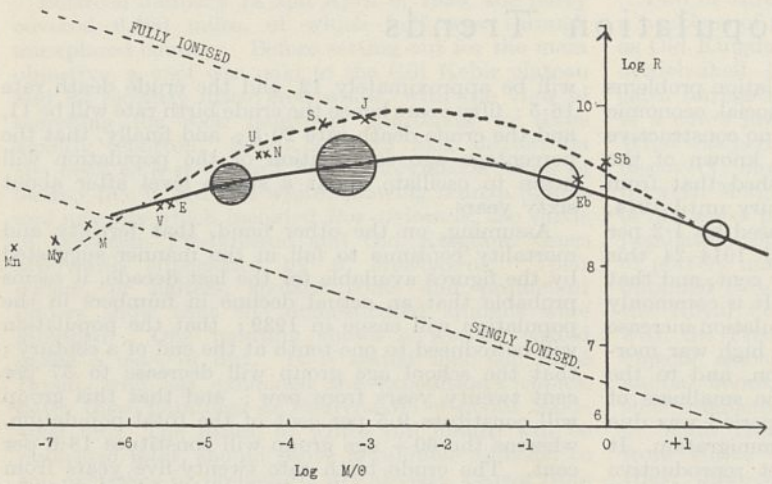

FIG. 1. The full-line curve is theoretical. Shaded circles represent planets: unshaded circles, white dwarfs. (These circles are not drawn to scale.) The various letters stand for: *Mn*—moon, *My*—Mercury, *M*—Mars, *V*—Venus, *E*—Earth, *U*—Uranus, *N*—Neptune, *S*—Saturn, *J*—Jupiter, *Sb*—Sirius *B* and *Eb*—O_2-Eridani *B*.

The application of the Fermi-Dirac statistics in the explanation of the internal constitution of white dwarfs is now well established. If we have a star of mass M which has ceased to radiate (that is, a "black dwarf", as Fowler called it) and is composed of ionised matter *degenerate* in the sense of the Fermi-Dirac statistics, then as has been shown by several authors, the radius R of the star is connected with its mass by the relation[2] (neglecting relativity effects, this being justified for masses not much larger than the sun),

$$R = \frac{5(\omega^{\circ}_{3/2})^{1/3}}{2^{7/3}\pi^{2/3}} \frac{K}{G\mu^{5/3}} \frac{1}{M^{1/3}} = \frac{2{\cdot}8 \times 10^{9}}{\mu^{5/3}} \left(\frac{\odot}{M}\right)^{1/3} \text{cm.} \quad (1)$$

where μ is the mean molecular weight of the free electrons present. If ρ denotes the density and m_H the mass of the hydrogen atom, then $\rho/\mu m_H$ gives the number of free electrons per unit volume. $\odot$ stands for the mass of the sun. Relation (1) shows that, if μ were independent of the stellar mass, the smaller the mass M, the larger would be its radius.

We have now to ask the important question: What value of μ is to be taken in (1)? Does it depend on M or is it independent of the stellar mass? To answer this question we must inquire as to why (degenerate) cold matter should be ionised at all. For *non-degenerate* matter ionisation can be calculated by Saha's theory, but for *degeneracy* the temperature concept is relegated to the background and the usual ionisation formula loses its validity. In degeneracy the electrons will fill the lowest available levels, and hence *free* electrons will exist only when no *bound-levels* are available for the electrons to fall into. Consider matter composed of atoms of atomic weight A and atomic number Z compressed to such an extent that the volume available per atom is less than the atomic volume of the $(r+1)$-times ionised atom and more than the atomic volume of the r-times ionised atom. Under such conditions, the material will be on an average r-times ionised, that is, there will be r free electrons per atom; the reason for the existence of these free electrons being that all levels higher than a certain one (we may designate it as the $(r+1)$th), on account of the closeness of packing, have been obliterated; or as we say in the electron theory of metals, the higher levels of different atoms have fused into continuous bands. *The degree of ionisation in cold degenerate matter is thus determined essentially by its density or pressure.* For this reason it is often spoken of as 'pressure ionisation' (a term originally due to Bridgman). As has been shown elsewhere, we can express the condition of pressure ionisation in several equivalent forms. For the present purpose it is best expressed in the form, that

$$\eta_{r+1}\,\psi_{r+1} > 2E_0 > \eta_r\,\psi_r \quad . \quad . \quad . \quad . \quad (2)$$

must hold, if the matter is to be r-times ionised, that is, $\mu = A/r$. ψ_r and ψ_{r+1} are the r-th and $(r+1)$-th ionisation potentials respectively, E_0 is the maximum electron energy for the degenerate gas. E_0 is 5/3-times the null-point energy. As an approximation the η's can be replaced by unity. In carrying out numerical work, we have taken the case of iron ($A = 55{\cdot}8$, $Z = 26$). The successive ionisation potentials have been calculated by Hartree. As E_0 is expressible with the help of (1) in terms of M and μ, we can calculate from (2) values of M for values of $\mu = A/r$, where r takes the values 1, 2 . . . up to 26. For any value of M thus found, and using the value of μ that corresponds to it, the radius R is obtained from (1).

The full line curve in Fig. 1 represents the relation between M and R so obtained. The straight line marked "fully-ionised" is a graph of (1) for $\mu = 56/26$, corresponding to complete ionisation. For $M > 1/10\ \odot$, it merges into the full-line curve. The lower parallel line refers to the value of $\mu = 56$, for

single ionisation. The dotted curve refers to the observed masses and radii of planets and white dwarfs. The run of the theoretical curve is very similar to the observed curve. The theory thus explains the fundamental point that whereas for a white dwarf a smaller mass corresponds to a larger radius, for a planetary mass, *which one can now say is only a black dwarf of mass less than about* 1/1,000*th the solar mass*, a smaller mass corresponds to a smaller radius. The calculated radii of Jupiter and Saturn are about $3\frac{1}{2}$ times too small. For other planets the agreement is better. However, we shall not enter into these details in this note.

