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The Utilisation of Coal*

THE British Science Guild has now published the full text of the papers delivered, and a verbatim account of the subsequent discussion, at the symposium on the utilisation of coal, held at the Royal Institution on March 27, a report of which appeared in NATURE of April 1. Members of Parliament ; some of the largest trade unions ; interested Government departments ; coal-getting and coal-distributing organisations ; gas, oil and chemical interests ; scientific and technical institutions, were all well represented, a fact which should encourage the Council of the Guild to arrange more meetings of this kind on subjects of national importance and where scope is given for the expression of varying opinions and differing interpretations of available data. It is the object of the British Science Guild to promote the application of scientific method and results to public affairs, and probably there is no surer way of appealing to the public imagination than by providing facilities for experts to express in terms intelligible to the layman the effects of their investigations on industrial aspects of national progress.

While, however, we must congratulate the British Science Guild on arranging a symposium on a subject of such interest as to prevail upon so many busy and distinguished persons to forsake all other duties to be present, we must confess to a feeling of disappointment that the expert protagonists of coal and oil and gas, and most of those authoritative experts who contributed to the discussion, made such poor use of the exceptional opportunity afforded them. Engineer Rear-Admiral Scott-Hill's paper on "Coal and Sea Transport" was the only contribution of real merit, noteworthy alike for its substance, the impartiality with which he assessed the relative advantages of coal and oil as fuels for the mercantile marine and the navy, and the suggestions made for the extended use of coal. The paper by Mr. Stephen Lacey, of the National Gas Council, on "Development of the Use of Gas", exhibited the same regard for accuracy but it presented no new features and dealt far too briefly with either the possibilities of high pressure gas cylinders for lighting and power purposes, or those of high pressure gas mains for distributing heat, light and power direct from coal-fields to the towns and other industrial centres, of which the

* "A Symposium on the Utilization of Coal." Pp. 46. (London: British Science Guild, 6 John Street, Adelphi, W.C.2.) 1*s*.

practical possibilities have already been demonstrated in Germany.

Capt. Acworth and Mr. A. C. Hardy have been in the lists before as protagonists of coal and oil respectively. It is unfortunate that both these experts preferred to indulge in polemics instead of providing the audience with complete comparative data from which the experts and laymen present could have drawn their own conclusions. In his enthusiasm for a 'Back to Coal' movement Capt. Acworth made assertions to which even a back-bench politician would hesitate to commit himself. We do not question the fact he gave that Great Britain's annual output of coal decreased from 287,000,000 tons in 1913 to less than 220,000,000 tons in 1931. But his paper contained no justification for his conclusion that "considerably more than 67,000,000 tons of British coal has thus been replaced by oil". Again, his statement that since 1913 "the change over on sea and land from coal to oil has adversely affected our national trading balance by £960,000,000" should not have been made without his audience being informed of the statistics on which he based this estimate.

Capt. Acworth asserted also, in support of his argument, that the oil industry has been subsidised at the expense of the British taxpayer, that "In this country alone £1,600,000,000 has been expended in making the roads fit for motor-traction", a total which obviously includes expenditure on making and upkeep of roads which would have been incurred if the motor-car had never been invented. Although Capt. Acworth believes that "low temperature carbonisation has a considerable future if the solid fuel is treated as the main product", he discounts the possibility of the mercantile marine and navy obtaining their supplies of oil by this process of extraction from home-produced coal and dismisses as fantastic the economic practicability of obtaining oil from coal by the hydrogenation process.

Mr. Hardy was guilty of at least two important omissions in his own contribution, both of which unfortunately passed without comment. In the first place he made no reference to the decision of one of our greatest ocean liner companies to experiment with pulverised coal and colloidal fuels; and in the comparative figures he gave of fuel consumption by coal-burning, oil and Diesel ships, he made no reference to the relative costs of coal and oil and the running expenses of the three different types of marine engines. It is surprising also that he did not refer at all to the possibility of obtaining our oil supplies from our own coal. Curiously enough, Mr. Stephen Lacey made no mention of the part played by the gas companies in connexion with home-produced hydrocarbons. Neither did he deal with the economics of the other by-products of coal in relation to the coal-gas industry.

Mr. Hardy fell into the grave error of assuming that any body which offers the expert exponents of competing industries an opportunity to inform public opinion on recent advances in the fields of enterprise in which they are interested, necessarily subscribes to their views or vouches for the accuracy of the data which they use in their papers. *Petroleum Times*, in its issue of April 1, made the same error. Commenting on Capt. Acworth's paper, it said: "rarely, if ever, can coal and oil technologists have listened to so many mischievous and distorted statements"; and added, "we are left with a deep conviction that the British Science Guild has lowered its reputation by allowing such distortion to pass out under its name". The fact is, the British Science Guild provided a platform for a controversy which is of vital interest to the nation, and it was evident from the company which assembled that pains had been taken to ensure that in the audience were experts who could, if they had chosen, challenge the accuracy of the data given and comment on the conclusions drawn, by those who read papers.

Unfortunately, however, most of the experts who contributed to the subsequent discussion were apparently more concerned to prove that the coal-owners and distributors are largely responsible for the present unsatisfactory situation of the coal industry than to enlighten the audience on the relations between the coal industry and the oil and the chemical industries. The dyestuffs industry was not even mentioned: and only casual reference was made to low temperature carbonisation and hydrogenation of coal, although these two processes have been the subject of comment and controversy for years past. This is a great pity, for there are very many people in Great Britain who wish to be informed on the economics of oil from coal projects, more particularly as seventy per cent of our imported oil supplies come from the United States of America, to which we are already heavily indebted and to which we are unable to sell much in exchange owing to the prohibitive tariffs.

Civilisation and War

They that take the Sword. By Dr. Esmé Wingfield-Stratford. Pp. xv+422. (London: George Routledge and Sons, Ltd., 1932.) 12*s.* 6*d.* net.

ONE of the principal arguments of this book is that the next war on the grand scale will mean the complete annihilation of modern civilisation; a phrase easily uttered, but the terrible significance of which is not easily apprehended. Probably by the cynics and pessimists among us it will be so little apprehended that this particular argument will make no very profound or soul-stirring appeal. They will at once agree that our civilisation, such as it is, deserves no other fate, which is, in any case, inevitable. This, however, is a question of fundamental philosophy or historical interpretation which is perhaps beyond our present scope, and, as the author of this powerful denunciation of war in all its aspects has done, it is taken for granted that civilisation must be saved.

If reasoned argument and moving eloquence alone could abolish war, then war would long ago have been abolished, or if not, this book would surely finish the perfect work. As a reasoned statement of the case against war these scholarly and persuasive pages could scarcely be surpassed in strength and lucidity and cogency of argument, in splendid wealth of apt illustration and historical lore, and in devastating logic against the folly and madness of war from every point of view; or, from nearly every point of view: there are one or two aspects which, as noted later on, do not appear to us to be sufficiently treated. No rational mind in its calm moments could for one instant dispute or deny the truth, wisdom, broad-minded charity, and profound scholarship breathing in every page. In both breadth of learning and scope and in depth of philosophical reasoning the book is remarkable, though the author's attitude towards Old Testament Hebrew history may be unpalatable to some; and alike for the general reader and the student of history the keenest interest is sustained to the very end, despite its more than four hundred closely printed pages.

To the man of science the work will be of particular interest. Dr. Wingfield-Stratford's main thesis indeed is that, chiefly owing to scientific progress, the fabric of civilisation tends to become ever more liable to fatal injury with increasing development in extent and complexity; the powers of destruction and self-destruction conferred on mankind by science are continually increasing; and the combination of these two tendencies must mean annihilation (p. 378). Whilst apparently accepting the evolutionary doctrine in the main, the author nevertheless holds that "progress in evolution is a progress in unity, in co-operation, in the membership of each in all, in the fulfilment of every lesser individuality in a greater, until God, the supreme and ultimate unity, shall be all in all". There is no basis in fact for the so-called economic theory of enlightened selfishness—which was often extremely dark and unenlightened, expressing itself in cut-throat competition. The respective merits of competition and of co-operation in all their manifold complex forms are vital factors in any discussion of war; and a growing realisation of international dependence and the advantages of co-operation as against trade war is one of modern civilisation's hopes, though unfortunately, at the moment, this realisation is more in theory than in fact.

The alleged Darwinian necessity of a struggle *à outrance* for survival has by no means been universal; and the author brings all the weight of his wide historical knowledge in support of this view, as also against the popular fiction of a pugnacious and ruthless club-wielding caveman. Thence he argues against the supposed inherent love of fighting in human nature. Even if this latter propensity be real it could play no part in, nor derive any satisfaction from, the nameless horrors of modern mechanised warfare. Its proper sphere is the boxing ring or other place of sport, and it is as little intended for the shambles of a modern battlefield as a high-spirited dog is intended for the abattoir of the butcher. Courage, strength, skill, stand as little chance in the one as in the other.

Sir Norman Angell long ago showed the great illusion of war from a material point of view. This needs no further emphasis in these days when even victory brings no gain, but irreparable loss. Dr. Wingfield-Stratford now, with masterly analysis and illustration, in his chapters on the mind and soul of the soldier, brings into startling visibility the repressing and stultifying effect of military preoccupations on the mentality of the professional soldier, and, more generally, the tragic bar to national progress and culture formed by diversion of so much of the nation's energy

into military channels. He is particularly severe against Napoleon and other "conquering heroes", whose reputations for real greatness are shattered in this book with the enthusiasm of an iconoclast.

It is not, of course, possible to follow the author wholeheartedly in every point he endeavours to make; there will be dissent from the sweeping condemnations contained in the chapters just referred to on the professional soldier's mentality. Some exceptions are indeed admitted by the author himself. In any event, his remarks on the attitude of the military mind towards scientific advance in the arts and mechanised means of war will be read with marked interest. As a general rule he thinks the military mind is too low-grade and undeveloped to understand or appreciate scientific help.

Then again, despite his breadth of treatment, touching, it would seem, every possible aspect of a highly complex subject, the author does not appear to treat very adequately of what may be called defensive wars. There have been, of course, in the past and may well be again in the future, cases of unprovoked assault in which the attacked nation could do no other than defend itself. Also should not the weak nation be protected against the strong and ruthless aggressor? These and many other difficult matters of a highly controversial kind necessarily go to the heart of the *raison d'être* of the League of Nations, its policy and methods.

Dr. Wingfield-Stratford is mainly concerned in stating the case against war: he does not say a great deal as to practical measures for ensuring peace, except world-wide and enthusiastic support for the League and a change in spirit. It should, no doubt, be sufficient for all reasonable men to realise the full significance of another world-war to ensure the complete abolition of war. Unlike all wars of the past, the next war may include the exposure of the entire civilian populations to the horrors of air-bombing and poison gas on a scale not yet known or realised. Is further appeal needed? Civilisation would indeed be utterly destroyed amid every circumstance of unmitigated horror and terror, and the fate of the world in such case could scarcely be depicted in too lurid colours. The most powerful safeguard to ensure world peace is, in the author's opinion, a change in spirit worked by a full and complete return to the teaching and practice of the founder of Christianity. W. G. L. C.

The Naturalist and the Country Side

(1) *The Common Earth*. By E. L. Grant Watson. Pp. xi+148. (London: J. M. Dent and Sons, Ltd., 1932.) 5*s*. net.

(2) *The Trail that is Always New*. By Willoughby P. Lowe. Pp. xix+271+22 plates. (London and Edinburgh: Gurney and Jackson, 1932.) 16*s*. net.

(1) THIS little book is made up of essays on English country life, which were broadcast in 1931–32. They are pleasantly written observations on the seasons, on animal, bird and insect life, and on the life-history of a typical old peasant. Such lectures do not aim at the revelation of anything new, but we take it were given with the object of arousing the interest of the townsman, and of the otherwise unobservant person, in the many attainable delights of a lover of the country.

The author tells his stories of animals and of his country rambles so attractively, that the reviewer regrets his occasional excursions into philosophical surmise, and agrees with his assertion that feelings aroused by observation of Nature cannot be put into a few simple words. Thus after about two pages on the starlit sky, we read: "As we gaze, the persuasion grows that all these marvels of the sky are under-arched and upheld by the no less potential vastness of mind which perceives them." Here surely the words convey no clear meaning or feeling at all. In describing autumn, the author emphasises the steps taken in Nature to ensure the fall of the leaf, etc., and then remarks: "In this widespread seasonal act of deliberate dying, nature is saying something with no uncertain voice. It is worth listening to." Surely Nature is saying that the fall of the leaf is no more a deliberate act of dying than is the moult of a bird, or perhaps the hibernation of an animal.

Mr. Grant Watson has the power of sharing his pleasure in birds and beasts with his reader. We know that he has respect and affection for wild life, so that his last chapter—on Wicken Fen—gives us the more surprise. He refers to "these good days when one could see as many as twenty sheets on the fen at night with lamps in front of them"—these being provided by one Solomon Bailey at a cost of half a crown each, with the object, be it noted, not of the observation of wild life, but of the ruthless slaughter of as many rare moths as possible. He himself thus

captured the rare *palustris* which only appears every seven years or so, and then only in ones and twos for one week in June.

The reviewer hoped against hope that a word of appreciation for the work of the National Trust in preserving the wild life would have shown that the words "these good days" were writ "sarcastic-like". Entomologists, naturalists, botanists, all are welcomed to Wicken, without the half-crowns, provided that they come to *learn*, not to destroy, to observe and commune with Nature rather than to kill her children for pecuniary gain as so often in "these good days".

(2) Mr. Willoughby Lowe was bred in Lincolnshire, but in 1888, when only sixteen, joined a brother in Colorado. Here he lived for nine years, collecting, communing with Nature and learning that reliability and assurance of self to which he many times afterwards owed his life. It was a wild, open country and no better training ground can be imagined with its plains and heights, its summers of drought and its winters almost glacial. In 1912 commenced an honourable connexion with the British Museum, the collections of birds and mammals of which he so greatly enriched.

Many lands were visited, even Siam and the Philippines, but perhaps the reader will be most interested in the repeated investigations of African life. After a trip in East Africa in 1913, he travelled from Lake Rudolf to the Nile through waterless and dangerous country, from which the party was fortunate to emerge. When returning home, Lowe met Abel Chapman, another fine naturalist, with whom he collected afterwards in the Sudan. The biggest venture was in 1920 with Admiral Lynes to Darfur, where they were detained owing to the rebellion of 1921, the expedition extending over eighteen months. The haul here was 365 species of birds and 62 mammals, many hitherto undescribed. The west coast of Africa was visited many times, and extensive collections were also made in Madagascar, in parts the wildest of countries.

Then "farewell" to the reader without fuss for the trail is calling, "this time to the borders of China". Perhaps later Lowe will reflect on his life, all he has time to add here being a few health hints which we summarise as recommending warm baths, as little exposure to the sun and insect bites as possible, equal parts of penny royal and olive oil to deter mosquitoes, boiled water, 5 grains of quinine per day, and *one* peg of whisky but "never before sundown".

We confess that we did not expect to enjoy the story of a collector's expeditions, but Mr. Lowe has written such a simple, unaffected narrative that he has disarmed us. He is primarily a naturalist as indeed the successful collector must be, and his tale excited us in the same way as did Wallace's "Amazon", more than forty years ago. The science of both these 'travels' consisted of the facts observed, and the 'how, when and why' of the pseudo man of science, usually mere guess-work, is eschewed. All naturalists will like to have this book on their shelves.

Relativity and the Structure of the Universe

The Expanding Universe. By Sir Arthur Eddington. Pp. ix+128+2 plates. (Cambridge: At the University Press, 1933.) 3*s.* 6*d.* net.

SIR ARTHUR EDDINGTON'S skill as a writer is well known to-day. He makes effective use of it in this brilliant exposition of the theory of the structure of the universe from the point of view of the theory of general relativity. The observational problem to be discussed is becoming familiar to all scientific workers. Our galaxy is apparently surrounded by a cloud of other galaxies, the spiral nebulæ, which appear to be evenly scattered throughout space. This cloud, moreover, does not seem to have a boundary. The spectral lines of the light emitted by these nebulæ exhibit a shift towards the red end of the spectrum which increases proportionately to the distance of the nebula concerned. By means of the Doppler effect in the wave theory of light, this observed red-shift is interpreted as a velocity of recession. The speeds so found are enormous: the most recent determination is 24,000 km./sec. for a faint cluster of nebulæ in the constellation Gemini. With this interpretation of the red-shift, we are evidently dealing with a material system which is certainly expanding and is also boundless.

Sir Arthur Eddington points out that the existence of such a system of material particles (the nebulæ) which has no boundary and in which each particle is uniformly surrounded by all the rest, implies that the system occurs in a curved and closed space. If each particle sees all the others moving away from it with velocities proportional to their distances, the space must be expanding as well as closed. Of course, it is always open to those who have preconceived ideas as to what space 'ought' to be, to represent this curved space as 'flat' by

introducing appropriate distortions, just as the curved surface of the earth may be mapped on a flat plane. But the relativist will not feel called upon to do this. The equations of general relativity not only expressly allow for the possibility of using curved spaces, but also contain the cosmical constant $\lambda\,(>0)$ which suggests that such spaces may be 'expanding'. Roughly speaking, the presence of the 'λ-term' in the equations is tantamount to the assumption that, in addition to the gravitational attraction between particles of matter, there exists a universal repulsive force which will cause a general scattering of any collection of particles provided it can get the upper hand of their mutual attractions. In the physical universe this is supposed to have happened, with the result that all the nebulæ now appear to be receding from us.