We are attempting to refine the above theory in two ways: to evaluate the η's in (2), and to make the calculations for a mixture of elements. The presence of hydrogen, we find, while not appreciably modifying the theoretical curve in the region of lighter planets, raises it for heavier ones. The point we would like to emphasise here is that any satisfactory theory of the structure of stellar masses composed of degenerate matter must also combine with it the theory of ionisation in degenerate matter. This is what we have done, and we find that this combined theory is capable of explaining the broad features of planetary structure.

[1] *Observatory*, Sept. 1935, p. 260.

[2] Milne, *Mon. Not. Roy. Ast. Soc.*, **92**, 610; 1932. In the above formula Milne's μ and K have been replaced by μm_H and $K/\mu^{5/3}$ respectively. (See, for example, Kothari, *Mon. Not. Roy. Ast. Soc.*, **93**, 74; 1932.)

[3] Kothari and Majumdar, *Astro. Nach.*, **244**, 74; 1931.

Population Trends

IT is now generally agreed that population problems lie near the root of many others—social, economic and political—and that there can be no constructive statecraft whilst nothing accurate is known of the quantity of a people. It is established that from the beginning of the nineteenth century until 1914, the population of England had increased by 1·2 per cent a year, that during the period 1914–24 this annual increase had fallen to 0·47 per cent, and that in 1924–34 further to 0·44 per cent. It is commonly agreed that the slowing down of a population increase in the second period was due to the high war mortality, to the decrease of immigration, and to the diminution of fertility; and that the smallness of the population increase in the third period was due to a further decrease in fertility and immigration. It is further accepted that the greatest reproductive rate of England and Wales is now less than unity, and that this implies that whatever changes in mortality ensue, a continuous decline of the total population is inevitable unless something happens which will increase fertility well above its present level. This being so, it is highly desirable that attempts should be made to project present trends in fertility and mortality into the immediate future.

This has been done very ingeniously by Dr. Enid Charles in a Special Memorandum issued by the Executive Committee of the London and Cambridge Economic Service*. In this, the author examines certain questions and seeks to arrive at satisfactory answers. Assuming that fertility and mortality for each year of age continue to remain constant at the 1933 level, she arrives at the conclusion that an actual decline in the numbers of the population will ensue in 1943; that the population will be halved at the end of a century; that the school age group within the population will decrease to 79 per cent of the present figure twenty years from now, and will then constitute only 12·6 per cent of the total population; that the age group 60+ will constitute 16·6 per cent of the total population; that the crude birth rate per thousand twenty-five years from now will be approximately 12, and the crude death rate 16·5; fifty years hence the crude birth rate will be 11, and the crude death rate 20·5; and finally, that the percentage age composition of the population will begin to oscillate about a stable level after about sixty years.

Assuming, on the other hand, that fertility and mortality continue to fall in the manner suggested by the figures available for the last decade, it seems probable that an actual decline in numbers in the population will ensue in 1939; that the population will be reduced to one-tenth at the end of a century; that the school age group will decrease to 57 per cent twenty years from now; and that this group will constitute 9·5 per cent of the total population, whereas the 60+ age group will constitute 18·6 per cent. The crude birth rate twenty-five years from now will be 6 per cent, and the crude death rate 14 per cent. Fifty years hence, the crude birth rate will be 2·5 per cent and the crude death rate 24 per cent.

Considering a third assumption, that mortality continues to fall and fertility remains constant at the 1931 level (and Dr. Charles argues that this, together with the first assumption, are conservative estimates of the immediate prospect of declining population, whilst the second represents a more reasonable forecast of the trend of population), she shows that the actual decline in numbers of the population will be felt between 1960 and 1965.

The effect of this declining fertility will be to raise the sex ratio of the total population owing to the preponderance of females in the older age groups. Between the ages of twenty and fifty years the present ratio of females to males is 1·099. This would appear to be abnormally disturbed on account of the loss of male lives during the Great War; for, according to the arguments based on any one of the three assumptions, there are fewer females than males in this age group in 1965 and hereafter.

This paper is an outstanding contribution to knowledge; it represents probably the most important use to which census figures have been put for many a year.

* London and Cambridge Economic Service. Special Memorandum No. 40: The Effect of Present Trends in Fertility and Mortality upon the Future Population of England and Wales and upon its Age Composition. Pp. 20. (London: C/o London School of Economics, 1935.) 5*s*.

Archæological Investigations in the Libyan Desert

THE Libyan Desert is a never-failing source of archæological material of interest and often of considerable importance. Further evidence in support of this was afforded by the account given by Mr. W. B. Kennedy Shaw before the Royal Geographical Society on January 6 of an expedition in 1935 of which he was leader. The main objective of the expedition was the further exploration of the Wadi Hawa, which west of long. 24° forms the boundary between French Equatorial Africa and the Anglo-Egyptian Sudan. East of that meridian, the Wadi has been visited only by four expeditions since 1923, and is little known, a section of fifty miles being unsurveyed and the extreme eastern end unexplored until the present occasion.

Between January 14 and April 9, 1935, the party covered 6,300 miles, of which half was through unexplored country. Before setting out for the main objective, a visit was paid to the Gilf Kebir plateau and its recently discovered wadis, with the view of searching for rock paintings additional to those already reported. Small caves or rock shelters on the neck of a re-entrant valley provided a series of twenty-five in red and white, showing human figures and animals which included *Bos africanus*, the cattle of Egyptian Predynastic and Old Kingdom times afterwards superseded by *B. brachyceros*. Their collars, or halters, spotted coats and prominent udders show that the domesticated animals were intended. One painting shows a woman seated inside a cave or hut. It is stated that the Abbé Breuil, who has examined the expedition's copies, dates these paintings as Predynastic of about 5000–4000 B.C. The series, of which full details will be published later, should prove a valuable addition to the examples of prehistoric art already known from the Libyan Desert. A solitary cairn burial in 'Grassy Valley' (which lies somewhere about 100 miles south-east of 'Uweinat) yielded a crouched skeleton with carnelian beads and a pot closely paralleled in the Predynastic period.

In the Wadi Hawa some valuable work of exploration was carried out with which it is not proposed to deal specifically here, except to say that the whole of the Wadi from long. 24° eastward was traversed and surveyed, and observations taken of the animal and vegetable life. The archæological investigations covered a number of ancient sites, which occur along the Wadi. On a hill on the north bank were some hundreds of stone grave cairns. Of these, two were opened and found each to contain a contracted burial but without associated objects. At one large site farther to the east was found the evidence of what had clearly been an important settlement. The ground was covered with sherds, ashes and burnt bones with polished diorite axes, ostrich-shell beads, querns, grinders, etc. Here burials are unmarked by cairns or otherwise.

Two or three skeletons were excavated. One had a necklace of five turquoise beads, dated tentatively as Old Kingdom, and at its waist were many coils of ostrich-shell beads. Farther east near Jebel Rahib cairn burials re-appear. In one of these, two halves of a cow's jaw had been buried alongside the body. What was perhaps the most interesting and significant discovery, however, was made in a depression lying between Merga and Burg et Tuyur, where a number of old water pans indicates the attraction for an early population, of which evidence was seen in fragments of pottery and implements. The skull of a skeleton obtained here has been pronounced by Dr. Cave of the Royal College of Surgeons to agree strikingly with the Predynastic type. Though there were no objects associated with this burial, nearby were animal bones, sherds, polished stone axes, ostrich-shell fragments, etc., of a kind similar to those found in Wadi Hawa. Hitherto archæological material from Hawa has been assigned to Meroitic times. Here, however, is evidence of a considerable and much earlier population, which the character of their artefacts shows to have followed an agricultural and pastoral mode of life. These pursuits for such a number would have been impossible either to-day or in Meroitic times, and evidently point to conditions more favourable some four to five thousand years the latter.

Passenger Transport in London and Berlin

IN a paper read to the Royal Society of Arts on December 11, Mr. Frank Pick discussed the organisation of London transport with special reference to the London Passenger Transport Board. He pointed out that progress in conceiving and organising London has been unequal and unbalanced. The L.P.T.B. enjoys at present a certain uniqueness of character which makes its study useful and advantageous. There is a drawback in the fact that the suburban services of the main line railways, representing 273 million car miles, are still dispersed in the hands of four amalgamated companies. These services represented in car miles 34 per cent of the whole, or in passengers 13 per cent of the whole. There is a standing joint committee to settle disputes, but this is not the same as the welding of those interests into one. The electrification of the Southern Railway and the failure to electrify the railways north of the Thames have led to the growth of London in the south, and have diverted the population in that direction.

Unluckily, traffic considerations are partially subordinated to other considerations still retaining elements of competition. Local authorities vie with one another in seeking expansion. Housing programmes have a tendency to settle and concentrate in unexpected areas. In particular, a vacant piece of land, vacant because the transport facilities are

inadequate, seems specially attractive. There cannot be a competitive basis to the economic and intelligent planning of the Metropolis.

When motor-coaches were put on the arterial roads running out of London it was thought that they would merely displace railway suburban traffic. In addition, an unexpected traffic grew up along the roadside, provided it could be taken to the centre of London where it wanted to go. Regulations then descended upon the system of coach routes so built up, excluding them from the centre and limiting their stops, and so destroyed more than a quarter of the traffic. This went just as mysteriously as it came, and did not reappear anywhere else.

The Board has opened two new interchanges between its railways, one at Holborn between the Central London and Piccadilly lines, and one at Monument between the City and District lines. At Holborn there used to be an exchange of traffic of about 1½ million a year; it is now 10 million, an increase of nearly seven-fold in two years. At Monument there was no exchange; but now after two years there is an exchange of 6 million passengers. It came as a surprise; no one knew that there was a large suppressed traffic waiting to be realised. The realised traffic is very considerably in advance of the estimates.

The expenditure of forty million pounds by the L.P.T.B. looked to an increase in population of 750,000 for its support, and scientific observers prophesy that it will be long before the population becomes stationary. These prophecies are a warning, and the various forms of transport must be co-ordinated in view of the certainty that development must ultimately cease. The railways must be pieced together and supplemented so that their expensive facilities can be filled with the traffic they can reasonably accommodate. The L.P.T.B. is the commencement of a new policy designed to grapple with affairs on a larger scale than the past afforded. Underneath all the commercial activities of the Board, there is the conception of a metropolis as a centre of life, of civilisation more intense, more eager, more vitalising than there has ever been before. Out of the mere pressure of all these millions of people one upon another, a pressure which transport encourages, some new whole must arise. It may well be a metropolitan State which organises the activities of its millions of citizens to a common end and purpose which we hope will be more liberal and worthwhile than that which could come from anything smaller.

In his reply during the discussion on his paper, Mr. Frank Pick referred to the traffic problem in Berlin, which, he said, is quite different from that in London. Relatively speaking, the German people are poorer and the average number of rides they take per head of the population is 330 as against 430 in London. They rarely take journeys for pleasure or for casual purposes; they travel mainly for business. The loading of the transport system in Berlin, therefore, is acute at the peak hours, and the vehicles have few passengers at the slack hours, and hence the daily service is unremunerative.

In both London and Berlin, the cheapest form of transport is the tramcar. The place the bus holds in London is held by the tram in Berlin. There is some talk of replacing trams by trolley buses, but the difficulty is to get the necessary capital. The dominant factor in Berlin is the State Railway, which works in and out of Berlin and is part of the national railway system. A large season ticket traffic at low rates has been built up, and this entirely dominates the underground system. The difficulty in framing a pooling scheme is how to pool losses. As Berlin has a population of about five million and covers an area of twelve miles, at most, from side to side, it might have been expected that the transport is on a self-supporting basis. An increase in the population may make the losses greater. In London, an increase would probably make the profits greater.

Educational Topics and Events

CAMBRIDGE.—Prof. C. G. Darwin, Tait professor of natural philosophy in the University of Edinburgh, and a former fellow of Christ's College, has been elected master of Christ's in succession to Mr. Norman McLean, who is retiring.

W. S. Mansfield, University lecturer in agriculture and director of the University farm, has been elected a supernumerary fellow of Emmanuel College.

EDINBURGH.—Prof. J. Dover Wilson has taken up duty as regius professor of rhetoric and English literature.