It is possible to imagine a state of affairs in which, throughout the whole universe, gravitation and repulsion just balance one another. This is the so-called Einstein universe. Space is then spherical and the condition is one of unstable equilibrium, so that the slightest disturbance in the appropriate direction will start an expansion. Sir Arthur Eddington considers that physical space started from such an equilibrium state. This has the advantage, amongst others, of giving the longest time-scale yet proposed (some 10^{10} years) since the expansion effectively began.

The last chapter of the book is devoted to Sir Arthur Eddington's own investigations on the border-line between relativity and quantum mechanics. The wave-equation for an atom gives the size of the latter. Sir Arthur believes that a 'length' at any point in space must be relative to the radius of curvature of space-time at that point. Hence the wave-equation must contain this radius. It must also involve something representing the action on the atom of the rest of the universe. It is then possible to deduce, from the constants occurring in the wave-equation, the value of the velocity of recession of the spiral nebulæ and the number (10^{79}) of the protons and electrons in the universe. These results are, as yet, not universally accepted but there can be little doubt that they point towards the goal so long sought after: the all-embracing theory which shall account for both the microscopic and the macroscopic phenomena of Nature. G. C. McV.

Short Reviews

Indian Caste Customs. By L. S. S. O'Malley. Pp. ix + 190. (Cambridge: At the University Press, 1932.) 6*s*. net.

MR. O'MALLEY quotes a remark by Lord William Bentinck, when the prohibition of suttee was under consideration, that the question was not what the rite was, but what it was thought to be. His own account of Indian caste customs is quite in this spirit. His object is to show how the caste system works in the everyday life of India, without entering into any inquiry as to origins, or the origin of specific castes and groups except in so far as present conditions are thereby affected. He writes for those whose knowledge of caste is at best superficial, and shows how it works in the spheres of social position and intercourse, marriage and morals, internal regulation and external control, food and drink, and occupations.

A chapter is devoted to the Untouchables, and one to modern tendencies, in which it is pointed out to what extent caste regulations are now breaking down. Here, in view of the public for whom the author writes, even more stress might have been laid upon the weight of conservatism in the rural population, which constitutes nine-tenths of the whole Hindu population. He wisely emphasises the strength of feeling within the castes for its preservation as the fitting, and indeed to them the only possible, ordering of society which would maintain social prestige. This applies even to the Untouchables. This is an aspect of the problem upon which Mr. O'Malley, as an ex-census officer, is well qualified to speak. The advantages and disadvantages of caste as a social, political and ethical factor are balanced with judgment.

It is to be regretted that this book was not published earlier by two or three years; as it is, it will give the public a juster estimate of the difficulties which still have to be faced in India.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 12: *U, Mn, Ma, Re, Fe* (Part 1). Pp. xiii + 944. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 63*s*. net.

THE new volume of "Mellor" includes the elements uranium, manganese and its recently discovered homologues, and iron. The chapters dealing with the first two elements do not call for special comment, although it may be noted that triangular diagrams are used extensively to illustrate the properties of ternary alloys of manganese and that the spectrum of the element is recorded in unusual detail. It is, however, of interest to note that the homologues of manganese already occupy 17 pages, including more than 1½ pages of references, nearly all dating from 1929, when rhenium was first isolated in substantial quantities.

The chapter on iron differs from any that have

appeared hitherto, in that nearly half a volume is now devoted to pure metallurgy. The compounds of iron are therefore held over to a subsequent volume. The thoroughness with which the literature has been searched is indicated by 17 pages each of references to the history of iron and to its extraction from its ores, and 30 pages of references to its occurrence. Greater interest will be found, however, in the sections on the allotropes of iron, its microstructure and crystalline form, the iron-carbon system, etc., where questions of wide general interest are discussed and illustrated with photomicrographs, equilibrium diagrams, and other figures, of which the chapter contains a total of no less than 178. Whilst, therefore, the chapter on iron will maintain (and may even enhance) the reputation of the book as an encyclopædic guide to the literature, its particular character makes it much more readable than some of the other chapters.

Théorie de la quantification dans la nouvelle mécanique. Par Prof. Louis de Broglie. Pp. xxviii+250. (Paris : Hermann et Cie, 1932.) 70 francs.

THE attention of theoretical physicists ought to be directed to this volume, in which Prof. Louis de Broglie develops the general theory of 'quantification' and elaborates the exposition given in his "Introduction to the Study of Wave Mechanics". Instead of following the method of matrices associated with the names of Heisenberg and Born, or Dirac's method using a non-commutative algebra, he systematically proceeds from the point of view of undulatory mechanics. His treatment approaches that employed by Weyl at the beginning of his work on group theory and quantum mechanics.

The first part of the book is introductory and deals with the general principles of wave mechanics. After discussing the indispensable mathematical preliminaries he proceeds to the general theory, which leads to the prediction of the quantified values of any mechanical magnitude whatever, and the respective probabilities of these quantified values. He attaches importance to the study of the first integrals, which he regards as one of the essential parts of the new mechanics. He claims to have given a logical and consistent treatment of modern quantum theory, which appears so strange to those who are familiar only with classical conceptions.

Collected Papers of Charles Sanders Peirce. Edited by Charles Hartshorne and Paul Weiss. Vol. 1 : *Principles of Philosophy.* Pp. xvi+393. 21*s.* net. Vol. 2 : *Elements of Logic.* Pp. xii+535. 31*s.* net. (Cambridge, Mass. : Harvard University Press ; London : Oxford University Press, 1932.)

THE authorities of Harvard University are to be congratulated for their publication of the papers and notes left by Charles Sanders Peirce. A master mind and a pioneer in philosophical inquiry, Peirce had never an occasion of publishing a standard work embodying his views. So that the editing of his papers is in itself a feat which deserves the praise and gratitude of all scholars. We would do little justice to the philosophical vision of Peirce in estimating his work on the strength of the first two volumes, out of a series of ten, which are to be published. It will suffice at present to indicate the wide range of topics touched upon in the present volumes : the method of science, the classification of the sciences, the logic of mathematics, the categories, the character of logic, speculative grammar, critical logic, and the theory of probable inference. T. G.

An Introduction to Analytical Psychotherapy. By Dr. T. A. Ross. Pp. vii+203. (London : Edward Arnold and Co., 1932.) 10*s.* 6*d.* net.

DR. ROSS is to be congratulated on a very readable book. He gives a good account of the unconscious which he considers must be assumed to exist. Although the author, to a large extent, is a very staunch supporter of Freud, he is very honest in his appraisal of his methods, and candidly admits that suggestion must in any analysis play a very important part. This we consider very important and very true.

The author is not inclined to accept a fixed symbolism for any interpretation of dreams. He rightly points out how Freudian symbolism carried to undue limits may give interpretations which are undoubtedly false ; dream interpretation is not so straightforward as some good Freudians would have us believe.

We cannot agree with the author that Adler does not appear to have made much contribution to psychotherapy. There are many who do not accept Freud or Jung, but are willing to accept Adlerian ideas.

Meet the Sciences. By W. M. Malisoff. Pp. vi+196. (Baltimore, Md. : The Williams and Wilkins Co. ; London : Baillière, Tindall and Cox, 1932.) 15*s.* 6*d.* net.

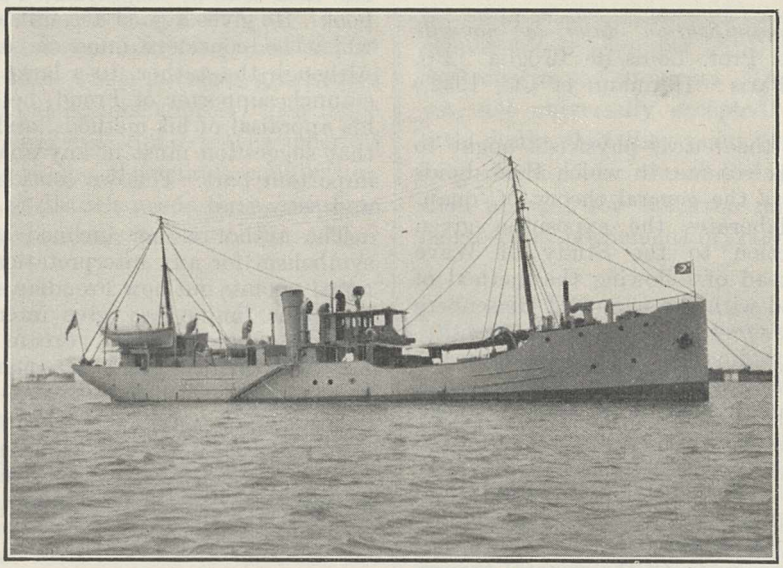
CLASSIFYING the sciences has been a pleasant and harmless game for the philosopher ever since the time of Plato. The complex growth of our knowledge has, however, of late discouraged amateurs of this kind of jig-saw puzzle. The trouble with it is that either the definition of any science is too wide and thus annexes foreign territory on its borders ; or it is narrow and allows border provinces to be taken over by a neighbouring science. Yet, order of some kind is badly needed in the description of our present-day knowledge : this ungrateful task is courageously performed by the author of this book. The result of his efforts should be, for the scientific worker, a more tolerant understanding of his subject, and for science, a clearer conception of its humble aims and human value.

The John Murray Expedition

By PROF. J. STANLEY GARDINER, F.R.S.

THE late Sir John Murray, whose name will ever be associated with the *Challenger* Expedition, left for scientific purposes certain funds, which have been allowed to accumulate since his death. He desired that these funds should be used for a scientific expedition, a sequel to the *Challenger*, and such an expedition has now been arranged by his children, who are also his trustees. In seeking to carry out their father's intentions, they sought the advice of oceanographers of all countries as to its venue and objects. The responses were most gratifying, but many of the proposals were beyond the means at the disposal of the trustees, while others represented sections of research already in progress. All the replies were submitted to Drs. E. J. Allen and W. T. Calman, the writer acting on behalf of the trustees.

Three practical proposals of areas for the research of an expedition emerged, namely, off the north-west coast of South America, the Indian Ocean and the Red Sea. It was felt that the last-named, an enclosed sea of more than 1,000 fathoms with a sill to the south of less than 100 fathoms, presented peculiar opportunities for intensive and continued research, but that this should be based on Ghardaga, the newly erected Egyptian marine station off the Gulf of Suez, rather than attacked by an isolated expedition. In all three seas, a knowledge of the bottom fauna and conditions was emphasised. In addition, the two oceans present problems of oceanic circulation of considerable complexity and of wide interest.



Barki, Alexandria

FIG. 1. The *Mabahiss*, for the John Murray Expedition of 1933-34.

On consideration and inquiry, the difficulties of arranging a west American expedition proved insuperable, so that the referee's choice fell on the Indian Ocean, which had been suggested in several memoranda. One of the latter had been presented by Col. Seymour Sewell, director of the Indian Zoological Survey and formerly surgeon-naturalist on the *Investigator*, and he was invited to lead the expedition. The further plans have been worked out by a committee including representatives of the Admiralty, the British Museum, the Royal Society and the trustees of Sir John Murray, in co-operation with Col. Sewell. The Committee consists of Mr. J. C. Murray (chairman and treasurer), Vice-Admiral Sir H. P. Douglas, Capt. J. A. Edgell (hydrographer to the Admiralty), Dr. C. Tate Regan (British Museum), Prof. G. I. Taylor (Royal Society), Drs. E. J. Allen, W. T. Calman and Stanley Kemp and Prof. J. Stanley Gardiner (secretary).

It would have gratified Sir John Murray to know that the Indian Ocean has been selected, since this ocean was deliberately omitted from the route of H.M.S. *Challenger*, the Indian Government having undertaken to carry out its exploration. The whole area proved too large for the elaborate and detailed research demanded to-day, so that the operations of the expedition are to be confined to the Arabian Sea, which is bounded to the south-east by the Maldive and Chagos ridge and to the south by the latitude which passes through the Seychelles. This area feeds the Red Sea to the north-west and the shallow Persian Gulf to the north, and its conditions to some degree are simplified by its continuous land-boundary to the north and east. Its deep sea life has never been collected save by the I.M.S. *Investigator* and then only by spasmodic observations and a few trawlings near the Indian coast. The *Valdivia* traversed the southern part of the area on her great cruise and the *Dana* crossed it on her way home. Lately, the Admiralty has taken serial water samples in and off the Gulf of Aden, and much attention has been paid for many years to the water movements by the Marine Division of the Meteorological Office. H.M.S. *Sealark* spent the season of 1905–6 amongst the islands and submerged banks to the south, visiting in turn the Chagos Archipelago, Mauritius and Seychelles, besides most of the smaller islands and banks. Her investigations were mainly concerned with coral formations, their growth and decay, the deep sea being studied mainly by soundings. Even to-day, except on certain steamer routes, the

depths are little known. The greatest charted is 2,930 fathoms, and the average depth about 2,500 fathoms, with openings to the south of 2,000 fathoms between Seychelles and Chagos and perhaps between Chagos and Maldives. With this topography the question of water circulation from the surface to the bottom is naturally a subject of particular interest.

Great difficulty was experienced in obtaining a suitable ship of the trawler type for the expedition. Any vessel would have to be fitted with sonic sounding apparatus and few proved to be suitable. The best available vessel appeared to be the *Mabahiss*, which was built for scientific work by the Egyptian Government in 1929. The Committee placed its dilemma before Egypt, King Fuad being well known for his interest in oceanography, and at the same time pointing out the desirability of an Egyptian scientific expedition down the Red Sea. In reply the Egyptian Government most generously proffered the loan of the *Mabahiss* for the winter of 1933–34, the Committee to equip her with echo and other necessary scientific gear. This friendly action will be most deeply appreciated by science, the international appeal of which is thus recognised.

A further plan is to use the *Mabahiss* in 1934–35 for an Egyptian exploration of the Red Sea, the same scientific methods to be followed in both expeditions so that results will be strictly comparable. The Red Sea expedition will give a worthy start to the Ghardaga Marine Laboratory of the University of Cairo, which, possessing deep water and tropical conditions in its immediate vicinity and being of easy access from Europe, bids fair to become of great value to science.

According to the present plans, the *Mabahiss* will be commissioned at Alexandria and sail on September 1. She will be commanded by Capt. Mackenzie, formerly of the S.S. *Discovery*. Lieut.-Commdr. Farquharson, who has been seconded for the expedition, is to take charge of the echo sounding and other survey work. On his side, Col. Sewell will be accompanied by four biologists, two of whom will specialise on the physico-chemical side and two on the ecological. The officers and crew will be Egyptian, and there will be two research students from the University of Cairo. After anchoring for a night at Ghardaga, the *Mabahiss* will run a depth section down the Red Sea to the Gulf of Aden, where several weeks will be occupied in the investigations of its depths, bottom fauna and circulation. While a continuous graph of the surface temperature will be taken on board the *Mabahiss*, the surface water samples, collected not only by the *Mabahiss* but also by certain liners, will be sent to the University of Cairo for analyses. The deeper water layers, however, will be investigated on board the *Mabahiss* by rapid methods, and it is hoped that thereby estimations of hydrogen ion concentration, oxygen, phosphates, nitrogen compounds and silica or some of these may be so quickly available that they will be of help in the planning of future work.

So soon as the north-east monsoon has become established, the *Mabahiss* will proceed to run a series of parallel lines of soundings between India and Ceylon and the African coast, unless the results obtained determine otherwise. In any event, there will be a special cruise in the Gulf of Oman for comparison of its conditions with those of the Gulf of Aden, and this will be followed by a cruise down the Maldives, where Major Glennie of the Indian Survey will take a series of pendulum observations across the bank with the object of determining the depth of the foundations on which its coral reefs are built. On all cruises, stations will be established at intervals for serial temperature observations and to obtain water samples from the surface to the bottom. In certain regions, the deposits should be of particular interest, and they will be collected by sounding leads and conical dredges. It is suggested that the blue mud off South Arabia may well be of especial interest, as also the green sand (glauconite), which in places is found from 50 fathoms to more than 1,000 fathoms, and the conditions of formation of which are uncertain.

The investigation of the deep sea biology, to the understanding of which all observations, physical, chemical and topographical, will be applied, is to be especially concentrated in the Gulfs of Aden and Oman and off the East African coast. Otter and Agassiz trawls and dredges of standard sizes will be regularly employed down to 1,000 fathoms, as well as the Petersen grab. Quantitative estimations of the bottom may not be possible, but it is hoped that the fauna will be adequately represented in collections and to a considerable degree determined in depth zones. The 'mud line' at about 100 fathoms, so named by Sir John Murray, is of especial interest off the Arabian coast, which, in spite of a high water temperature and an apparently suitable topography, is almost devoid of coral reefs. In connexion therewith, the shallower coastal waters may be investigated, a motor launch being carried for this work. It is hoped also that transparency observations may be possible. Plankton as such is not an object of study since the collections obtained by the *Discovery*, *Dana* and other vessels are sufficient to tax the energies of systematic workers for twenty to fifty years. On the *Mabahiss* it will be collected mainly in connexion with the investigation of the water layers and movements, but mid-water nets will be employed for the examination of the fish and other swimming life.