On the recommendation of the Faculty of Medicine, the Cameron Prize has been awarded to Prof. C. H. Browning, professor of bacteriology in the University of Glasgow, in recognition of his work on the antiseptic properties and practical applications of acriflavine and other aniline dyes.

LONDON.—Prof. B. A. McSwiney has been appointed as from April 1, 1936, to the University chair of physiology tenable at St. Thomas's Hospital Medical School. He has been, since 1926, professor of physiology in the University of Leeds.

In June and July the University will celebrate the centenary of its incorporation by Royal Charter. In connexion with the celebrations, the Dean and Chapter of St. Paul's Cathedral have arranged to hold a special service on July 1 at 11.30 a.m., at which the Archbishop of Canterbury will preach the sermon.

THE New Education Fellowship will celebrate the twenty-first anniversary of its foundation at its seventh World Conference to be held at Cheltenham on July 31–August 14. The subject for discussion is "Education in a Free Society". To Sir Percy Nunn, the president, will fall the task of expounding the lessons of the past twenty-one years; Prof. Pierre Bovet will speak on "Can Religious Education make for Freedom and Peace?", Prof. Paul Langevin on "Science and Freedom", Prof. Piaget on the "Formation of the Free Personality", and F. Clarke on "Democracy and Social Control". In 1937 the Fellowship is to co-operate with the Australian Council for Educational Research in conferences to be held in all the capital cities of Australia in July and August. The executive committee includes Mr. Frank Tate, president of the Australian Council for Educational Research, Profs. Lovell and Mackie of Sydney, the director of education, Victoria, and the vice-chancellor of the University of Melbourne. A similar conference held a year ago in South Africa was very well attended, the enrolments reaching a total of 4,000.

Science News a Century Ago

The Royal Geographical Society

AT a meeting of the Royal Geographical Society held on January 25, 1836, presided over by Sir John Barrow, accounts were read of the Laccadive Islands and of the English Settlement at Cape Coast Castle. The account of the Laccadive Islands was from the private journal of Lieut. Wood of the East India Company's Marine. There were, he said, about fifty islets all told with a total population of less than 7,000. The islands were of coral formation, the larger ones being generally well planted with coco-nut trees, the manufacture of coir from the outer husk of the nut, into ropes, being the chief source of employment to the natives, beyond fishing, cultivating rice and a few vegetables and gathering cowrie shells, which were found in considerable abundance. The inhabitants were poor and inoffensive, carried no arms and lived in stone-built, thatched houses kept very low as a security against the violent gales by which the islands were often swept.

Records of Halley's Comet

IN a long letter published in *The Times* of January 26, 1836, the Rev. George Cornelius Gorham gave a review of the observations made of Halley's comet from 1456 until 1835, as recorded in various scientific publications, and referred especially to an article which had recently appeared in the *Quarterly Review*. "From these recorded appearances of Halley's comet during its last six visits in about four centuries," he said, "it would seem to be a rash conclusion that this body is gradually wasting away in space, or that the trains and luminous envelopes of comets decrease every time they return to our system (*Quart. Rev.*, Dec. 1935, p. 207), for the train of Halley's was only 4 deg. long as seen in Europe in 1759; it was 40 deg. in 1835, and the comet itself was brighter in the last return than in the preceding. . . . It was perhaps most splendid in 1456—most obscure in 1607—and more conspicuous in 1835 than in 1759. In short, it appears to have waxed and waned in brilliancy, by irregular alternations, during each of its last six perihelion journies; while its small oblong nucleus has been accompanied by a train of variable colour and magnitude, but is so far from dispersing, that it is considerably longer at present than it was 200 or 300 years ago." Gorham, who was born in 1787 and died in 1857, was third wrangler and second Smith's prizeman in 1808. He took the degree of B.D. in 1820, and his letter was addressed from Maidenhead Parsonage. From 1847 until his death, he was vicar of Brampford Speke, Devonshire, his appointment to this living leading to the famous ecclesiastical case Gorham *v.* the Bishop of Exeter.

The Institution of Civil Engineers

AT a meeting of the Institution of Civil Engineers held on January 26, 1836, Bryan Donkin being in the chair, Mr. C. Bourns read a paper giving a historical account of legislative measures for the jurisdiction of the Port of London, and the regulation of its commerce, from the earliest period, and suggested other enactments for the better regulation of steam vessels in the pool. After the reading of the paper some conversation took place on the effects produced by the new London Bridge. It was stated that the current of the river was much increased, particularly in the middle of the stream, and that a great alteration had taken place in the tide, which ran out much lower, while there was a greater deposition of mud on the shores. It was agreed that correct observation of the height of the tides, above and below the bridge, would be desirable, and some of the members promised to present tables of them constructed with considerable attention.

The Tides at Liverpool

KEPLER, Galileo, Newton, Daniel Bernoulli, Euler, Maclaurin and Laplace had all contributed to the theory of the tides, a subject which in the first half of the nineteenth century engaged the attention of Whewell, J. W. Lubbock and Airy. On January 28, 1836, Lubbock read a paper to the Royal Society entitled "Discussion of Tide Observations made at Liverpool". A report of this paper said: "The chief purpose which the author has in view in presenting the tables accompanying this paper, which are a continuation of those published in the *Philosophical Transactions* for 1835, and are founded on the observations instituted by Mr. Hutchinson at Liverpool, is to exhibit the diurnal inequality in the height of high water, which is scarcely sensible in the river Thames, but which at Liverpool amounts to more than a foot. The diurnal inequality in the interval appears to be insensible. The author has further ascertained that Bernoulli's formulæ expressing the height of the tide, deduced from the theory of the tides, present a very remarkable accordance with observation."