It is impossible to lay down beforehand detailed plans of the John Murray expedition or indeed of any future marine exploratory expedition. The coming of echo sounding allowing all depths to be read as a ship proceeds on her course, the determination of temperature sections and the invention of rapid chemical methods to be applied on ship-board to water samples from the surface to the sea floor, have altered the planning of all future marine expeditions, the course of which will undoubtedly be determined by the results obtained.

The Contribution of Radiotelegraphy to Geophysics

ON Thursday, April 27, the Kelvin lecture was delivered before the Institution of Electrical Engineers by Sir Frank Smith, who took as his subject, "The Travel of Wireless Waves". In the course of it, an interesting picture was presented of the position attained by modern research, both theoretical and experimental, on the mode of propagation of the electric waves employed in radio communication. Particular reference was made to the bearing of the results of this work on the general problems encountered in geophysics, and the manner in which modern research has provided the radio-geophysicist with an invaluable tool with which to probe into the higher reaches of the atmosphere.

The appropriateness of this lecture was expressed in the observation that Lord Kelvin first studied the oscillatory discharge of a condenser, and read a remarkable paper on it exactly eighty years ago. Kelvin also introduced a tool known as the 'image method', applicable to many problems of physics; and when this is applied to Hertz's dipole oscillator, the familiar pattern is obtained of the electric field due to an oscillating charge over a perfectly conducting plane. The energy radiated from such an oscillating dipole is in the form of electromagnetic waves, the properties of which are identical with light waves, due allowance being made for the difference in wave-length. The waves will travel in straight lines except for such deviation as will occur due to refraction or diffraction effects.

When Marconi successfully demonstrated the transmission of wireless signals around considerable portions of the earth's surface, much attention was directed to the problem of the manner in which the necessary deviation was produced. Fleming showed that refraction due to the variation of atmospheric density with altitude would produce a negligible effect, while similar conclusions were reached in a study of the diffraction effects, even making allowance for the conductivity of the earth and the resulting currents set up by the waves passing over it. Moreover, G. N. Watson found that in the case of diffraction the factor showing the dependence of the effect upon wave-length was of a different power from that obtained empirically and embodied in the well-known Austin-Cohen formula. The experimental investigations also produced later some remarkable results, such as the striking differences between day and night transmissions, and the unexpected potentialities of the shorter wave-lengths for long distance communication, in spite of their well-known rapid absorption by the earth.

The need for a 'deflecting' region in the upper atmosphere was recognised in a note published by Prof. A. E. Kennelly in March 1902. A similar suggestion was made by Heaviside in an article written in June of the same year and afterwards published in the "Encyclopædia Britannica". In 1912, W. H. Eccles directed attention to the possible influence of the ionisation of the upper atmosphere on the propagation of electromagnetic waves through it, and to the resulting differences in day and night transmission. A few years later, Watson overcame his previous difficulty in a calculation of the field intensity of a wave propagated in the space between the earth and a conducting shell concentric with it.

In such circumstances it is natural to find the radio worker turning to the geophysicist for some knowledge of the properties of the atmosphere. By the aid of direct measuring instruments, the geophysicist has learnt much of the detailed physics of the troposphere and lower portions of the stratosphere; but it is not until a height of about 50 km. is reached that much information of direct interest to the radiotelegraphist is supplied. At this height ozone is found as the result of the dissociation of oxygen by ultra-violet light, and this action is accompanied by ionisation, which naturally suffers a rapid reduction after sunset as a result of recombination. Further information on such ionisation in the higher regions of the atmosphere has been obtained from the study of aurora and also from investigations in terrestrial magnetism; and attention may be directed to the fact that Balfour Stewart in 1878 was the first to suggest that the daily changes in intensity of the earth's magnetic field are due to electric currents in the conducting portions of the upper atmosphere.

As a result of all this work, the radio investigator is informed that there exists, concentric with the earth, a spherical conducting layer, that the conductivity is due to electrons or ions, and that the conductivity varies with the direction so that electric waves penetrating the layer will be polarised. The probable ionising agents are ultra-violet light and charged or neutral particles projected from the sun, so that the layer is likely to be much more highly conducting on the side of the earth exposed to the sun than on the side in darkness. On this geophysicist's picture of the ionosphere no accurate scale of heights can be placed, nor can values of the ionisation density be assigned. It is merely known that the ozone is most dense at about 40 km., and that the electron streams produce aurora at heights of from 90 km. to above 500 km.

With all this information at his disposal, the radiotelegraphist has been able to obtain at least a qualitative explanation of many of the phenomena encountered in his experimental investigations of the results of emitting waves from a radio station. In the first place, it is clear that, so far as the waves sent along the ground are concerned, the distance to which they travel before their field intensity falls to some specified value increases as the wave-length is increased; and for this reason moderately long waves of wave-length 200 to 2,000 metres are employed for general broadcasting services. Next, the portion of the waves which are sent into the upper atmosphere

will be refracted on entering the ionised portions and, upon reaching a height at which the density of ionisation is sufficiently great, the deviation will be such as to return the waves to the earth's surface. It has been found that on a wave-length of about 50 metres and using an antenna power of 5 kilowatts, these waves returning from the ionosphere reach the earth and affect a receiver at a minimum distance of the order of 2,500 miles. Since under the same conditions the ground wave will only be detectable at distances up to about 90 miles, there will be an annular space around the emitting station having inner and outer radii of 90 miles and 2,500 miles respectively in which no signals will be detectable. This is commonly known in radio engineering circles as the 'skip' effect and the larger radius above is termed the 'skipped distance'. As the wave-length is increased, this distance decreases steadily owing to the greater refraction effects taking place in the upper atmosphere; at the same time the range of the ground wave increases, and finally the two overlap for wave-lengths approximately in the shorter broadcasting band of 200 metres to 500 metres. Under these conditions, both ground and atmospheric waves reach the receiving station, and it is the interference effects resulting from these two sets of waves which cause the well-known phenomena of fading in broadcast reception, and of the variation of bearing in radio direction-finding.

In the later portion of his lecture, Sir Frank Smith described how the radio investigator has recently directed his attention to obtaining more conclusive proofs of the existence of the ionosphere and to the quantitative measurement of its properties; that is, to obtain information which the geophysicist has been unable to supply. Methods employed in other branches of physics have been adapted to radio communication for this purpose. One of these makes use of the interference effects obtained between the ground and atmospheric waves to determine the height of the ionosphere. The same objective has also been attained by using an echo method to measure the time taken by a pulse of electric waves to travel up to the ionised deflecting layer and return to earth. Owing to the very high velocity of the waves, this time interval is short—about one-thousandth of a second—and the cathode ray oscillograph has proved an invaluable tool in the determination of this quantity.

Working in this manner, the radiotelegraphist has conclusively proved the existence of the Kennelly-Heaviside layer in the ionosphere at an average height of about 100 km. The measurements showed that for most nights the height of this ionised layer gradually increases, a maximum value being reached about one hour before sunrise. Further investigation showed that on certain occasions and with wave-lengths less than 400 metres, the height of the deflecting layer suddenly changes from 100 km. to about 230 km. It then became evident that on such occasions the density of ionisation in the Kennelly-Heaviside layer is insufficient for the deflection of the shorter waves, which thus penetrated this layer, but are ultimately deflected by a second layer above the first, the existence of which had not previously been suspected. This upper layer has been named after Prof. E. V. Appleton, who, with the co-operation of the Radio Research Board, has played the leading part in Great Britain in the investigations just described.

Having fixed the heights of these two important regions of the atmosphere, it has next been found possible to determine the density of the ionisation in these regions by ascertaining the limiting wave-length or frequency of the waves which will just penetrate the layer. Experiments carried out in this manner have shown that the ionisation is at its maximum about noon and decreases steadily as sunset is approached. After sunset, a rapid fall in ionisation takes place until, at about two hours afterwards, its value is only about one-tenth of the maximum, and this then remains reasonably constant until shortly before sunrise. Two further facts which emerge from the work are that there is very little ionisation between the Kennelly-Heaviside and the Appleton layers, and that, for wave-lengths less than about 8 metres, the waves penetrate both layers and there is as yet no evidence of their return to earth from the upper atmosphere. As to the cause of the ionisation, some data obtained during the solar eclipse of August 31, 1932 appear to establish the fact that the principal ionising agent for the two layers is ultra-violet light. The possible bombardment of the earth by neutral particles is not yet wholly excluded, but undoubtedly the evidence so far is against it.

The review provided in this lecture shows very clearly that the modern radio research worker is obtaining detailed quantitative knowledge of certain portions of the atmosphere in a manner which was beyond the reach of the former geophysical methods of attack.

Hydrogenated Motor Lubricants

THE recent display of advertisements has directed public attention to a new oil, "Essolube", a product representing the much-discussed process of hydrogenation successfully applied to the refining of petroleum. This particular lubricating oil is the product of many years research, involving much expenditure and the laying down of large-scale plant. The entry of hydrogenation as an established commercial process in the oil industry is an event of first-class technical and economic importance, and in many respects it will be a surprise to most people that the first satisfactory synthetic product in this field is a lubricant, a class of material distinguished for

its extreme variability and one of the most sensitive (in performance) of the whole range of petroleum distillates.

Broadly speaking, it is demanded that a high-quality lubricating oil should possess a good viscosity index, a low pour point, a wide range of stability, high flash point and low carbon value; these properties are claimed as entirely characteristic of the synthetic product. A good viscosity implies an oil which changes least in characteristics with temperature range, making for easy starting of an engine in cold weather, reducing wear of the moving parts and, at the same time, ensuring that under operating conditions an adequate oil film is preserved round the piston; these factors naturally affect the question of oil consumption. The essence of stability is the ability of the oil to preserve its fundamental characteristics in performance, and the lack of tendency to form sludge or to coagulate in any manner which might tend to choke the lubricating system. The low carbon value is sought for many reasons; chiefly to take care that, whatever carbon is formed, is of a soft and non-crystalline character, as hard carbon particles returned to the oil sump will inevitably act as an abrasive and do damage to the vital parts of the engine.

Production of modern lubricating oils is, quite apart from this new process, a highly specialised subject, concerning which much still remains to be, and is being, done in the matter of fundamental research. Possibilities of hydrogenation as applied to petroleum products have of course been long foreseen by technologists both in Great Britain and in America, but the advent of a marketable product at this juncture is certainly a most commendable departure.

An account of this enterprising action of the Anglo-American Oil Co., the concern responsible for the introduction of this new lubricating oil, appears in the *Times* of April 29. Concurrently with the appearance of this product, the same Company is responsible for introducing a new method of delivery of the oil to motor engines. Supplies will be fed directly to the engine from sealed glass bottles and the displacing of the familiar tin will be an advantage in many ways since, apart from guaranteed measure, the contents can be seen and, incidentally, the shape of the bottle is such that it can be easily inverted into the oil filler of the engine, thus obviating loss by spilling, especially where such fillers are placed in awkward positions.

It is of interest to note the Company's exhibition of hydrogenation at Charing Cross Underground Station, a place, incidentally, one now instinctively associates with modern commercial enterprise in educating the public to at least some visual knowledge of commodities in everyday use which, in a vast majority of cases, are taken very much for granted. So much has been heard of, and written about, hydrogenation in the last few years without, to the lay mind, as yet any tangible expression, that the coincidence of a new synthetic hydrocarbon and the display of technique and issues involved, will do much to awaken interest in the untiring service that science renders to the community to-day.

Lessons in Visualisation from the Royal Academy

By DR. VAUGHAN CORNISH

SCENERY is defined as the appearance of a place from the picturesque point of view, and so, without pausing to consider what constitutes picturesqueness, we may note at once that scenery is an appearance. The science of scenery is, therefore, a science of appearances, and consequently the question whether a landscape painting is true to the facts can only be answered if we know how the physical surroundings are pictured through the agency of the eye.

There are three very different modes of picturing landscape; by the camera, by the representational school of painting, and by the imaginative school. Leaving the discussion of the last category for another occasion, let us now compare the rendering of the facts of scenery by the camera and by the school of painting hitherto dominant at the Royal Academy.

Even within the limits of monochrome, to which the camera is usually restricted, a clear photograph of a well-lit landscape is radically different from the natural picture. Not only the eye of the artist but also that of the ordinary man is selective. The natural picture of the landscape is not the sum of those features which we can see when we examine bit by bit the whole field of outlook, but a *composition* formed of that which we notice spontaneously. It may even be that in scenes which stir the emotions deeply, the proportion that remains unnoticed, that is to say mentally invisible, is greatest.

Largely on account of this selective action of the eye, and not merely on account of the vagueness of the image near the edge of the retina, the skilful composition of the landscape painter is in some important respects nearer than the photograph to the facts of scenery. It may be suggested in passing that the customary preference of the landscape artist for painting largely from memory, is not only on account of the troublesome variation of light in the actual scene, but also because memory is selective, and its partialities help to obliterate the inessential from the mental picture.

As an example of truth to Nature (in the wider sense) as exemplified in the school of landscape painting usually dominant at the Royal Academy, I may cite "The Shores of Clyde" (340) by

Mr. Robert Houston. This is an entrancing picture of sea and sunshine, flowering gorse and sheep grazing, cottages of fisher folk by the shore (at the foot of the hill from which the scene is viewed), a rocky islet catching the light, and in the distance a range of mountain peaks suffused with the tranquil, atmospheric blue. A few clouds are floating high, and from above the field of sight, the sun streams down, casting a broad lane of light upon the rippling summer sea. It all seems so natural, and exactly as we recall the scenery of Scotland in its happiest mood. The descriptive title of the picture does not tie us to a particular view-point, and this is fortunate for the average man, who is apt to feel that some deception has been practised when he finds the natural features arranged otherwise than as he is accustomed to see them from a specified view-point. In this connexion it is well that scientific people should recall the fact that mathematicians exercise a license somewhat similar to that of the artist in the generalisation of geophysical facts. The tidal bore in the River Severn, for example, does not always conform to the type of wave to which mathematicians restrict the name, although the mathematical conception was largely based upon this local example.

The water-colour "Gate Crag, Grange, Westmoreland" (1039) by Mr. Harold Gresley, has a definitely locative title, but as I am not acquainted with the particular spot the question of composition does not obtrude, and I simply welcome a delightful rendering of the charm of the English Lakeland. A single-arched bridge spans a rapid stream beside which stand the simple, whitewashed houses that Wordsworth loved. The foliage of pleasant round-topped trees diversifies the vale, and in the background the steep fell-side stands in shadow, with white clouds half uncovered, half hidden by the rugged mountain crest.

The sympathetic rendering of such scenes is always welcome, but it must be confessed that our painters have been less alert than the cameramen in availing themselves of modern facilities of transport for extending their range of subjects. Such pictures as that by Mr. Norman Wilkinson ("Territorials", 385) are as welcome as they are rare. The view, from an aeroplane, is of companion aeroplanes, backed by the piled domes of massive cumulus revealed in all their grandeur from a more advantageous point of sight than the ground provides.

When the man of science goes to the Royal Academy to learn what he can from the artist, it is well that he should not confine his attention to landscape, for pictures of interiors also convey lessons in visualisation. That of "The Library, Eaton Hall" (235), by Mr. Frederick W. Elwell shows a long gallery with the amplitude of dimension relatively to the human figure which is an outstanding advantage of the great country mansion. The perspective of such an interior satisfies certain faculties of the eye for which the natural landscape does not provide appropriate exercise. Moreover, the appointments of the room illustrate the fact that a well-furnished interior can provide more satisfaction for the eye in respect to diversities of texture than any natural scene. Here we have, skilfully painted, the glaze of pottery and porcelain, the glint of metal, the lustrous reflexion and transmission of glass vessels, and the polish of fine wood-work. Rich and varied as are these textures, it is the vase of flowers which brings the ultimate refinement of texture to the furnished interior.

Obituary

Sir Jivanji Modi, C.I.E.

WE regret to record the death at Bombay of Sir Jivanji Jamshedji Modi, the widely-known and highly esteemed Orientalist, on March 28, aged seventy-two years. He was born on October 26, 1854, the son of the head priest of the Parsee Fire Temple at Colaba on the island of Bombay, and was educated at Elphinstone School and College. The studies to which he gave special attention, and in which he won a world-wide recognition as the foremost authority, were the origins, literature and teaching of Zoroastrianism, as well as the history of the Parsee community. For many years he was the secretary of the Parsee Panchayat in Bombay. He was one of the most active members of the Bombay Branch of the Royal Asiatic Society, which recognised his services to Oriental studies by the award of the Campbell medal in 1918. He was prominent in promoting the Oriental Research Institute at Poonah in memory of his friend, Sir Ramkrishna Bhandarkar, and did much work in connexion with the Cama Oriental Institute.

Sir Jivanji Modi's very considerable published contributions to scholarship for the most part appeared in the form of monographs, which were afterwards collected and republished in volumes such as his "Asiatic Papers", in four parts, "Anthropological Papers", also in four parts, "Memorial Papers", "Dante Papers", etc. He also wrote a history of the Parsees and published a number of translations from the Pahlavi.

His learning was widely recognised in both India and Europe; although it may be said without detraction from his scholarship that his commanding position in the world of Oriental studies was in some degree enhanced by his singleness of purpose and charm of character, which won the admiration and affectionate respect of all with whom he came into contact. He had long been a fellow of the University of Bombay, which conferred on him the degree of LL.D. in 1930. The Government of India made him an honorary correspondent of the Archæological Society in 1914 and conferred on him the title of Shams-ul-ulama. He was made a C.I.E. in 1917 and knighted

in 1930. He was one of the few honorary members of the Royal Asiatic Society, an Officier d'Académie and Chevalier of the Legion of Honour.

WE regret to announce the following deaths:

Commdr. W. M. Carey, R.N.(retd.), captain of the R.R.S. *Discovery II*, which has just completed its second cruise, during which the Antarctic Continent was circumnavigated, on May 2, aged forty-six years.

Prof. R. E. Jeffs, associate professor of botany in the University of Oklahoma, known for his work on plant physiology, on February 11, aged fifty-three years.

Prof. Jules Piccard, formerly professor of chemistry at the University of Basle, aged ninety-three years.

Sir Arthur Whitelegge, K.C.B., chief inspector of factories from 1896 until 1917, author of "A Manual of Hygiene and Public Health", on April 25, aged eighty years.

Mr. E. B. Williamson, formerly assistant curator at the Carnegie Museum, and since 1930 research associate in the Museum of Zoology of the University of Michigan, who was an authority on dragon-flies, on February 28, aged fifty-five years.

News and Views

Portraits at the Royal Academy

IN addition to the pictures at the Royal Academy mentioned by Dr. Vaughan Cornish in his article elsewhere in this issue, scientific workers will be interested in the following portraits: Prof. S. Alexander, honorary professor of philosophy in the University of Manchester, charcoal, by Francis Dodd (1212); Sir Richard Glazebrook, formerly director of the National Physical Laboratory, by Edward I. Halliday (390); Dr. George Francis Hill, director and principal librarian of the British Museum, bronze medallion by Frank Bowcher (1650); Prof. J. G. Lawn, mining engineer, director of and consulting engineer in England to the Johannesburg Consolidated Investment Co., Ltd., bronze bust by Maggie Mitchell (1736); Dr. Eleanor Lodge, formerly principal of Westfield College, London, by Gerald F. Kelly (91); Sir Murdoch Macdonald, president of the Institution of Civil Engineers, bronze bust by Gladys Barron (1725); Lord Melchett, director of Imperial Chemical Industries, Ltd., by Glyn Philpot (274); Dr. Alexander Scott, director of scientific research at the British Museum, head by Sir W. Reynolds-Stephens (1638); the late Sir William Smith, founder of the Royal Institute of Public Health, bust by Charles L. Hartwell (1602); and Sir J. J. Thomson, master of Trinity College, Cambridge, chalk, by W. T. Monnington (1180). Among the other exhibits are a tempera of the foundations of the new Geological Museum, South Kensington, by Laurence Wheatley (881); while the architectural drawings and models section includes the library of the same Museum, by John H. Markham (1405), proposed additions to the Ashmolean Museum, Oxford, by Stanley Hall, and Easton and Robertson (1400), the completion of wings to Gower Street of University College, London, by Richardson and Gill (1512); and an etching and dry point of Battersea Power Station, by H. R. Myerscough-Walker (1257).

New Gorilla House at the Zoological Gardens

THE new Gorilla House at the Gardens of the Zoological Society of London was opened on Friday, April 28. Sir Peter Chalmers Mitchell, in a short but admirable speech, traced the origin and the merits of the new house, which are many; indeed, there is no other like it in Europe. Having regard to the rarity of gorillas in captivity, and their frailty, it was felt that an entirely new method of housing them should be devised. The general plan of the house was conceived by Sir Peter, but its elaboration was entrusted to Mr. B. Lubetkin, of Messrs. Tecton Ltd., architects. Briefly, it forms a large, circular chamber divided into two equal portions, a winter and a summer house. In the winter, the public have access in the half set aside for summer, and they are shut off from the animals by a glass screen to eliminate the danger of infection from influenza by the public. The air in this enclosure is filtered, warmed, and moistened, before passing into the chamber, which is free from draughts. Here we saw the two gorillas which the Society has now had since last August in a particularly frolicsome mood, due no doubt to the ample proportions of their apartment. In the summer the semicircular wall and roof of iron which forms the winter "Hall of Audience", is caused, by machinery, to pass behind the winter house, leaving it fully exposed to the sun and air, and enclosed only by strong bars. The glass partition is also withdrawn, leaving a great circular space wherein the animals may furnish their visitors, now standing outside, with opportunities for studying the habits and movements, of these, the largest and most powerful of all the great apes.

New Autogiro

A NEW model of Senor de la Cierva's autogiro, incorporating a radical alteration in the method of control, was demonstrated by the inventor at the London Airport, Hanworth, on April 27. The autogiro derives its lift from a number of blades rotating in a horizontal plane, instead of fixed wings as in a normal aeroplane. Thus there is relative motion between the blades and the air, with consequent lift, even when the machine has little or no forward speed. The autogiro can therefore fly with little speed relative to the earth, and can land and take off almost vertically. Hitherto, the orientation of the machine when airborne has been governed by

the orthodox aeroplane aileron, elevator and rudder for lateral, horizontal, and directional control respectively. This new model, Type C.30, replaces all of these controls by altering the direction of the resultant lift of the rotors by tilting their supporting pillar. A lever attached to this column is pulled back to make the nose rise, forward to drop, sideways to turn and bank correctly at the same time. Thus the pilot's task in the air is considerably simplified, although apparently at the expense of a certain amount of rapidity in manœuvrability. Another advantage of this new control is that its effectiveness is a function of the speed of the rotating blades, and not of the forward speed of the machine as in the normal aircraft. It is therefore equally effective at low flying speeds, a particularly important point in landing, taking off, and flying near the ground generally. The absence of the usual control surfaces and their supporting parts should give a considerable saving in both weight and head resistance, and should simplify construction. A fixed tail plane and a vertical fin are still retained for stability, and a tail wheel controlled by an orthodox rudder bar is used for turning on the ground.

Royal Institution

THE annual meeting of the members of the Royal Institution was held on May 1, the president, Lord Eustace Percy, being in the chair. The annual report of the Visitors for the year ended December 31, 1932, testified to a year of considerable activity. The membership had been well maintained. The privilege of free attendance at the afternoon lectures by *bona fide* students in London had been much appreciated and used. The report on the progress of the researches in the Davy Faraday Laboratory gave a good indication of the considerable extent of the research organisation which is at work under the direction of Sir William Bragg. Some sixteen or eighteen workers are engaged, the majority on problems related to the X-ray determination of structure. Mention was made of Dr. J. M. Robertson's determination of the structure of anthracene, of Dr. A. Müller's work on the long-chain compounds, and of the growth in accuracy and capacity of the large experimental X-ray plant in the hands of Dr. Müller and Mr. R. S. Clay. The capacity of the apparatus is calculated to be about 50 kw.; as yet it has worked well up to 10 kw. The treasurer's report and accounts showed a very satisfactory position, in spite of the heavy demand on the financial resources of the Institution caused by the recent reconstruction. After a total expenditure in connexion with the rebuilding of more than £100,000, a diminution in the invested funds of the Royal Institution of about £2,000 is shown. This gratifying result is a consequence of many generous donations to the Building and Research Endowment Fund raised by the Institution in the past three years. The donations and other receipts to this fund have been sufficient to defray almost the entire cost of the rebuilding, and to go a considerable way towards completion of the programme of permanent endowment of research which the Managers of the Institution have as one of their principal objects. The following officers for 1933–34 were elected: *President*, the Right Hon. Lord Eustace Percy; *Treasurer*, Sir Robert Robertson; *Secretary*, Major Charles E. S. Phillips.

Portrait of Sir William Bragg, K.B.E., O.M., F.R.S.

AFTER the formal business of the annual meeting of the members of the Royal Institution, a portrait of Sir William Bragg, painted by Mr. William Nicholson, was presented to the Institution, on behalf of a group of subscribers, by the honorary secretary, Major Charles E. S. Phillips, who expressed the gratification of the donors at having secured the help of so distinguished an artist. Mr. Nicholson had given them, he said, not only a good portrait of Sir William, but also a very fine painting. Major Phillips went on to pay a tribute of admiration for the work of Sir William Bragg and to speak of the affection in which he is held by the members and all others with whom he comes into contact in his work. The portrait was accepted by the president, who thanked Major Phillips for having taken the initiative in regard to its painting and presentation, resulting in a valuable acquisition to the permanent treasures of the Institution. Sir William Bragg spoke briefly of his own pleasure at the expressions of goodwill with which the presentation had been made, and said that the success of the work of the Royal Institution was largely due to the friendship and devotion of its members, who had always responded freely to any request for services or appeal for help.

Centenary of Hancock's Steam Omnibus

To commemorate the centenary of the inauguration of the first power-driven omnibus in London, a joint meeting of the Newcomen Society and the Omnibus Society was held at the Institute of Marine Engineers on April 27 at which papers were read by Mr. C. E. Lee and Mr. C. F. D. Marshall. Mr. Lee said that the three principal pioneers of the steam omnibus were Goldsworthy Gurney (1793–1875), Walter Hancock (1799–1852) and John Scott Russell (1808–1882), of whom Hancock was the most successful. A watchmaker by trade, Hancock patented a very ingenious type of boiler and then built two steam carriages, the second of which, called the *Infant*, in February, 1831, began running between Stratford and London. Two years later, the London and Paddington Steam-Carriage Co. was formed and for this Hancock built the omnibus *Enterprise* with accommodation for fourteen passengers. This vehicle began running between Moorgate and Paddington on April 22, 1833, and was the first mechanically propelled vehicle specially designed for omnibus work ever to be placed in service. The route covered was about ten miles and the distance was performed in about fifty minutes. The service was worked for 16 days only, under the superintendence of Hancock, and was then withdrawn owing to differences between him and the Company. Three years later, after other experimental work, Hancock had other steam vehicles at work and

in the course of twenty weeks these ran 4,200 miles and carried 12,761 passengers. Both the papers contained much information on the construction of these and other early steam omnibuses and it cannot be doubted that if the inventions had been fostered, instead of hindered, by legislation, the steam vehicle would have been brought to a high degree of perfection at an early date.

Observational and Theoretical Astronomy

ON April 28, Prof. H. H. Plaskett delivered his inaugural lecture as Savilian professor of astronomy at Oxford. Recalling the fact that the year of the foundation of the professorship was also that of the publication of Kepler's three laws of planetary motion, and directing attention to the injunction of Sir Henry Savile that the holder of his professorship should occupy himself with "observation by day and night", he remarked that three hundred years ago the observational method in astronomy might be said to have reached its zenith. Since then, the constantly increasing importance of the theoretical method has been abundantly shown; as, for example, in the discovery of Neptune by calculation and in the present conclusions as to the physical conditions in the interior of stars. Nevertheless, the achievements of theoretical astronomy still rest in part on an observational basis. This is shown by consideration of the means by which knowledge of the spatial distribution of the stars has been gained by the work of Herschel and Shapley, and of that of their physical constitution by the work of Lockyer, Franklin and Hertzsprung. It would be fair to say, looking forward to the next three or four hundred years, that it will be allowed that, so far, observation and theory have gone along hand in hand. In a more distant future it may not be so. At present, theory has played its part in the refinement of observation, but some of the results of theory must for ever be removed from observational control. But just as the explorer of the earth's surface suggests to the geographer plans for further fruitful exploration, so the astronomer going to Nature with a definite theory may succeed in getting an answer. Finally, there can be no doubt that a great university should have an observatory as part of its equipment; but it must be recognised that the part of astronomy under these conditions necessarily has its limitations.

Lachish

EXCAVATIONS at Tell Duweir in Palestine, where the Wellcome Historical Museum Expedition has been at work under Mr. J. L. Starkey, have now closed for the season. The particular interest of this excavation lies in the possibility that the site may be the city of Lachish which was captured by Joshua after a stout resistance. So far, nothing has been found to contradict this tentative identification, while some of the evidence from this season's work tends to confirm it. Lachish was captured by Sennacherib in 701 B.C.—this siege is represented on bas-reliefs from Nineveh now in the British Museum—and by Nebuchadnezzar in 586 B.C. Tell Duweir, which is situated about twenty-five miles south-west of Jerusalem at a height of 900 ft. above sea-level, dominating the Philistine country, is a mound of some forty acres in extent, tapering to eighteen acres at the summit. The stone walls identified with the city of Rehoboam show the breaches made by Sennacherib's army and traces of the conflagration by which they were made to collapse under Nebuchadnezzar. Under the stone walls of Rehoboam's city were found the red brick walls which are identified with the city of Joshua's day. A further piece of evidence pointing in the direction of the identification is the find of a metal helmet crest which corresponds with the crests on the peculiarly shaped helmets of some of Sennacherib's soldiers shown on the British Museum bas-reliefs. Part of a royal palace on the summit of the mound was uncovered, and a number of graves at the base belonging to all ages were examined and yielded a large number of skulls in excellent preservation. Objects from Tell Duweir will be on exhibition at the Wellcome Historical Museum, Euston Road, London, N.W.1, on their early arrival in England.

National Research Council of Canada

THE National Research Council of Canada has issued a statement covering its sixteen years work which indicates a close parallel between the activities of this Council and those of the Department of Scientific and Industrial Research in Great Britain. In addition to the direction of a wide range of investigations in a National Research Laboratories system, the development of a national library of science, and the publication of a *Canadian Journal of Research*, the Council has developed co-operation in research throughout Canada, instituted a policy of grants to individual research workers, and assisted in the training of scientific personnel by the award of scholarships to selected students and graduates. Its efforts have raised the whole standard of research in Canada and in addition the National Research Council has already proved its value in the day-to-day problems of government and to various State departments. During the sixteen years of its existence, the Council has paid a total of 527,951,000 dollars in research scholarships and 131,801,292 dollars in grants for research. More than half of the total expenditure has been incurred on the building and organisation of the National Research Laboratories, which were formally opened on August 10, 1932, and have already made notable contributions to scientific knowledge and industrial development.

FROM a summarised account of these activities occupying nearly fifty pages, it is only possible to select a few points as illustrations. Important contributions to the asbestos industry have been rendered by investigations on asbestos cements and the standardisation of testing and methods. Studies of the resistance of concrete structures, the development of a highly resistant cement, of the treatment and disposal of sulphur dioxide fumes from smelter stacks, waste gas and bitumen utilisation, on the

prevention of rust on wheat and other cereals and on weed killing, have already proved of great economic advantage to the whole country as well as to the particular industries. There is scarcely one of Canada's wide range of interests—agriculture, mineral industries, transport, fisheries, building, fruit growing, coal, leather, wool—to which the Laboratories are not offering direct service. Highly important work has already been carried out on rubber and extensive facilities have been provided for standardising and testing all classes of materials.

Metropolitan-Vickers Research and Testing Departments

A BOOKLET which has just been issued, describing the Research and Testing Departments of the Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, shows what an important part industrial research plays in the advancement of science. The somewhat fragile and makeshift construction of the equipment of many science laboratories is often due to an excessive use of glass, rubber and similar materials. Modern engineering principles, materials and manufacturing methods have led to great improvements. The original research work carried out by the scientific staff of the Company has led to many important developments. In particular, the discovery of the Apiezon series of low-pressure oils and distillates has led to highly important advances in vacuum technique. Valves, X-ray tubes, etc., can now be taken to pieces for repair and adjustment and then re-assembled for use. They can also be made of materials like metal and porcelain and so have not the disadvantages of permanently sealed glass apparatus. The physics and engineering staff have done excellent pioneering work in many branches of research. Their vacuum furnaces, their arrangement of apparatus to apply testing pressures of a million volts continuously and their testing methods for impulse pressures as high as one and a half million volts are scientific triumphs. In developing apparatus for measuring noise they have broken new ground. The principle on which the apparatus works is that of aural comparison of the complex noise under observation with a pure reference tone of fixed frequency but adjustable amplitude. By listening simultaneously to the two sounds and adjusting the loudness of the reference tone until it sounds as loud as the noise under observation, the loudness of the complex noise can be expressed, by an experienced observer, in terms of that of the simple reference tone.

Railway Electrification Experience

COL. CORTEZ LEIGH, electrical engineer to the London, Midland and Scottish Railway Co., read a paper to the Institution of Electrical Engineers on April 6, which attracted a large audience. He described the experience gained by working the electrical railway between Manchester and Altrincham, a distance of about nine miles, since it was opened in May 1931. It appears that notwithstanding the competition of a recently inaugurated express bus service, the increase in the passenger traffic was 35 per cent. This is attributed to the greatly accelerated service made possible by electrification and to the increased comfort of travelling. Another reason is the great success of the 1,500-volt mercury arc rectifiers, the first used in Great Britain for railway work, for converting the alternating current supply into direct current for the railway motors. It looks as if these devices would come into general use, seeing that the 1,500 volt D.C. system was standardised by the Pringle Committee in 1927. This will make it easy to merge into a general scheme of main line electrification later. In the discussion, H. W. H. Richards, electrical engineer of the London and North Eastern Railway, compared the straight electric drive adopted on this line with the Diesel electric drive which has been much advocated lately. He calculated that the straight electric drive takes forty per cent less power. Prof. W. Cramp referred to the wear of the overhead conductors which are in contact with the pantograph collectors. It has been found that the wear of the conductors when the wires are oiled is about six times less than when there is no oil. Sir Josiah Stamp said that the results obtained on this line have more than fulfilled expectations.