Societies and Academies

DUBLIN

Royal Dublin Society, December 17, 1935. H. H. DIXON: Sap movement in the bast. M. J. GORMAN and THOMAS TURPIN: An ineffective strain of nodule organism on red clover. This strain was isolated locally and is one of those which produces numerous small nodules distributed over the finer roots. In culture the ineffective strain did not grow in the sugar broths used. An effective strain studied concurrently grew well on the sugar media and produced, as is usual, a slight amount of acid. Other differences between the strains were noted. D. A. WEBB: The nitro-chromic reaction and its application to the estimation of small quantities of alcohol. By a modification of Agulhon's reagent (potassium dichromate in nitric acid) the strength of alcoholic solutions of the order of 100 mgm. per litre can be estimated to within two per cent, and more approximate estimations made down to 2·5 mgm. per litre. The method may be applied to blood serum, urine, milk, coloured fluids and expired air.

PARIS

Academy of Sciences, December 23 (*C.R.*, 201, 1301–1444). The president announced the death of Victor Grignard. MARCEL DELÉPINE and ALAIN HOREAU: The hydrogenation of some carbonyl compounds by nickel and platinised nickel. In the presence of small quantities of alkali, the velocity of hydrogenation

with nickel as catalyst is greatly increased. Details of the reduction of various ketones of different types are given. HENRI DÈVAUX: The centrifugal transformation of a thin film of copper sulphide under the influence of metallic copper: the arrest of this transformation by a separation of one Angström. NICOLAS BOURBAKI: A theorem of Carathéodory and measurement in topological spaces. MAURICE DE NEVE: The surfaces of Tzitzéica-Wilczynski. PAUL DELENS: Certain deformations of surfaces. MARCEL BRELOT: The integration of $\Delta u(M)=\varphi(M)$. L. B. ROBINSON: An equation with mixed differences. ANDRÉ MERCIER: Clifford numbers. HENRI ROURE: The average movement of Pluto deduced from observations. JEAN DUFAY: The continuous spectrum of the night sky and the diffusion of light in space. WANG SHIH KY: The diffusion of light in the Milky Way. HENRI BÉNARD: Is the superficial solar photosphere a layer of cellular vortices? From a discussion of previous work on this subject and a re-examination of the Janssen photographs, it is concluded that the extreme photospherical layer, the only one in which convection currents can exist, is constituted by a layer of semi-regular polygonal cellular vortices. ANDRÉ FORTIER: A new arrangement for measuring the viscosity of gases. MARCEL PAUTHENIER and MME. MARGUERITE MOREAU-HANOT: An ionic generator for high potentials. MAURICE LAMBREY and JEAN CORBIÈRE: Some quantitative data on the absorption spectrum of nitrogen peroxide. THADÉE PECZALSKI and NICOLAS SZULC: Study of the concentrations of sodium vapours in the electric arc. LÉON GRILLET and MICHEL DUFFIEUX: The spectrum of first discharge through nitrogen peroxide. JEAN LECOMTE: The infra-red absorption spectra of halogen derivatives of hydrocarbons with nucleus. Summary of the results obtained from the study of the infra-red spectra of about thirty halogen substituted aromatic compounds. RAYMOND RICARD: Observations on the second spark spectrum of mercury. RENÉ DE MALLEMANN and FRANÇOIS SUHNER: The superficial optical properties of Iceland spar. JEAN ROIG: A photographic method for determining the distribution of light intensity in interference rings. The method described eliminates error due to the slit not being uniformly illuminated and also that due to variable sensibility of the photographic plate. TIEN KIU: The study, between 4000 A. and 2400 A., of the contrast of plates treated with solutions of sodium salicylate. Immersion of the plates in solutions of sodium salicylate not only increases the sensibility of the plates in the ultra-violet, but also stabilises and considerably increases the factor of contrast, an important advantage in photographic photometry. MAURICE LAMBREY and JEAN CORBIÈRE: A deviation from the Schwarzschild law observed with certain plates in the ultra-violet. MAURICE CURIE: Heterogeneities in crystals and phosphorescence. ANATOLE ROGOZINSKI: The role of the slit in the distribution of the intensities of the lines of a powder diagram. HORIA HULUBEI: New data on the K spectra of molybdenum and rhodium. MLLE. YVETTE CAUCHOIS: New data on the K spectrum of copper. E. LOPOUKHIN: Some properties of the radioactive series. LOUIS CARTAN: The agreement of the nuclear energy balances with the experimental masses of the light elements. RENÉ WURMSER and MME. NÉLICIA MAYER: The oxido-reduction potential of reductone. MLLE. PAULETTE BERTHIER: The filtration of some mineral powders in suspension in water and in various aqueous solutions. PAUL MEUNIER: An electrophotometer with boundary layer cells intended for practical opacimetry. ANDRÉ KLING and MAURICE ROUILLY: A rapid method for the detection of toxic gases used in war. The air is aspirated through water containing bromothymol blue. The hydrolysis of the halogen compounds usually present produces a lowering of pH and this is made evident by the indicator. It has been shown that if there is no change of colour after passing 8–10 litres of the air, the toxic gas, if present, is in too small quantity to have injurious effects. MME. GENEVIÈVE GUÉRON, JULES GUÉRON and MARCEL PRETTRE: The induced oxidation of potassium iodide by ozone. MAURICE DODÉ: The structure of nitrogen peroxide deduced from its action on potassium iodide. HENRI MOUREU and GEORGES WETROFF: Phosphorus pernitride, P_4N_6. This nitride is obtained by heating in a vacuum at 550° C. the products resulting from the action of liquid ammonia on phosphorus trichloride. This nitride is spontaneously inflammable in air, differing from the compound P_3N_5. JEAN AMIEL: Some organic cupritetrachlorides and cupritetrabromides formed with secondary and tertiary amines and with alkaloids.

(To be continued.)