The Palæontographical Society

THE eighty-sixth annual meeting of the Palæontographical Society was held in the rooms of the Geological Society, Burlington House, on Friday, April 28, Dr. F. L. Kitchin, vice-president, in the chair. The annual report recorded the publication of vol. 84 of the monographs, containing instalments of the Corallian Lamellibranchs, Gault Ammonites, and Cambrian Trilobites. It is anticipated that vols. 85 and 86 will be issued during the present year, thus bringing the publications more nearly up to date. Dr. F. A. Bather, Mr. Robert S. Herries, and Sir A. Smith Woodward, were re-elected president, treasurer, and secretary respectively; and Mr. F. H. Edmunds, Dr. W. D. Lang, Prof. S. H. Reynolds, and Prof. W. W. Watts were elected new members of council.

Science Forum

HOWEVER on financial grounds the apparently unending stream of new scientific organisations and publications may be deplored, one cannot honestly withhold sympathy when these are founded with the object of promoting international co-operation in the general advancement and practical development of science in all its phases. The first issue of the *Science Forum*, the quarterly journal of the International Faculty of Sciences, is therefore of interest as an indication of the manner in which it is proposed to achieve these objects. The articles include discussions on the relation of science and religion by Dr. Ernst Almquist, and on changes in moral ideas likely to result from the study of psychology in relation to ethics by Dr. R. Money-Kyrle. W. H. Wakinshaw's "Consuflatia" provides a useful elucidation (with an unconvincing solution) of the world's economic problems, and an interesting note on the gladiolus scab and its prevention comes from

R. H. Jeffers. The articles are written in a semi-popular strain with, however, a slight tendency to emphasise the sensational which should be firmly repressed if the publication is to carry weight among scientific workers or thinking laymen.

Auguste Rateau, 1863–1930

THE late Prof. Auguste Camille Edmond Rateau, whose death was recorded in NATURE of February 8, 1930, held a chair at the School of Mines at St. Étienne for about ten years. When, in 1897, he resigned this position, he was succeeded by M. Emile Jouquet, who in the *Annales des Mines* for September 1932 gives a full account of the researches and inventions of his distinguished predecessor. The son of an architect, Rateau at an early age gave signs of mathematical talent and, when he completed his two years' study at the Ecole Polytechnique, he passed out at the head of his class. He was twenty-five years of age when in 1888 he was made a professor in the School at St. Étienne, where previously, as M. Jouquet says, Burdin was a professor and Fourneyron, "the Watt of the hydraulic turbine", was a student. Rateau's work was in direct line with theirs and from it came the Rateau mine ventilators, centrifugal pumps and steam turbines. The impulse steam turbine of Rateau was applied to a French torpedo boat in 1904 and Rateau turbines, as developed by the Ateliers et Chantiers de Bretagne, Nantes, have recently been fitted in the fastest flotilla leaders in the world. A prominent member of many societies, Rateau was elected a member of the Paris Academy of Sciences in 1919. A monument to him was unveiled on January 17, 1931, in the grounds of the works of the Société Rateau at La Courneuve (Seine).

Expedition to South-Eastern Honduras

THE Smithsonian Institution, Washington, D.C., announces the dispatch of an expedition of archæological exploration to the Chorotegan area of south-eastern Honduras. The members of the expedition are Messrs. Alan Paine, W. D. Strong and Norman Haskell. The Chorotegan area is one of the least known in the whole of America and no trustworthy maps of it exist. The object of the expedition is to locate and determine the character of ancient ruined-city sites, to collect specimens of bird and animal life, and to get into touch with the practically unknown Payas and Sumu Indians, whose language, thought to be linguistically on the border line between North and South America, may throw light on the language of the ancient Maya. The specific problem to be investigated is the possibility that the culture of this area may have been a southward extension of the Mayan 'New Empire' of Yucatan, three hundred miles to the north. From time to time, natives and chicle hunters have reported the existence of ancient ruined stone cities in this area, and it is believed that it was from here that the Maya obtained the precious metals and the turquoise, of which they made such extensive and elaborate use in their decorative art.

Air Survey Methods

THE increasing use of aerial photography for mapping makes the publication of a simple handbook on the subject very welcome. This has been written by Lieut. J. S. A. Salt under the title of "A Simple Method of Surveying from Air Photographs" and published as No. 8 of the Professional Papers of the Air Survey Committee (London: H.M. Stationery Office, 4*s*.). The book aims at explaining the methods required in the production of medium-scale maps based on a limited ground control and involving the use of comparatively simple apparatus. The demands made on pilot and navigator are explained and there is a full discussion of the relation between ground control and plotting and the problems of the cartographer in general. The work is clearly written and amply illustrated with diagrams and plates. It should prove a useful guide and textbook.

Announcements

DR. C. TATE REGAN, director of the British Museum (Natural History), has been elected a foreign member of the Royal Danish Academy.

MR. CHARLES AUGUSTUS CARLOW was elected president of the Mining Institute of Scotland at the annual general meeting held on April 26.

THE Rubber Industry Bill was introduced in the House of Lords by Lord Irwin, president of the Board of Education, on May 2, and read a first time. The Bill provides for contributions by the rubber manufacturers in the United Kingdom to the Research Association of British Rubber Manufacturers, and for the collection and application of such contributions.

THE Challenger Society for the Promotion of the Study of Oceanography is offering a sum of money, not exceeding £25, for the assistance of a suitable student (or students) carrying out research at any of the marine laboratories. Application should be made to the Hon. Secretary, Mr. J. R. Norman, British Museum (Natural History), South Kensington, S.W.7.

FROM the interest of the Sir George Beilby Memorial Fund, awards are made to British investigators in science to mark appreciation of records of distinguished original work, preference being given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering and metallurgy. Two awards of £250 each were made in 1930, and two awards of £105 each in 1932. The administrators will meet in June, and will be glad to have their attention directed to outstanding work of the nature indicated. Correspondence should be addressed to the Convener, Sir George Beilby Memorial Fund, The Institute of Chemistry, 30, Russell Square, London, W.C.1, not later than June 1.

THE Rockefeller Medical Fellowships for the academic year 1933–34 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than

June 1. These fellowships are awarded to graduates who have had some training in research work in the primary sciences of medicine, or in clinical medicine or surgery, and are likely to profit by a period of work at a university or other chosen centre in the United States before taking up positions for higher teaching or research in the British Isles. In special circumstances, the fellowships may be tenable at centres of research not in the United States. A fellowship held in the United States will have the value of not less than £350 a year for a single fellow, with extra allowance for a married fellow. Full particulars are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

ADDITIONAL lists of articles chargeable with duty under Part I of the Safeguarding of Industries Act, 1921, have been issued by the Board of Trade, and will take effect as from May 12. These lists refer to articles under the following headings :—Optical Instruments ; Scientific Glassware ; Scientific Instruments ; Synthetic Organic and other Fine Chemicals. Copies of the lists may be obtained from His Majesty's Stationery Office, price 2*d*. net.

NATIONAL BABY WEEK in Great Britain will be held on July 1–7, and among the topics for special consideration this year is preparation for parenthood. A conference on maternity and child welfare, organised by the National Association for the Prevention of Infant Mortality, will take place on July 5–7, at the Friends' House, Euston Road, London, N.W.1. Free displays of propaganda films in London are also being arranged. Further information can be obtained from the Secretary, National Baby Week Council, 117, Piccadilly, London, W.1.

As from July next, *Science Progress*, the well-known quarterly review of scientific thought, work and affairs, will be published by Messrs. Edward Arnold and Co., London (7*s*. 6*d*. net per copy). The principal features of the review are being retained by the new publishers, though typographical improvements are being made. Each issue will contain at least one article by a leading man of science describing work with which he has been identified ; in the July number this feature will be contributed by the Astronomer Royal, Dr. H. Spencer Jones.

JOHN EVELYN'S "Fumifugium or the Inconvenience of the Aer and Smoake of London Dissipated", dedicated to Charles II and published in 1661, has been reprinted by the National Smoke Abatement Society, with an introduction by Rose Macaulay (National Smoke Abatement Society, 23, King Street, Manchester ; 1933. Paper, 6*d*. net ; cloth, 1*s*. 6*d*. net). Modern work on atmospheric pollution shows that conditions in London have changed, and that it is the domestic fire rather than the factory which is now fouling the air. Nevertheless, Evelyn's pungent invective and constructive proposals make interesting and entertaining reading. It will be recalled that the pamphlet was also reissued as an Old Ashmolean Reprint three years ago (Oxford : Dr. R. T. Gunther, Folly Bridge, 1930. 2*s*. 6*d*.) and was reviewed at length in NATURE of March 8, 1930, p. 368.

IN a notice of the second edition of Pohl's "Einführung in die Mechanik und Akustik" in NATURE of April 22, p. 568, the hope was expressed that an English translation would be made available. Messrs. Blackie and Son, Ltd., have reminded us that they have already published an English translation of this edition of Pohl's book. It was reviewed in NATURE of March 4, p. 320.

A BIOGRAPHY entitled "Charles Parsons—His Life and Work" by Rollo Appleyard, will be published on May 11 by Messrs. Constable and Co., Ltd. The book contains the life-story of the Hon. Sir Charles Parsons, whose achievement in developing the modern turbine and dynamo, and in applying them to the propulsion of ships and for power stations, marks him as one of the leading engineers of his time.

PROF. JULIAN S. HUXLEY has accepted the invitation of Messrs. Thornton Butterworth Ltd. to become science editor of the "Home University Library", in succession to the late Sir J. Arthur Thomson. The "Library", founded in 1911, and added to each year, now consists of more than 160 volumes covering the chief subjects in history and geography, literature and art, science and social science, philosophy and religion. Prof. Huxley joins the Right Hon. H. A. L. Fisher and Prof. Gilbert Murray on the editorial side.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A technical assistant to the Secretary of the Institution of Structural Engineers—The Secretary, 10, Upper Belgrave Street, S.W.1 (May 10). A head of the School of Architecture and Building in the Technical College and Central School of Arts and Crafts, Plymouth—The Secretary for Education (May 12). A student assistant in agricultural economics in the Department of Agriculture and Horticulture at the University of Bristol—The Agricultura. Officer, 22, Berkeley Square, Bristol, 8 (May 12). A principal of the Kenton Lodge Training College for Women, Newcastle-upon-Tyne—The Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne (May 15). An assistant pathologist to the Infirmary and demonstrator of pathology in the University of Sheffield—The Registrar (May 17). A full-time engineering workshop instructor in the Municipal Technical School, The Gamble Institute, St. Helens—The Secretary for Education, Education Office, St. Helens (May 22). An assistant engineer to the Great Yarmouth Water Works Co.—The Secretary, 84, York Road, Great Yarmouth (May 22). Five district veterinary officers in the Public Health Department of the Cheshire County Council—The Clerk to the County Council, County Offices, Chester (May 27). Robert Blair fellows in applied science and technology, tenable overseas—The Education Officer (T.3), County Hall, London, S.E.1 (June 1).

Letters to the Editor

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

Egyptian Neolithic Barley

WHEN, where and with what species man first began the cultivation of grain are questions intimately bound up with the development of our civilisation. Fresh light has been thrown on these questions by specimens of grain which were found a few years ago in the course of explorations carried out in Egypt by Miss G. Caton-Thompson and Miss E. W. Gardner, who have given preliminary accounts of their work in two papers[1]. The archæological and geological evidence given in these papers shows that this grain was grown between 5,000 and 6,000 B.C. by a people in a Neolithic state of culture, living on the shores of a lake, which still exists, though now much smaller than in Neolithic times.

In the course of the work, more than a hundred small straw-lined pits were found which had served as granaries. Most were empty but several contained agricultural implements, and eight, varying quantities of grain, which, in five cases, was entirely or mainly wheat, but, in three, to a large extent barley.

The number of varieties of barley in cultivation is very great, amounting to several hundreds; these varieties or, at any rate, groups of them, are fairly well confined to different parts of the world. As my work during a good many years past has made me familiar with many of them, I thought it would be interesting to see how these ancient specimens compared with modern barleys; by the kindness of Miss Caton-Thompson, I have been able to do so.

Of the three specimens containing barley, one was found to be in a practically perfect state of preservation; some 800 corns were examined, with the following results:—

Wheat	20 per cent
Barley (6-rowed) ..	57 ,,
,, (2-rowed) ..	23 ,,

As I have no special knowledge of the varieties of wheat, I did not examine this further but confined my attention to the barley, the characters of which were compared with those of modern barleys grown not only in Egypt but also in other Eastern countries, namely, Tunis, Syria, Danubian countries, Persia and India. The result of this comparison was to show that this prehistoric barley was to all intents and purposes identical with that in cultivation in Egypt at the present time and clearly distinguishable from the barleys now grown in the other countries mentioned.

These facts give rise naturally to the thought that, since no appreciable improvement can be seen to have taken place in it during the last seven thousand years, a very long time must have been needed for this barley to have developed from the wild state to the degree of perfection which this specimen shows; in other words, the origin of agriculture must have been long before 5,000 B.C.

The other evidence collected by Miss Caton-Thompson and Miss Gardner permits of a few more conclusions being drawn as to the part which cereals and their cultivation played in the lives of these people.

From the size of the pits and on the assumption that the contents of each pit were the produce of one area and the property of one family of, say, 5–10 persons, it is evident that these people were not essentially an agricultural folk, for the proportion of grain in their food supply was less than in modern England, whereas in truly agricultural populations like those of India or China, it is very much higher. Its cultivation must have made small demands upon their time, which must have been spent mainly in fowling and fishing. They were, therefore, a people in the interesting intermediate stage between hunting and agriculture, and it is significant that we find them on the borders of a lake, for the presence of water must have been a most important, if not the most important, factor in bringing about the difficult transition between hunting and agriculture. A hunter is essentially a wanderer; an agriculturist essentially a settler. Even if the brilliant idea of growing wild grass instead of merely gathering it did occur to a hunter, there would be little inducement for him to do so, for the game might move away at any time and he could never be sure that he would be able to return at the right time to reap it nor could he give it any attention while growing. But if, as in this case, he were already more or less anchored to a spot where it was easy for him to obtain his food supply by the methods of hunting and fishing, with which he was already familiar, he would be very favourably placed for supplementing it by practising the newer method of tilling the ground.

A. JACKSON.

101 Anglesea Road,
Dublin, S.E.1.
Feb. 23.

[1] "The Recent Geology and Neolithic Industry of the Northern Fayum Desert" (*Journal of the Royal Anthropological Institute*, vol. 56, 1926) and "Recent Work on the Problem of Lake Moeris" (*Geographical Journal*, vol. 73, 1929).

Chemical Detection of Artificial Transmutation of Elements

IF detection of elements originating from artificial transmutation can be attained by chemical methods, not only will this mean a desirable checking of physical observations, but also new results may thereby be obtained. For physical means of discerning the transmutation of elements—whether by observing scintillations or by electrical methods—presuppose that the atoms which originate are expelled with a certain minimum energy; processes which take place with lesser energy remain at present unknown to us, even although they are perhaps quantitatively more important than the already ascertained cases of artificial disintegration of atoms.

First may be discussed the question whether the hitherto known modes of artificial disintegration of atoms offer any prospect of giving sufficiently large amounts of matter for a chemical test of the new products. Here we will confine ourselves to hydrogen, helium and neon, as so far we have worked only on these elements, and because the methods of their analysis are amongst the most sensitive of all. Several years ago we ascertained[1] that under the most favourable conditions the practical detection-limit for helium is within the order of magnitude of 10^{-10} c.c. (that is, about 10^{10} atoms), and that one

can recognise with certainty 10^{-9} c.c. helium (about 10^{11} atoms). As hydrogen and neon possess lower excitation potentials than helium, the presence of these two gases as small admixtures can be spectroscopically observed; according to an early statement of Collie and Ramsay[2], 10^{-3} per cent of hydrogen in helium can still be recognised. Since by our method the slight amount of helium, which forms from the α-rays used for the artificial disintegration of atoms, can be isolated and spectroscopically examined[3], there would therefore be a possibility of finding in this the content of hydrogen originating from atomic disintegration, if its quantity stood in no more unfavourable ratio than that of 1 : 100,000 to the helium. Now, in many cases of artificial atomic disintegration, the yield of hydrogen is at least of this order; and it seemed therefore not altogether unpromising to attempt spectroscopically to detect hydrogen originating in the disintegration of atoms by α-rays.

Our numerous experiments in this direction have been unsuccessful, for the reason that it was not possible for us with small amounts of helium to verify Collie and Ramsay's statement. We have not succeeded in preparing in glass vessels helium which was with certainty free of hydrogen; as Collie and Ramsay say nothing about hindering hydrogen liberation from the glass, it seems to us that the hydrogen lines observed by them may have been due to some contamination rather than that they should be attributed to the intentionally added amount.

Much more favourable are the circumstances for testing neon in helium. Here the influence of glass walls, and the danger of deception through the leakage of neon from the atmosphere, can be precluded. We have found that down to 2×10^{-3} per cent neon in helium can certainly be detected, and probably even less. This gave a possibility of proving whether, by bombarding a substance with α-rays, neon originates in larger amounts than 1 atom to 100,000 α-particles. Hitherto we have had only negative results (the limits of which are nevertheless so low that they are not uninteresting); we were able to ascertain that by bombarding oxygen with α-rays, such neon as may be formed falls short of that proportion; herein, as pointed out above, is included any rayless production of neon. Other experiments in bombarding the fluorides of potassium and sodium with α-rays also gave no definite positive effects.

At present the best prospects for spectroscopic identification are given by helium originating in consequence of a bombardment of lithium, boron, etc., with protons, according to Cockcroft and Walton's process[4]. The number of from 10^{10} to 10^{11} helium atoms, which is necessary for the application of our method, must form themselves in reasonable time if a somewhat stronger stream of protons is applied and the main amount of helium developed is intercepted; if we can assume that helium rays of even shorter range than those already known are present, then the prospects of results are still more favourable. We are now occupied, in conjunction with physical laboratories, in chemically isolating, and spectroscopically testing, the helium originating after bombardment with protons; also the effect of electrons of high speed on the formation of helium is being investigated.

We have also made experiments to find out whether helium appears after bombardment with β-rays or neutrons. In the case of both these rays, the above-mentioned extremely small amounts of helium would be detectable, but as yet the use of moderately strong radio-active preparations (about 50 mgm. of radium) has given no suggestion of the formation of helium[5]. The proof of helium originating under α-bombardment is naturally less sensitive by many orders of magnitude; the quantity of newly produced helium would need to amount to several per cent of that originating from the α-rays, and such a yield of an artificial transmutation would surpass all that has hitherto been observed in this sphere. Nevertheless it seemed to us worth while using our micro-method of quantitative helium measurement[6] to ascertain the amount of helium which developed from various substances after bombardment with the unfiltered rays of thorium-B and thorium-C, namely, with a mixture of α-, β-, and γ-rays and recoil atoms.

While with water, carbon, potassium, tin and mercury the amount of helium found corresponded, within a ten per cent limit of error, to the number of α-particles which had been shot into the substance, in the case of carbon-hydrogen compounds, such as paraffin, palmitic acid and diphenyl, we have found surpluses up to a hundred per cent. We hope to interpret this surprising phenomenon after further experiments; but as the completion of our work may be hindered, we therefore make this preliminary statement.

F. A. PANETH.
P. L. GÜNTHER.

Chemical Institute,
University of Königsberg i. Pr.
April 7.

[1] F. Paneth and K. Peters, *Z. phys. Chem.*, **134**, 353; 1928. See also NATURE, **123**, 879, June 8, 1929; **125**, 490, March 29, 1930.
[2] J. N. Collie and W. Ramsay, *Proc. Roy. Soc.*, **59**, 257; 1896.
[3] Cf. *Z. phys. Chem.* (B.), **1**, 170, 185; 1928.
[4] J. D. Cockcroft and E. T. S. Walton, *Proc. Roy. Soc.*, **137**, 229; 1932. NATURE, **131**, 23, Jan. 7, 1933. See also H. Rausch v. Traubenberg A. Eckardt and R. Gebauer, *Naturwissenschaften*, **21**, 26; 1933.
[5] Cf. the earlier, also negative, results, *Z. phys. Chem.* (B), **1**, 180, 182; 1928.
[6] F. Paneth and Wm. D. Urry, *Z. phys. Chem.* (A), **152**, 110; 1931.

Orientations of Molecules in the *p*-Benzoquinone Crystal

THE crystal structure of *p*-benzoquinone has recently been studied by W. A. Caspari[1] by X-ray methods. The crystal belongs to the monoclinic system and is assigned by Caspari to the space-group C^5_{2h}; there are two molecules in the unit cell, the molecules possessing a centre of symmetry. His X-ray measurements are not sufficient to determine uniquely the orientations of the molecules in the unit cell. However, by combining his X-ray data with certain considerations concerning the crystal habit and the dimensions of the molecules, he concludes that the molecular planes are parallel to (201) and that the lines joining the two oxygen atoms of the molecule lie in the (010) plane. This orientation of the molecules secures a large concentration of the oxygen atoms in the $(20\bar{1})$ plane, which concentration, according to Caspari, will account for the exceptional development in the crystal of so peculiar a face as $(20\bar{1})$.

It seems to us that the molecular planes in the crystal are orientated differently. A study of its magne-crystallic properties shows that the $(20\bar{1})$ plane is indeed the mean plane of the molecules. Denoting by χ_1 and χ_2 the principal gram molecular

susceptibilities of the crystal in the (010) plane, and by χ_3 the susceptibility along the b axis, we find that

$$\left.\begin{aligned}\chi_1 &= -27{\cdot}1\\ \chi_2 &= -64{\cdot}5\\ \chi_3 &= -25{\cdot}4\end{aligned}\right\} \times 10^{-6} \text{ c.g.s. e.m.u.}$$

The χ_3 axis, which is plainly an axis of approximate magnetic symmetry, is inclined at 20·2° to (001) and at 87·0° to $(20\bar{1})$.

We may compare the above principal susceptibilities of the benzoquinone *crystal* with those for the *molecule* of the substance—deduced from the known constants for the benzene molecule. We then find that χ_1 and χ_3 are about the same as the susceptibility of the molecule for directions in its plane, while χ_2 is nearly equal to the susceptibility of the molecule along the normal to its plane. We may therefore conclude that the molecular planes in the crystal are perpendicular to the χ_2 axis, and are thus almost coincident with the $(20\bar{1})$ plane.

The orientation proposed by us is also supported by the optical properties of the crystal. Since the optical polarisability of the benzene ring for vibrations perpendicular to its plane is known to be considerably smaller than for vibrations in the plane, the refractive index of the crystal for vibrations perpendicular to $(20\bar{1})$ should be a minimum and be much less than the other two principal refractive indices. This is indeed so, since the crystal exhibits a strong negative birefringence, and the acute bisectrix is almost perpendicular to $(20\bar{1})$.[2]

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S. BANERJEE.

Physics Laboratory,
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March 5.

[1] *Proc. Roy. Soc.*, A, **136**, 82; 1932.
[2] See P. Groth, "Chemische Kristallographie", vol. 4, p. 140.

Detection of Traces of Carbon Monoxide in Air

A PARAGRAPH among the "Research Items" in NATURE of March 25, page 441, states that Dr. Ackermann has made comparative tests of two methods of estimating carbon monoxide gas in air: the palladous chloride method and the hæmoglobin method. The latter method consisted in exposing the hæmoglobin to the gas to be examined; then adding a reducing agent (ammonium sulphide) to the hæmoglobin and examining it with an ordinary spectroscope for the presence of the two absorption bands of carbon monoxide hæmoglobin.

With palladous chloride it was possible to detect 0·015 per cent of carbon monoxide as against 0·13 per cent with the hæmoglobin method.

I should like to point out that there is a better hæmoglobin method than that used by Dr. Ackermann, which depends on the wave-lengths of the bands of oxyhæmoglobin being different from those of carbon monoxide hæmoglobin. Thus the α band has a difference of wave-length of about 60 angstrom units for ox, sheep or human blood. This change in wave-length can under suitable conditions be estimated with an accuracy of 1 angstrom unit by means of the reversion spectroscope.

Dudley, Edmed and Frederick have recently used this instrument[1] for investigating the production of carbon monoxide gas by various paints. Some of the air analyses showed values as low as 0·004 per cent carbon monoxide. Substituting this value for that obtained by the hæmoglobin method by Dr. Ackermann, the comparison with the palladous chloride method would now be:

Hæmoglobin method (with reversion spectroscope) ..	0·004
Palladous chloride method (Dr. Ackermann)	0·015

This reverses the conclusion reached by Dr. Ackermann, for the hæmoglobin method appears to be the more delicate.

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March 31.

[1] *J. Indust. Hygiene*, **15**, p. 1, Jan. 1933.

Radioactivity of Samarium and the Formation of Hibernium Halos

IN their interesting communication to NATURE for March 25, p. 434, G. Hevesy and M. Pahl have referred to Joly's work on the so-called hibernium halos. The agreement between their determination of the range of the α-ray radiation of samarium and Joly's[1] value is very striking. He found that the air equivalent of the radius of a hibernium halo was 1·15 cm., which may be compared with their figure for the range of the samarium α-ray of 1·1 cm. In his final estimate of the range of the hibernium α-ray Joly gave 1·5 cm. This figure was arrived at from the fact that in a normal positive uranium halo the boundary of the halo does not coincide exactly with the full range of the α-ray, due to the decreasing ionising power of the ray very near the end of its path. It must be remembered, however, that all the hibernium halos observed were reversed halos, and, as is shown later, it is probable that some non-radioactive reversal and intensification effect is necessary to render them visible, if they are samarium halos. Under these conditions it is possible that the radius of the halo would give practically the full range, which would thus agree nearly exactly with the samarium α-ray range.

When we consider whether a samarium nucleus of the size observed in the hibernium halo would furnish sufficient α-ray radiation to produce a halo since Archæan times, we encounter certain discrepancies. The radius of a hibernium halo is 5×10^{-4} cm., with a central nucleus of about 3×10^{-5} cm. radius. If this nucleus were a pure samarium sphere, its mass would be $8{\cdot}7 \times 10^{-13}$ gm. Using Hevesy and Pahl's value for the number of α-rays per gram of samarium, that is, 75 α-rays per gram per second, this sphere would emit $2{\cdot}0 \times 10^{-3}$ α-rays per year. Taking a rough figure for the age of the Archæan of 10^9 years, and allowing for the total volume of the complete halo sphere, we arrive at a total number of α-particles per cubic centimetre of halo sphere of $4{\cdot}0 \times 10^{15}$.

Unfortunately, no quantitative measurements on the effect of α-rays on the very opaque Ytterby mica are available. Joly and Rutherford's[2] experiments on Ballyellen mica show that it requires about 2×10^{16} α-particles per cubic centimetre to produce an amount of staining corresponding to a weak positive halo

in this material. The amount of α-ray radiation required to produce a reversed halo must be very much greater than this, as is shown by Jedrzejowski's[3] work on the production of reversal by α-ray radiation of a Siberian mica. Thus if we are to assume that hibernium halos are due to samarium, we must either conclude that Ytterby mica is specially sensitive to α-ray radiation, or that some reversal and intensification of the halos has been produced by either thermal or chemical effects in the course of their long history. I am inclined to favour the latter alternative, since I have observed a similar intensification of positive halos when heated to a temperature not sufficient to obliterate the halo by the blackening of the surrounding mica[4]. Joly, also, has observed the reversal of immature uranium halos in Ytterby mica. The fact that hibernium halos are so rare, even in Ytterby mica, is perhaps explicable on the view that the conditions for the reversal and intensification of the halos are only very occasionally satisfied.

J. H. J. POOLE.

Trinity College,
Dublin.
March 29.

[1] *Proc. Roy. Soc.*, A, **102**, 682; 1923.
[2] *Phil. Mag.*, p. 644, April 1913.
[3] *C.R.*, **186**, 135; 1928.
[4] *Phil. Mag.*, p. 132, Jan. 1928.

Volumes of Alkyl Groups and their Orienting Powers

IN some of their applications, the current generalised theories of benzene substitution discard steric factors too lightly. For the purpose of *a priori* consideration, it can be assumed that the effective reagent in a substitution does not occupy a *smaller* volume than the group which is eventually installed in place of hydrogen.

A drawing to scale[1] is reproduced (Fig. 1) of the compound (i): the groups R_1 and R_2 are omitted and the two positions which could be taken by the methyl group in the plane of the benzene ring are indicated.

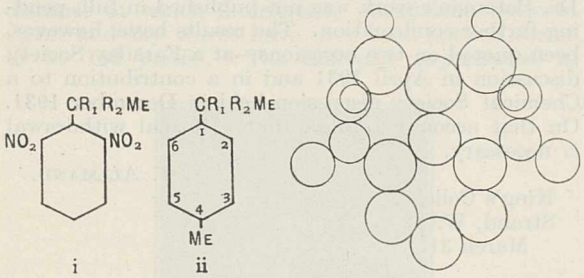

FIG. 1.

It is seen that some degree of interlocking of groups occurs. Various applications of this are at present under investigation; for example, that during nitration of (ii), attack by HNO_3 molecules at the 2- and 6- positions might be impeded by a real screening effect from the $-CR_1R_2Alk$ radical. To a less extent the same might apply to halogenation. Thus the absolute number of reagent molecules colliding with these positions may be less than those colliding at 3- and 5-, and/or some of the reagent molecules may succeed in penetrating to the 2 : 6-carbon atoms only after preliminary collision. In the last case, their kinetic energies being reduced, the threshold energy of activation necessary for substitution is likely to be attained less frequently than among the more direct collisions occurring at positions 3- and 5.

Expressed differently: if velocities of substitution can be represented by $k = \alpha\, e^{-E/RT}$, then in compounds of the type now under discussion the two pairs of vicinal positions available for substitution will be abnormal in not having identical α terms (contrast Bradfield and Jones's results[2]). Such abnormality must be expected with all alkyl substituents larger than methyl.

The net consequence will be a depression of substitution ortho to the radical, $-CR_1R_2Alk$ in favour of other positions where substitution will be able to occur by default. Thus orientation in discord with electronic theories (requiring substitution more at positions of greater electron availability) should be expected from *a priori* reasoning alone.

Experiments on the nitration and halogenation of *p*-cymene and some of its derivatives have justified this conclusion. The results with the hydrocarbon itself are tabulated:

2-Substitution in 1-methyl-4-isopropylbenzene.

268 G *p*-cymene subjected to:—	Total wt. of crude material isolated	Unchanged *p*-cymene recovered	Theoret. yield for mono substn.	Pure 2 substd. cymene obtd.	Per cent in crude product.	Per cent yield on cymene taken
Nitration .	290	—	358	252	87	70
Chlorination .	318	1	338	200	63	59
Bromination.	376	19	396	214	57	54

The numbers in the last column give minimum estimates of the yields of 2-derivatives obtained in these experiments. The amount of actual 2-substitution of *p*-cymene in each case is certainly greater than is indicated by these results. Thus methyl appears to possess a greater ortho directive influence than isopropyl. On pure electronic theories the reverse should be the case.

R. J. W. LE FÈVRE.

University College,
University of London.
April 11.

[1] "Atomic Radii", *An. Rep. Chem. Soc.*, p. 402; 1931.
[2] Bradfield and Jones, *J. Chem. Soc.*, 1009; 1928.

Nuclear Moment of Arsenic

THE hyperfine structure of two-electron spectra of heavy elements with configurations involving an *s* and one other type electron have been under investigation for some time in this laboratory. The As IV spectrum, classified by K. R. Rao[1], is of this type, and is particularly suited for the detection of hyperfine structure and the determination of the moment of the nucleus. About a year ago, the As IV lines λ3216, 3190, 3109 ($4s5s^3S_1 - 4s5p^3P^\circ_{012}$), excited by a condensed electrodeless discharge, were examined with a multiple prism spectrograph and found to have comparatively large hyperfine structures. The patterns, although not completely resolved, showed that the I value of arsenic was small and probably equal to $1\frac{1}{2}$. The recent acquisition by this Department of an excellent 21 ft. concave grating, ruled by Prof. Gale of Chicago, has made possible the completion of this investigation. The results definitely show that the nuclear moment of arsenic is $1\frac{1}{2} \times h/2\pi$.

The line λ3216 ($^3S_1 - {}^3P^\circ_0$) is well resolved in the fifth order, and shows three components decreasing in intensity from the red to the violet and separated by the intervals 0·907 and 0·544 cm.$^{-1}$. Since the $^3P^\circ_0$ term is not split by the nuclear interaction, the triple line-structure corresponds directly to the hyperfine structure of the $^3S_1$ term. This triplet structure shows that $I \geqslant 1$, and the interval ratio definitely fixes I as $1\frac{1}{2}$. Theoretically, the interval ratio for a term with $J = 1$ is $(I + 1)/I$. The observed ratio, obtained by averaging twenty measurements from two plates, is 0·907/0·544 = 1·67. It is evident that the only value of I that satisfies this ratio is $1\frac{1}{2}$. The intensities are consistent with this value of I and they, with the intervals, show that the hyperfine levels of $^3S_1$ are normal.

The lines λ3190 ($^3S_1 - {}^3P^\circ_1$) and λ3109 ($^3S_1 - {}^3P^\circ_2$), although not completely resolved in the fifth order, both show four distinct components. These structures were interpreted by Fisher and Goudsmit's method for incompletely resolved patterns[2]. In both cases the positions and the intensities[3] of the fine structure components were consistent with the predictions based on the known separations of the $^3S_1$ term, obtained from λ3216, and on the deduced value $1\frac{1}{2}$ for I, which was used to determine the interval ratios of the $^3P^\circ_1$ and $^3P^\circ_2$ terms.