BRUSSELS

Royal Academy of Sciences (*Bull. Classe Sci.*, 21, No. 10, Oct. 19). L. GODEAUX: Canonical curves (2): Cubic surfaces possessing six Eckardt points. J. E. VERSCHAFFELT: Thermomechanics of the electric conductor (1). The theory of the Peltier and Thomson effects. (2) The relation between the coefficients of the Ettingshausen and Nernst effects. Further thermodynamical treatment of the problem in relation to the work of Bohr, Sommerfeld, Odone and Dupont. E. ASSELBERGHS and W. HENKE: The Siegenian and Gedinnian of Hunsrück and Taunus. The correspondence of the Hunsrück slates and the Taunus quartzite to the Siegenian of the Ardennes is exhibited in a comprehensive table. F. BACKES: Nets which are reproduced after four Laplacian transformations. O. ROZET: Deformation of the paraboloid. L. LONG: New definitions of Weingarten surfaces (W surfaces) (1). E. BODSON and F. E. NISOLI: The behaviour of certain diatomic molecules in stellar atmospheres. Application of Russell's theory to the oxides and hydrides of calcium, magnesium, boron and aluminium to determine their abundance as a function of the temperature, the necessary physical data being calculated approximately from the formulæ of Birge and Sponer and of Morse. J. FAUTREZ: Determinations of the dispersion of pluridisperse solutions. Critique of the results obtained with Nistler's apparatus. This apparatus gives accurate results for the radius of the dispersed particles only in the case of unidisperse solutions. The varying results obtained with pluridisperse solutions (solutions containing particles of various radii) give no immediate indication of the actual radii of the particles present. P. BAUDOUX: Skin effect in cylindrical conductors. Generalisation of Kelvin's calculations.

LENINGRAD

Academy of Sciences (*C.R.*, ?, No. 8, 1935). S. KOHN-VOSSEN: The existence of the shortest route. E. J. REMES: On some fundamental theorems

concerning the best approximation of functions of several independent variables. V. G. NEVZGLIADOV: A generalisation of Dirac's method for the calculation of the energy level of a system by permutations as operators, in the case of several original levels. V. A. NEMILOV and A. A. RUDNICKIJ: Physico-chemical investigation of gold-manganese alloys. P. P. BUDNIKOV: Heat of the reaction between kaolin burnt at different temperatures and $Ca(OH)_2$. O. K. ELPIDINA: On toxins of wilting. Wilting of potato caused by a *Fusarium* is due to a toxin. The toxic principle of *Fusarium* extracts is ammonia. A. A. PROKOFJEVA-BELGOVSKAJA: The *Y*-chromosome in salivary glands of *Drosophila*. V. A. KOVDA: The types of alkali soils (solontzi). Five types are distinguished and characterised. A. N. FORMOZOV and A. G. VORONOV: Principal features of the activity of rodents on pastures and meadow land. Quantitative estimations of damage to vegetation; effects of burrowing on the soil. I. V. KOZHANTCHIKOV: Insect metabolism at temperatures below zero. J. M. RALL: New data on the distribution of *Diplomesodon pulchellum*, Licht. (Mammalia, Insectivora) between the Rivers Volga and Ural. A. M. DJAKONOV: New Ophiurans of the genus *Amphiodia* from the Sea of Japan (2). Two species are described. A. BORISSIAK: New materials to the phylogeny of Dicerorhinæ.

SYDNEY

Royal Society of New South Wales, November 6. GERMAINE A. JOPLIN: Endogenous contact-zone of the magnesian limestones at Ben Bullen, New South Wales. The assemblages produced by the reaction of a quartz-mica-diorite magma and magnesian limestone are described in detail. These are compared with rocks formed by the assimilation of non-magnesian limestones, and though the assemblages are essentially different, certain similarities are noted and parallel degrees of contamination are recognised. It is also shown that certain rocks have been contaminated first by the assimilation of solid limestone and then by solutions carrying lime and magnesia derived from the limestones themselves. D. P. MELLOR and F. M. QUODLING: Birefringence of potassium chloropalladite and potassium chloroplatinite. Crystals of both compounds are strongly birefringent and optically negative. K_2PdCl_4, $\omega_D = 1{\cdot}710$, $\varepsilon_D = 1{\cdot}523$; K_2PtCl_4, $\omega_D = 1{\cdot}683$, $\varepsilon_D = 1{\cdot}553$. The strong birefringence is attributed to the parallel planar $[PdCl_4]^{--}$ and $[PtCl_4]^{--}$ ions which occur in the structures of these compounds. M. B. WELCH: Effect of chemical solutions on some woods. A number of commercial Australian woods were immersed in different concentrations of several acids, alkalis and inorganic salts to determine their ability to withstand chemical action. In general, the coniferous woods proved to be most resistant, whilst many of the hardwood and brush timbers are very inferior.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 587–631, Nov. 15). HARLOW SHAPLEY: A study of 7,900 external galaxies. The results are described of a survey of 174 square degrees of the southern galactic hemisphere (galactic long. 215° to 245°, lat. − 38° to − 59°). Several fairly distinct groupings of galaxies are found. There is an increase in the number of galaxies for photographic magnitudes between 15·5 and 17·0, due to a metagalactic cloud at a distance of the order of 22 megaparsecs; the five observed clusters are at much the same distance. HARLOW SHAPLEY and ARTHUR R. SAYER: The angular diameters of globular clusters. Seventy of these diameters, which have been used in estimating relative distances and average linear dimensions, have been re-determined with a Moll densitometer. The new measurements are greater than previous measurements, the mean ratio of new to old being $3{\cdot}7 \pm 0{\cdot}14$. J. L. CARTLEDGE, M. J. MURRAY and A. F. BLAKESLEE: Increased mutation rate from aged *Datura* pollen. Anthers picked just before they opened were stored for periods of two to twenty days at a temperature of 29°–31° C.; thus the pollen was kept under somewhat drier conditions than normal, although the temperature was within the range of that to which *Datura* flowers are normally subjected. The plants from such aged pollen showed a high rate of pollen abortion mutation, and the mutations involved the whole plant. Relatively few plants were used and no special precautions were taken, but the results are so consistent that it is suggested that mutations in Nature may be dependent, to an unsuspected extent, on the conditions to which pollen is subjected before it functions in fertilisation. HARRY H. LAUGHLIN: (1) The probability-resultant. The probability-resultant is defined as the combined effect, on the same measured quality, of several mutually independent constituent factors, and is measured in terms of a probability-distribution of the quality among the subject population. The principles underlying the computation of this quantity are demonstrated. (2) How to use the specific formula of heredity. The use of this formula leads to the construction of a Manerkon, a formula which, it is claimed, gives the soundest mathematical judgment at present possible for a particular probability-value. For each Manerkon, a thousand or more cases of a specific relationship covering the entire range of both prediction-basis and thing-predicted are required. I. S. SOKOLNIKOFF and E. S. SOKOLNIKOFF: The problem of Dirichlet for an ellipsoid. Determination of the electric field produced by a distribution of charge in equilibrium on a conducting ellipsoid of revolution lying midway between two parallel conducting planes at zero potential. MARSTON MORSE: Three theorems on the envelope of extremals. G. A. MILLER: Groups of order 2^m determined by subgroups generated by their squares. B. H. WILLIER, T. F. GALLAGHER and F. C. KOCH: Sex-modification in the chick embryo resulting from injections of male and female hormones. A single injection of 0·1 c.c. of sex-hormone solution (aqueous or in ethylene glycol) of varying potency was made into the albumen of eggs of 24 hours incubation. The hormones used were theelin, theelol, bull testis extracts and extracts of male human urine. With theelin and theelol, the left testis of a zygotically determined male develops ovarian characters and the oviducts persist; females are little affected. Bull testis extract produces small effect, but male human urine causes appearance of ovarian tissue on left testis. It is concluded that the left testis, but not the right, bears a germinal epithelium from the seventh to the tenth day, and is thus potentially bisexual. The hormones thus activates a tissue already laid down in normal development. The degree of sex-reversal is roughly proportional to the quantity of female hormone injected.

Forthcoming Events

Monday, January 27

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Miss Mary Doveton: "The Economic Geography of Swaziland".

Tuesday, January 28

UNIVERSITY OF LEEDS, at 8.—(in the Philosophical Hall, Park Row, Leeds).—Dr. R. E. Mortimer Wheeler: "The Earliest Towns in Britain: with Special Reference to Recent Archæological Excavations".

Wednesday, January 29

ROTHAMSTED EXPERIMENTAL STATION, at 11.30.—Conference on "The Use of Electricity in Agriculture". Papers by M. M. Harvey, Dr. B. A. Keen, F.R.S., G. H. Cashen, F. E. Rowland, C. A. Cameron Brown. Discussion to be opened by Sir Bernard E. Greenwell.

BRITISH ACADEMY, at 5.—Prof. A. S. Ferguson: "Plato and the Nature of the Soul." (Annual Philosophical Lecture.)

ROYAL INSTITUTION, at 5.15.—Prof. W. L. Bragg, F.R.S.: "Atomic Arrangement in Alloys" (succeeding lectures on February 4 and 11).

Thursday, January 30

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—W. L. McPherson and E. H. Ullrich: "Micro-Ray Communication".

Friday, January 31

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—(Geophysical Discussion: Joint Meeting with the Royal Meteorological Society).—Discussion on "Ice Ages" to be opened by Sir George Simpson.

ROYAL INSTITUTION, at 9.—Dr. C. E. K. Mees: "Sensitising Dyes and their Application to Scientific Photography".

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Report for the Year 1934–35. (Cmd. 5013.) Pp. iv+185. (London: H.M. Stationery Office.) 3*s*. net. [3012

Proceedings of the Royal Society of Edinburgh. Vol. 55, Part 2, No. 10: Charles Darwin as a Student in Edinburgh, 1825–1827; an Address delivered on October 28, 1935. By Prof. J. H. Ashworth. Pp. 97–113+3 plates. 2*s*. 3*d*. Vol. 55, Part 2, No. 11: On Fourfold Sampling with and without Replacement. By Dr. A. C. Aitkin and Dr. H. T. Gonin. Pp. 114–125. 1*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [3012

The Warburg Institute. Annual Report 1934–1935. Pp. 12. (London: Warburg Institute.) [61

A Guide to Botanical Reading. By R. J. Peacock and C. T. Prime. Pp. vii+32. (Croydon: Public Libraries.) 6*d*. [61

The Wool-Textile Industry of the Pennines in its Physical Setting. By W. B. Crump. Pp. 20. (Manchester: The Textile Institute.) 1*s*. [71

Laboratory Organisation. By Dr. Leslie H. Lampitt. Pp. 26. Food and the Consumer. By Dr. G. W. Monier-Williams. Pp. 15. (London: Institute of Chemistry.) [71

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Welsh Timber Trees, Native and Introduced. By H. A. Hyde. Second edition, revised throughout. Pp. viii+107+26 plates. (Cardiff: National Museum of Wales; Press Board of the University of Wales.) 2*s*. [71

Peace and the Colonial Problem. By Lord Lothian, Sir Arthur Salter, Prof. Norman Bentwich, Leonard Barnes, Dr. Lucy Mair, Prof. Wm. Macmillan, Sir John Harris, W. McGregor Ross, C. Roden Buxton, Prof. Stanley Jevons, Rev. Leyton Richards, and others. Pp. 52. (London: National Peace Council.) 6*d*. [71

East African Agricultural Research Station, Amani. Seventh Annual Report, 1934–35. Pp. 47. (London: H.M. Stationery Office.) 1*s*. net. [71

Cherries and Soft Fruits: Varieties and Cultivation in 1935. Report of the Conference held by the Royal Horticultural Society at the Greycoat Street Hall, July 16 and 17, 1935. Edited by F. J. Chittenden. Pp. ii+164+10 plates. (London: Royal Horticultural Society.) 6*s*. [71

Leeds University. Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing, during the Session 1934–35. Pp. 22. (Leeds: The University.) [71

Natural Science and Archæology Society, Littlehampton. Reports of Proceedings, 1934. Pp. 18. (Littlehampton: The Museum.) [71

Other Countries

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1934. Pp. xvi+122+5. (Copenhague: Andr. Fred Høst et fils.) 7.00 kr. [61

India Meteorological Department. Scientific Notes, Vol. 6, No. 66: Normal Monthly Percentage Frequencies of Upper Winds at 4, 6, 8 and 10 Km. above Sea-Level obtained from Pilot Balloon Ascents. Pp. 121–211. (Delhi: Manager of Publications.) 3.12 rupees; 6*s*. 6*d*. [61