The interval factor of $^3S_1$ is $A(^3S_1) = 0{\cdot}363$ cm.$^{-1}$. The interval factors of the other two terms are $A\,(^3P^\circ_1) = 0{\cdot}18$ cm.$^{-1}$, and $A\,(^3P^\circ_2) = 0{\cdot}15$ cm.$^{-1}$. The last two were determined by the graphical method and are not so accurate as the first. The approximate equality of $A\,(^3P^\circ_1)$ and $A\,(^3P^\circ_2)$ shows that the coupling in the $4s5p$ configuration approximates to the (LS) type[4]. This is consistent with the multiplet separations of the $4s5p\ ^{3,1}P$ terms: although the interval ratio 3·2/1 for the $^3P^\circ_{012}$ separations[1] differs appreciably from the ratio 2/1, the g-factors calculated by Houston's method[5] depart only slightly from those for (LS) coupling.

The nuclear moment deduced from the hyperfine structures of these As IV lines is in agreement with the value deduced by Tolansky[6] from the hyperfine structure of As II. His publication appeared during the course of this investigation.

The $4s5p$ configuration of As IV and the $4p5s$ configuration of As II illustrate nicely the influence of binding on coupling. The coupling energy between the s and p electrons is expected to be about the same for both configurations. The $(1s)$ interaction of the p electron in the $4p5s$ configuration is expected to be from two to three times that of the p electron in the $4s5p$ configuration. This follows from an application of the Landé doublet formula when the screening effect of the two $4s$ electrons[7] and the variation in n^* are taken into consideration. Due to this increase in the $(1s)$ interaction relative to the interaction energy between the two electrons, the coupling in the $4p5s$ configuration should depart more from (LS) type than the coupling in the $4s5p$ configuration. This is consistent with observation: the coupling in $4s5p$, as pointed out, approaches (LS) type, whereas the coupling in $4p5s$ differs considerably from (LS) and tends toward (jj), as shown by the application of Houston's theory[5] to the multiplet separations and of Goudsmit's theory[4] to the hyperfine separations of As II.

In this research, hyperfine structure was also observed in several unclassified spark lines. These structures are being investigated.

The authors wish to thank Prof. E. F. Burton, director of the Laboratory, who co-operated and made possible the completion of the investigation by procuring the new grating.

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March 10.

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[1] K. R. Rao, *Proc. Roy. Soc.*, A, **134**, 604; 1931.
[2] R. A. Fisher and S. Goudsmit, *Phys. Rev.*, **37**, 1057; 1931.
[3] E. L. Hill, *Proc. Nat. Acad. Sci.*, **16**, 68; 1930.
[4] S. Goudsmit, *Phys. Rev.*, **37**, 663; 1931.
[5] W. V. Houston, *Phys. Rev.*, **33**, 297; 1929.
[6] S. Tolansky, *Proc. Roy. Soc.*, A, **137**, 541; 1932. NATURE, **129**, 652; 1932.
[7] R.A. Sawyer and C. J. Humphreys, *Phys. Rev.*, **32**, 583; 1928.

Photochemical Reaction of Hydrogen and Chlorine

PROF. BAKER and I have talked over the matter dealt with in his letter to NATURE published in the issue of January 7, p. 27, namely, the influence of traces of water vapour on the above reaction. We agree that no further discussion of the point at issue would be useful unless combined with a simultaneous first-hand and detailed examination of the experimental method used. This is impossible, as the apparatus in question has been dismantled. We therefore, for the time being at all events, hold to our respective and divergent views on the subject.

About three years ago Dr. J. B. Bateman, working in this Laboratory with dispersed monochromatic light, obtained results which indicated that the quantum efficiency for this reaction fell off in the ultra-violet, and became practically zero somewhere below 3000 A. Recent experiments carried out by Mr. H. C. Craggs under rather different conditions have shown that the results were due to the presence of a plate of glass, instead of quartz, at the exit side of the thermopile mounting in which the telescope slit of the monochromator is incorporated. This in turn was due to an unfortunate misunderstanding for which we can take no responsibility. In view of the extraordinary nature of the original conclusion, Dr. Bateman's work was not published in full, pending further confirmation. The results have, however, been quoted on two occasions—at a Faraday Society discussion in April 1931 and in a contribution to a Chemical Society discussion held in December 1931. On that account I think that a formal withdrawal is necessary.

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Strand, W.C.2.
March 31.

Sacred Sandstone of the Mayas

ALL archæologists are familiar with the work done on the remarkable Maya ruins at Chichen Itzá, in Yucatan, by Mr. Earl Morris and his associates, on behalf of the Carnegie Institution of Washington (see NATURE, **128**, 692, Oct. 24, 1931). In the course of uncovering the large building now known as the Temple of the Warriors, Mr. Morris found an older temple underneath it, which he was able to explore by means of suitable tunnels. It was in the basement of this older building that he found the beautiful turquoise plaque, now carefully restored so far as the materials permitted, and deposited in the National Museum of Mexico. The centre of this plaque consists of a circular area which

was filled with pieces of polished hæmatite, and beneath this, as Mr. Morris has fully explained in his recent book, is a disc of sandstone, of very ordinary quality, but not obtainable near Chichen Itzà.

The exact meaning of all this has remained uncertain. Mr. Morris found other discs of sandstone in the foundations of the later temple, and had inferred that they must have been held sacred, without suggesting any reason beyond their position and the fact that they were carefully protected from injury. While hearing Mr. Morris lecture on this subject, it occurred to me that in all probability the discs were connected with human sacrifices. The porous stone would become largely saturated with blood, and would thus afford a means of preserving the actual blood of the sacrificial victim in the foundations of the temple. The symbolism of the covering hæmatite would then be evident; it would present the appearance, when polished, of a pool of blood. Further confirmation appears to be afforded by the discovery, in an adjacent building, of another plaque and with it, covered with turquoise, a large knife or blade. This might have been the sacred instrument used in killing the victim. It is a question whether careful analysis would reveal any traces of blood now remaining in the sandstone discs, but it seems not impossible that this might be the case.

After consulting with Mr. Morris, I offer this note to direct attention to the matter, hoping that someone may be able to supply decisive evidence.

T. D. A. COCKERELL.

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March 6.

Recording Wireless Echoes at the Transmitting Station

RECORDS of wireless echoes by the group-retardation method of Breit and Tuve[1] show that the intensities and number of echoes diminish as the receiver is brought near the transmitter. The minimum distance from the transmitter at which we could detect echoes was 400 metres[2]. The nearest distance at which interference phenomena between direct and sky waves have ever been noticed seems to be 180 yards[3]. The difficulty experienced in

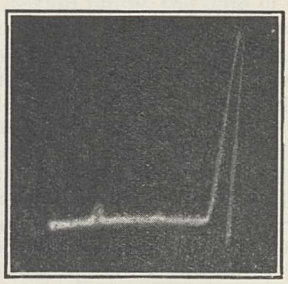

FIG. 1.

recording echoes at short distances from the transmitter is commonly supposed to be due to the enormous strength of the direct ground signal as compared with the strength of the echoes. This is undoubtedly one reason; but there is another reason to which proper attention has not been paid by investigators in this field.

In the group-retardation method, the transmitting aerial is energised for very short periods, for example, 1/5000 sec., at brief intervals of say 1/200 sec. The wave packet sent out during the active period of the aerial returns to the earth, during its quiescent period. During this latter interval, the transmitting aerial acts like a receiving aerial and collects energy from the reflected wave from over a comparatively large area surrounding it. The receiver with its small aerial, when brought within the 'collecting area' of the more efficient transmitting aerial, naturally fails to gather sufficient energy from the reflected wave and is unable to record the echoes.

It occurred to us that the difficulty mentioned above could be obviated if the transmitting aerial itself were utilised as a receiving aerial during its quiescent period when it absorbed energy from the reflected wave. Acting on this idea, the input coil of the receiver was coupled to the tuning inductance of the aerial, when echoes were recorded without much difficulty. A photograph of the echoes thus obtained is reproduced in Fig. 1. This, we believe, is the first record of echoes returned at absolutely normal incidence from the ionised layer. The direct signal of course comes out very strongly, but it can be kept down by suitable design of the receiver, such as by using an automatic volume control.

A great advantage of using the same aerial for transmitting as well as for receiving is that it dispenses with the necessity of erecting two stations, one transmitting and another receiving at two different localities, and employing two observers. A single observer is able to control and attend to both the transmitting and the receiving sides.

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H. RAKSHIT.

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92 Upper Circular Road,
Calcutta, March 25.

[1] Breit and Tuve, *Phys. Rev.*, **27**, 554; 1926.
[2] Mitra and Rakshit, *Phil. Mag.*, **15**, 20; 1933.
[3] Appleton and Naismith, *Proc. Roy. Soc.*, A, **137**, 36; 1932.

WE were much interested in a valuable paper by Mitra and Rakshit on "The Upper Ionized Atmosphere in Bengal"[1]. Their extension, to sub-tropical regions, of soundings of the ionosphere is very important. We are not concerned here to point out the bearing of the magneto-ionic theory on the results obtained by these authors, but the reading of the paper leads us to record one point arising from our experience of such work.

The receivers customarily used in pulse-reception at this Station are of the frequency-conversion type, with a band-width of 10 kc./sec., and with a diode as second detector. The ground distance between sender and receiver is only 120 metres, and the receiver was designed with such time-constants that the heavy overloading produced by the ground-pulse did not appear to lengthen the duration of the corresponding output-pulse as seen on the cathode ray oscillograph. This arrangement gives very satisfactory echo-patterns, and meets all our immediate requirements.

We were recently disconcerted to find, however, that the receiver as a whole was rendered relatively insensitive, for periods of many milliseconds, by the incidence of the strong ground-pulse, so that the electric forces, particularly in the earlier members of the echo pattern, were in fact higher than would have been inferred from the screen amplitudes and the steady state gain. Work towards removal of this

defect is in progress, and substantial improvement has already been attained.

We think it desirable even at this interim stage to direct attention to the possible existence of this defect as a contributory cause in the reduction of echo amplitude with ground distance reported by Mitra and Rakshit in their paper. It is clearly desirable that this instrumental point should be cleared up in each individual case before a geophysical interpretation of echo amplitudes is looked for.

R. A. WATSON WATT.
L. BAINBRIDGE-BELL.

Radio Research Station,
Slough, Bucks.
April 6.

[1] *Phil. Mag.*, **15**, 20; 1933.

Action of Quaternary Ammonium Salts on Nerve

EXPERIMENTS similar to those of Fromherz with curare on medullated nerve, referred to by Prof. A. V. Hill in his article on "The Physical Nature of the Nerve Impulse",[1] in NATURE of April 8, have been made with pure quaternary ammonium salts prepared by Dr. H. R. Ing. These have a curare-like action, preventing transmission of excitation from nerve to muscle, but not affecting muscle or medullated nerve directly in the concentration required for paralysis.

A frog's nerve, taken from a gastrocnemius-sciatic preparation which had been 'curarised' in Ringer's solution containing 2 millimols per litre of tetramethyl ammonium iodide or 1 millimol per litre of octyl trimethyl ammonium iodide, was asphyxiated until excitability had disappeared and then for a further hour. When oxygen was readmitted the nerve showed only a transient recovery of action current and this vanished in about half an hour. If a concentration of 2 millimols per litre of octyl trimethyl ammonium iodide or 1 millimol per litre of strychnine methiodide was employed, there was no transient recovery of action current on admission of oxygen. An increased dose of the two drugs first named, or the use of a similar compound of greater molecular weight, abolishes even the temporary return of the action current in oxygen after asphyxiation. A control nerve-muscle preparation left soaking in oxygenated Ringer's solution containing the quaternary ammonium salt was still 'curarised' at the end of the experiment, but when the nerve was cut off and tested the action current showed no diminution. Also, control nerves soaked in Ringer's solution without poisoning and then asphyxiated in the way described showed only a 15–20 per cent decline in action current.

Experiments made in September at the Marine Biological Laboratory, Plymouth, showed that the action current is abolished in the non-medullated nerves of *Maia squinado* by soaking for about a minute in sea water containing less than 1 millimol per litre of quaternary ammonium salt. As with veratrin, the salt can penetrate the non-medullated nerve without asphyxiation.

S. L. COWAN.

Department of Pharmacology,
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April 12.

[1] NATURE, **131**, 501, April 8, 1933.

Further Light on the Schneider Mediumship

LORD CHARLES HOPE is correct in stating (NATURE, April 15, p. 549) that the 'suspect' detected in trickery at Dr. Osty's experiments was 'allowed' to attend every séance at my laboratory, but this was because Rudi Schneider refused point blank to sit without her.

It had been arranged to hold a series of sittings during the summer of 1931, but negotiations broke down because we refused to allow the 'confederate' (a close friend of Rudi's) to accompany him. When we found that Rudi would not visit the Laboratory without his friend, we consented to have her, but—after Dr. Osty's experiences—special precautions were taken to keep her under close observation during the séances.

Although Dr. Osty now admits that he detected Rudi's friend producing the 'phenomena' herself, his report contains no mention of this, and the fact that she was present at any experiment is not recorded in the account prepared for the public.

Stress has been laid on the fact that our cameras caught Mr. Schneider evading control, but so long ago as 1924 Professors Meyer and Przibram of Vienna detected Rudi producing 'telekinetic' movements of objects by means of a freed arm. That he *can* free an arm from the usual tactual control (and without the controllers being aware of the fact) has now been proved by our photographic evidence.

Mr. Schneider has promised to visit us during the coming autumn, when we hope finally to settle the question as to whether he can externalise some 'force' capable of displacing objects at a distance, or of affecting infra-red rays. We want 'Olga' (his trance personality) again to hand round flowers and cigarettes: to play the zither: to place a paper basket over a sitter's head: to give us another 'farewell signature'—all of which 'supernormal' diversions we witnessed at previous experiments.

HARRY PRICE.

13d, Roland Gardens,
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April 21.

Invar

IL n'est pas douteux que les recherches de M. Honda soient fondamentales, et aient apporté de sérieux progrès à nos connaissances sur les alliages de fer avec le nickel, le cobalt et le chrome. Mais je voudrais rectifier une petite erreur dans son exposé, paru dans le numéro de NATURE du 22 avril, 1933, p. 587. M. Honda dit, en effet, qu'on n'a pas pu réaliser un invar ayant une dilatation inférieure à $1{\cdot}2 \times 10^{-6}$. Or, les fils employés en géodésie, et qui ont une très faible dilatation, passant même quelquefois au-dessous de zéro, sont, depuis plus de vingt ans, de fabrication courante. Pour expliquer la faible dilatabilité de l'invar, on s'est fondé sur l'existence réversible de fer α et de fer γ. Des publications importantes sur cette question ont été faites, notamment par F. Osmond, Louis Dumas et Pierre Chevenard. J'y ai fait moi-même plusieurs fois allusion.

CH.-ED. GUILLAUME.

Bureau international des Poids et Mesures,
Sèvres.

Research Items

Patwin and Maidu Cult Origins. A further investigation of the Patwin and Maidu tribes of California was undertaken by Mr. E. M. Loeb in 1931 with the object of adding to information previously obtained relating to the secret society organisation of northern California as it existed prior to 1870 (*Univ. California Pub. American Archæol. and Ethnol.*, **33**, No. 2). The main cults of north-central California are local or autogenous units; but the specific traits entering into the cults usually are more widespread than the cults themselves, and therefore have come to north-central California by diffusion, when they have not arisen by a process of disintegration and amalgamation. Tribal initiation was the oldest cult, and its elements (the bullroarer, the tribal mark, the death and resurrection ceremony, and the representation of spirits or ghosts) probably were brought in by the American Indians on their entrance to the New World. Some of these were adopted by later cults; others lost, as the bullroarer among the Patwin–Maidu. 'Ghosts' may be split into three sub-traits—clowns, running spirits, and representatives of the dead. Of these, running spirits alone are indigenous to north-central California, while clowns originated in the south-west or in Mexico. Human representation of the dead occurs in Lower California, and on the Colorado. It is possible that the annual mourning ceremony was located in Mexico. The use of the scratching stick and sucking tube points to the origin of the initiation ceremony at one point in the world. They occur in both North and South America as well as in the Old World. While the kuksu cult has affinities with the south, the hesi cult comes from the north, bringing with it private ownership of dances and dance dress, and probably bear doctors, bear dances and bear propitiation. The kernel of the hesi cult may lie in first-fruit, and especially acorn, rites.

Pleistocene Dating of Gafsa Hills, Tunisia. M. R. Vaufrey has now published (*Rév. Géog. Phys.*, **5**, fasc. 3) the communication presented to the Prehistoric Congress in London in August last, in which he brought forward evidence derived from the discovery of palæolithic implements *in situ* making it possible to fix, within certain limits, the date of the formation of the hills in the oasis of Gafsa, Tunisia. The low hills of the oasis, following the general conformation of southern Tunisia, run from north-east to south-west. It had been noted previously that the alluvial deposits, forming a conglomerate, of which the hills are composed, are tilted, the lamination being exposed by erosion on the north side. A considerable number of stone implements have been found on one of the hills, "la colline du signal", by previous investigators, notably Schweinfurth (1907) and de Morgan (1910), the former classifying the earlier implements elaborately according to the eolithic nomenclature of his day. One of the objects of M. Vaufrey's investigations, therefore, was to discover implements *in situ* with the view of establishing their exact relation to the tilting. Implements were found at three points in the tilted strata, the latest in type being an evolved Acheulean. On the other hand, in the horizontal strata of the alluvial deposits of later date which lie at the foot of the hills and have not been subjected to the folding to which the formation of the hills was due, he found a Mousterian implement, a typical Levallois flake. On this evidence he concludes that it is justifiable to fix the date of the formation of the hills at the interval between Acheulean and Mousterian, say, at the end of the Riss-Würm glaciation or at the very beginning of the last glaciation of the ice age. As he says in conclusion, this is the best example known of folding which can be attributed with certainty to the Pleistocene.