Canada: Department of Mines: Mines Branch. Laboratory Tests on Structural Assemblies of Brick and Tile. By L. P. Collin. Pp. ii+33+2 plates. (Ottawa: King's Printer.) 10 cents. [61

Publications of the Kapteyn Astronomical Laboratory at Groningen. No. 47: The Absorption of Light in Interstellar Galactic Space and the Galactic Density Distribution. By Prof. Dr. R. J. Van Rhijn. Pp. ii+34. (Groningen: Hoitsema Brothers.) [61

Zoologica. Vol. 20, Nos. 1 and 2: Deep-Sea Fishes of the Bermuda Oceanographic Expeditions. No. 1: Family Derichthyidæ; No. 2: Family Nessorhamphidæ. By William Beebe. Pp. 51. (New York: New York Zoological Society.) [71

Inigo Jones Seasonal Weather Forecasting Trust: Crohamhurst Observatory. Observatory Paper No. 1: The Crohamhurst Observatory; its Location and Functions and the Inaugural Ceremony. Pp. 16. (Crohamhurst, Qd.: Crohamhurst Observatory.) [71

Punjab Irrigation Research Institute. Report for the Year ending April 1935. Pp. iii+74+35 plates. (Lahore: Government Printing Office.) [71

The New Guinea Agricultural Gazette. Vol. 1, No. 1, October. Pp. 50. (Rabaul: Department of Agriculture.) [71

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 6: Malayan Agricultural Statistics, 1934. By D. H. Grist. Pp. iii+8+87 Tables. (Kuala Lumpur: Department of Agriculture.) 50 cents. [71

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 6: Fundamentals in the Education of Negroes. Compiled and edited by Ambrose Caliver. Pp. v+90. 10 cents. Bulletin, 1935, No. 7: Coordination of Effort for the Education of Exceptional Children. Compiled by Elise H. Martens. Pp. vi+82. 10 cents. Bulletin, 1935, No. 14: Federal Student Aid Program. By Fred J. Kelly and John H. McNeely. Pp. iii+39. 5 cents. (Washington, D.C.: Government Printing Office.) [71

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 15, No. 11 (Mathematics No. 14): On a Pair of Surfaces Mutually Related, I. By Sôji Matsumura. Pp. 265–282. (Tôkyô: Maruzen Co., Ltd.) [71

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 18, No. 2: Catalogue of the Tertiary and Quaternary Mollusca from the Island of Taiwan (Formosa) in the Institute of Geology and Palæontology, Tôhoku Imperial University, Sendai, Japan. Part 2: Scaphopoda and Gastropoda. By Sitihei Nomura. Pp. 176+5 plates. (Tôkyô and Sendai: Maruzen Co., Ltd.) [71

Canada: Department of Mines, Mines Branch. Limestones of Canada: their Occurrence and Characteristics. Part 3: Quebec. By M. F. Goudge. Pp. x+274. (Ottawa: King's Printer.) 50 cents. [71

Indian Forest Records, New Series. Vol. 1, No. 6: On the Biology of the Braconidæ (Hymenopt.). By C. F. C. Beeson and S. N. Chatterjee. Pp. 105–138+1 plate. 1.4 rupees; 2*s*. Vol. 1, No. 7: Immature Stages of Indian Coleoptera (18) Brenthidæ. By J. C. M. Gardner. Pp. 139–148+2 plates. 10 annas; 1*s*. Vol. 1, No. 9: On the Biology of the Tachinidæ (Diptera). By C. F. C. Beeson and S. N. Chatterjee. Pp. 169–184. 10 annas; 1*s*. (Delhi: Manager of Publications.) [71

U.S. Department of Agriculture. Circular No. 364: Cyanide Fumigation of Mushroom Houses. By A. C. Davis and H. V. Claborn. Pp. 10. 5 cents. Technical Bulletin No. 485: Effects of Particle Size on the Properties and Efficiency of Fertilizers. By A. L. Mehring, L. M. White, W. H. Ross and J. E. Adams. Pp. 27. 5 cents. (Washington, D.C.: Government Printing Office.) [71

The University of Colorado Studies. Vol. 23, No. 1: Abstracts of Theses and Reports for Higher Degrees, 1935. (University of Colorado Bulletin, Vol. 35, No. 15.) Pp. 80. (Boulder, Colo.: University of Colorado.) 1 dollar. [71

Proceedings of the United States National Museum. Vol. 83, No. 2980: Two New Species of Tapeworms from Carnivores and a Redescription of *Taenia laticollis* Rudolphi, 1819. By Mary Scott Skinker. Pp. 211–220+plates 19–21. Vol. 83, No. 2981: New Paleocene Mammals from the Fort Union of Montana. By George Gaylord Simpson. Pp. 221–244. (Washington, D.C.: Government Printing Office.) [71

National Research Council: Division of Geology and Geography. Report of the Committee on the Measurement of Geologic Time, April 27, 1935. Pp. iii+85. (Washington, D.C.: National Research Council.) [71

Catalogues, etc.

Acriflavine—Boots: its Properties and Uses. Pp. v+36. Acriflavine—Boots in the Treatment of Gonorrhœa. Pp. 6. (Nottingham: Boots Pure Drug Co., Ltd.)

Gulf Research and Development Corporation. Pp. 16. (Harmarville, Pa.)

Microscopes and Accessories. Pp. 122. (London: C. Baker.)

Multivite Pellets: Accurately-standardised and Correctly-balanced Amounts of Vitamins A, B_1, B_2, C and D in High Concentration and in Small Bulk. Pp. 12. (London: The British Drug Houses, Ltd.)

Absorptiometer for Liquids designed by Moll, Burger and Reichert. (Aso 34.) Pp. 4. Non-Recording Microphotometer. (Nomi 34.) Pp. 2. Moll Thermopiles. (Ther 34.) Pp. 2. (Delft: P. J. Kipp en Zonen.)

The Aldis Epidiascope. Pp. 6. (Birmingham: Aldis Brothers.)

100 livres curieux: alchimie, astronomie et astrologie, jésuites, médecine, météorologie, occultisme, physique, rose-croix. (Bulletin No. 1.) Pp. 20. (Paris: Émile Offenbacher.)