Internal Ear of Amphibia. C. Guareschi (*Mem. Roy. Accad. d'Italia, Classe Sci. Fis. Mat. Naturali*, vol. 3, pp. 147, 1932) records in detail the results of his experimental investigations on the internal ear of Amphibia, both Urodela and Anura. Into whatever region of an embryo of the same species and the same age the developing ear is transplanted, it will differentiate into an internal ear and the differentiation is independent of the relations with neighbouring organs and of the innervation. A part of the ear rudiment when transplanted is not capable of giving rise to the structures potentially contained in the other part. In the destruction which inevitably takes place in xenoplastic transplantations, after the absorption of the yolk, the otocyst presents a greater resistance than the eye, and its parts show a differential susceptibility resulting in the more rapid destruction of the sensitive area. Two otocysts may be made to fuse and the resultant is provided with all the structures contained potentially in the two rudiments. There exists an independence between the development of the cristæ and the maculæ.

Chromosomes of Amphibians and Fishes. In a series of five papers on the chromosomes of amphibians, Dr. Shigemori Iriki (*Sci. Rep. Tokyo Bunrika Daigaku*, vol. 1, p. 61) has added considerably to our knowledge of the cytology of this group, especially as regards the Japanese species. In two species of *Rana* he finds the diploid chromosome number to be 26, confirming his earlier count. In spermatogenesis he finds a V-shaped body which he interprets as a pair of *X*-chromosomes, and concludes that probably in all Anura the female is heterogametic for sex. He shows a spiral structure in the *X*-chromosomes of the male *Hyla arborea japonica*. Among Urodela, in *Diemyctylus pyrrhogaster*, $2n = 24$, while in *Megalobatrachus japonicus*, $2n = 64$. No differentiated sex chromosomes were found in urodelans, but it is concluded that here also the males are probably of the *XX* type. In fishes, too, attempts to differentiate sex chromosomes have been unsuccessful, but there is clear genetic evidence for an *XY* pair in the males of *Lebistes* and that in *Aplocheilus* also the males are genetically heterogametic for sex. On the other hand, in *Platypœcilus* the evidence is decisive that the female is the heterogametic sex.

Insect Pollinators of Orchard Trees. The sterility of fruit trees is a widespread evil. One sees many unproductive trees, especially in small orchards, in all parts of Great Britain. Many of the factors which affect sterility, such as genetic constitution, the nutrition of the tree and the influence of the grafted stock, are being investigated in several research stations. Mr. G. Fox Wilson has studied the actual mechanism of pollination as effected by insects. ("Pollination in Orchards", *J. Roy. Hort. Soc.*, **58**, pt. 1, 125–138, Feb. 1933). He describes many species of insect visitors to hardy fruit trees, and, in

the paper under review, outlines the pollinating habits of some of them. Many valuable suggestions are given for the planning of the orchard so that maximum pollination may result. It is shown, for example, that humble bees will not visit currants and gooseberries planted in the neighbourhood of cherries. Many of the wild species of pollinating insects visit the edges, but not the centre of a large orchard, and it is recommended for the fruit-grower to make quite sure of fertilisation by placing hives of bees here and there amongst the trees.

Nitrogenous Manuring of Legumes. The question of using nitrogenous fertilisers on leguminous crops like peas, beans and lucerne, has been much discussed of late on the Continent. What has generally been considered the best practice in Great Britain and elsewhere is to restrict their use to a young crop, the growth of which needs accelerating; otherwise they are uneconomic. The opinion is, however, fairly widespread that fertilisers containing readily assimilable nitrogen are distinctly harmful to the nitrogen-fixing activities of the nodule bacteria; and it was this contention that induced H. Burgevin, director of the Station Centrale d'Agronomie at Versailles, to investigate the question (*C. R. Acad. Sci.*, Paris, **196**, 441–3; 1933; and *C. R. Acad. d'Agric. de France*, **19**, No. 6; 1933). Soya beans were grown in naturally sterile soil contained in pots, one series being inoculated with a culture of *B. radicicola* specific to the soya bean, and the other left sterile. In addition to a basal dressing of phosphate, potash and chalk, inorganic nitrogen in the form of nitrates and ammoniacal salts was applied in dressings equivalent to 0, 45, 90, and 135 lb. of nitrogen per acre (or to 0, 2, 4, and 6 cwt. per acre of sulphate of ammonia); and it was found that the plants in the sterile soil that had received nitrogen developed proportionately to the amount of nitrogen applied, although their leaves turned perceptibly yellow. In every case the inoculated plants did best, and not only did they not suffer from the presence of the added nitrogen, but also they utilised it to advantage, as well as the nitrogen fixed by the bacteria. Even the highest applications of added nitrogen did not injure the nitrogen-fixing power of the nodule bacteria; so that the use of small dressings of nitrogenous fertilisers for legumes, to assist their early growth, if necessary, appears fully justified.

Canadian Minerals of the Rare Elements. H. V. Ellsworth has prepared an invaluable and highly interesting report on the rare-element minerals of Canada (*Econ. Ser.* No. 11, Geol. Sur. Canada, 1932, pp. 272). The elements dealt with are uranium and thorium and their associated transformation products; tantalum; columbium; zirconium; hafnium; beryllium; lithium; rubidium; and cæsium; all of which occur as constituents of minerals found in pegmatites. Chapters on these are followed by others devoted to the geological setting of the minerals and their occurrences in Canada, and to radioactivity and radioactive minerals as indicators of geological age. The report concludes with a record of all the chemical analyses of Canadian rare-earth minerals that have so far been made. One major object of the survey has been to study all the known occurrences with the view of ascertaining the feasibility of commercial exploitation, and determining the most favourable indications that might be useful to the prospector in searching for these minerals. Another important consideration was concerned with the possibility of correlating igneous rocks, the age relationships of which could not be determined by ordinary geological methods. The Besner uraninite, for example, which occurs in a pegmatite cutting granite-gneiss of probably Killarney age, has a lead ratio of 0·11, whereas many of the pegmatites of the Laurentian-Grenville area carry uraninites having an average lead ratio of 0·155. The radioactive method thus supports the probability that some of the granites are of Killarnean age and provides a means for distinguishing them from those of Laurentian age.

Everyday Photometry with Photoelectric Cells. Johann Heinrich Lambert, one of the pioneers of illuminating engineering, in his book "Photometria" (Augsburg, 1760) regrets that there is no instrument analogous to a thermometer which might be used for the direct measurement of illumination. In his paper on photometry read recently to the Illuminating Engineering Society, Dr. J. W. T. Walsh shows that such a photometer has now been invented, although not yet quite fully developed. There are three classes of photoelectric cells used with this type of photometer: the Elster-Geitel, the selenium and the photovoltaic or rectifier cell. The ideal photoelectric cell would provide a current which was strictly proportional to the illumination at the cell for all values of this illumination, no matter what the colour of the light, its angle of incidence or state of polarisation. In addition, the strength of the current should always be the same for the same illumination. Unfortunately, none of these requirements is satisfied in any of the cells available for practical work. In the case of the gas-filled Elster-Geitel cell and the selenium cell, proportionality between current and illumination can only be assumed over a limited range. With other types it is possible by careful design to obtain a close approximation to the desired linear law. In some types the error does not exceed two per cent. Colour sensitivity presents a difficult problem. No cell responds to the various wavelengths in the visible spectrum in precisely the same way as the human eye does. Colour filters have been used to correct this but they produce a serious loss of sensitivity. Photoelectric methods, therefore, can only be employed in high precision work when the lights to be compared have almost exactly the same spectral composition.

Fatigue-Resisting Properties of Aluminium Alloys at High Temperatures. In a paper read at the March meeting of the Institute of Metals, Mr. J. W. Cuthbertson extended the study of the rapid determination of the fatigue limit by his modification of the load-deflection test to aluminium and its alloys. In comparing the results with those obtained by the normal long-time endurance test, it is shown that the average of the results is $\pm$ 7·5 tons per sq. in. in the latter case against $\pm$ 7·9 with the load-deflection test. The extreme range of values obtained in the two cases was $\pm$ 2·0–10·6 and $\pm$ 2·1–10·7 tons per sq. in. respectively. The agreement is thus quite good. In the author's opinion, if 10 per cent be deducted from the results given by his rapid test, the fatigue limits so found will be well on the safe side and agree satisfactorily with those of the endurance method. The materials examined consisted of commercial aluminium, duralumin, 'Y' alloy and the complex alloy known generally as 'R.R. 56'. At temperatures up to 250° C., the fall in the fatigue limits of the

alloys is not great; duralumin, for example, which has a fatigue limit at room temperatures of ± 9·2 tons per sq. in., having at 220° C. a limit of ± 8·2 tons. Even at 300° C. the reduction is not excessive, but above about that temperature the fall becomes distinctly more rapid. Some most interesting observations are made on the 'creep' of these alloys at high temperatures under alternating stress. Under a constant skin stress of ± 6·5 tons per sq. in., all these alloys show just above 300° C. a marked increase in the rate of 'creep'; this, therefore, represents the maximum temperature to which load-deflection tests can be regarded as reliable.

Measurement of Volatility Range of Lubricating Oils. Messrs. R. N. J. Saal and C. G. Verver have given considerable attention to this matter and brought their results to the notice of the Institution of Petroleum Technologists at its meeting on April 11, 1933. The authors conclude that there are serious objections to an analytical vacuum distillation for these higher boiling-point products in that lubricating oils of various origins show signs of decomposition at about 320° C. and at 375° C. cracking is noticeable. Vacuum distillation methods render the use of direct heating essential, which entails a variable temperature; indirect heating is a condition which the authors claim is a *sine qua non*. The usual type of vacuum distillation is necessarily more or less arbitrary, giving results depending upon the existing degree of dephlegmation. Rigid standardisation is essential if reproducible results are to be obtained. Vacuum distillation also involves complicated apparatus and admittedly requires much attention and manipulative skill. To obviate these difficulties, steam distillation at a constant temperature is proposed and the authors gave a good account of the apparatus, procedure and results obtained by this method. They claim to have eliminated all the above objections to vacuum distillation by regulating conditions of test in such a way that there is substantially complete saturation of the steam with oil vapour and no dephlegmation occurs, and that their process of indirect heating by means of a bath of high specific conductivity is eminently satisfactory. It would seem that, as a result of their work, the measuring of the volatility range of lubricating oils and other high boiling-point petroleum fractions is no longer a purely empirical procedure, but a highly refined method giving concordant and comparable results.

Astronomical Topics

Comets. The periodic comet Giacobini-Zinner was detected by Prof. R. Schorr at Bergedorf on April 23 at $1^h\ 56{\cdot}4^m$ U.T., in R.A. $21^h\ 34^m\ 4^s$, N. Decl. 15° 18′, Mag. 15. Being the third discovery of the year, it is 1933 *c*. The deduced time of perihelion is about July 15·4. The ephemeris in the Handbook of the British Astronomical Association for 1933 will suffice to follow it, if three-quarters of the given corrections for T one day later be applied with reversed signs.

This is the fourth observed apparition of this comet; it was seen in 1900, 1913, and 1926. It is of special interest from the fact that its orbit makes a near approach to that of the earth; a shower of the meteors belonging to its system should be looked for in October next. The earth passes the comet's descending node about 8 p.m. on October 9.

Geddes's comet remains an easy object, and has a tail ½° in length. An ephemeris for the whole year is in the B.A.A. Handbook.

Mr. J. C. Du Pui of Utrecht has published a very careful study of the orbit of comet 1917 III, discovered by Prof. M. Wolf on April 3, 1916, and observed for twenty-two months. The systematic errors of the observers are determined, and the positions and proper motions of the comparison stars deduced from all available sources. The following are the elements:

T 1917 June 16·5694 G.M.T.
ω 120° 37′ 21·4″
Ω 183 17 44·3 } 1917·0
i 25 40 10·8
log *q* 0·226974
Period 193,100 years.

There is clear evidence of departure from a parabola. The aphelion distance is 6,682 units.

Sunspot Areas and Numbers for 1932. A résumé of the solar activity for the year 1932 appears in the February issue of the *Monthly Notices of the Royal Astronomical Society*. The mean daily area of spots (corrected for foreshortening), derived from solar photographs measured at Greenwich, was about 165 millionths of the sun's hemisphere as compared with 275 millionths for the previous year. The number of spots decreased in about the same ratio. Three groups of sunspots exceeded 500 millionths in area, the respective times of central meridian passage being April 25·4, November 16·2, December 13·0. A number of smaller groups, however, showed activity when examined in hydrogen light (Hα). All forms of prominence activity showed a considerable decrease below the 1931 values. It would seem that the solar minimum will be reached very shortly, but as yet no definite signs have appeared of high latitude sunspots which indicate the final phase of the completed 11-year cycle and the commencement of the new.

In *Astronomische Mitteilungen* (No. 130), the Director of the Federal Observatory, Zurich, publishes the relative sunspot numbers for 1932 derived from more than fifty collaborating observers. The mean number, R, for the year is 11·1 as compared with 21·2 for the previous year.

The Variable Star Delta Orionis. It has for some time been known that this star, the top star of the belt, is an eclipsing variable star with a very small light-range. Dr. J. Plassmann (*Astr. Nach.* No. 5931) now discusses the light-changes from 1881 to 1932; he finds evidence of small secular changes in the light-curve. The highest maxima occurred in 1913 and 1914, the lowest minima in 1895 and 1896, the extreme range between these being 2½ of his steps. He does not give the equivalent in magnitude. He notes that recent observations indicate a diminution of the epoch in the published elements by about a tenth of a day, also that the interval from minimum to maximum is about a day, and that three minor waves show themselves on the light-curve, somewhat resembling those found in stars of the Delta-Cephei type. He promises fuller details in a later paper.

Amino-Acids, Proteins and Proteolytic Enzymes*

By PROF. MAX BERGMANN, University of Dresden

I

APPROXIMATELY twenty-five amino-acids are generally recognised at the present time as constituents of proteins. It is usually assumed that the amino-acids are linked together in the protein molecule by condensation of the carboxyl group of one amino-acid with the amino group of the next with elimination of water to form an amide or peptide linkage; of such linkages the protein molecule contains very large numbers.

It has been calculated that the number of known amino-acids is fully sufficient to account, by variations in the order in which they are combined, for the existence not only of the clearly differentiated fundamental types of protein but also of the enormous number of individual proteins which are required by biological and immunological theory.

Such an arithmetical calculation is, however, no longer satisfying; we desire to know more precisely what is the influence of the nature of the component amino-acids and of the order in which the latter are combined upon the properties of the protein as a whole. One might anticipate, for example, that the action of proteolytic enzymes on a given peptide linkage would be determined by the properties and arrangement of the amino-acids of which the peptide is built up; it is impossible, however, to regard the properties of a protein as a simple summation of those of its constituent amino-acids.

The remarkable stability of the amino-acids is usually ascribed to their zwitterionic nature, from which results their capacity to form internal salts; the immediate neighbourhood of oppositely charged ionised groups must indeed exercise a dominating influence on the behaviour of the amino-acids. It is therefore to be expected that we shall modify the properties of the amino-acids, and in particular their chemical behaviour, if we combine the ionisable groups in peptide linkage and thereby alter their mutual electro-chemical effects.

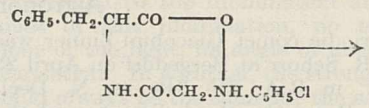
The outstanding problem of modern protein chemistry is thus twofold in nature: What effect does combination in peptide linkage exercise upon the different amino-acids? And how is the nature of the peptide linkage itself influenced by the character of the amino-acids which take part in its formation? Although work on both aspects of this question is still in an elementary stage, a number of facts have already been revealed which are significant both from a chemical and a biochemical point of view.

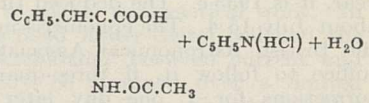
In the first place, I should like to show by a few examples that we can reveal a new series of chemical properties of the amino-acids if we convert the latter, by simple acylation of the amino group, into a condition analogous with that in which they exist in peptides. The simplest case is that of acetylation; if we acetylate the amino group of an optically active amino-acid, we find that contact with a small amount of acetic anhydride at the ordinary temperature is sufficient to catalyse the rapid racemisation of the acetylated amino-acid[1]. The striking ease with which this racemisation occurs must be ascribed to an intermediate enolisation:

$$R.CH(NH.OC.CH_3).COOH \longrightarrow R.C.(NH.OC.CH_3):C(OH)_2$$

In this reaction, therefore, different parts of the same molecule which are not directly connected with one another, namely, the peptide linkage and the α-hydrogen atom, exhibit a definite mutual influence. A similar mutual influence but in the opposite sense is shown by the complete absence of racemisation when chloroacetylated amino-acids are treated with acetic anhydride under the same conditions. Such remote actions of different parts of the molecule upon one another are of special importance in enzymic processes; their investigation in model experiments makes it possible to expose properties of the amino-acids and peptides which would otherwise remain hidden and to draw conclusions therefrom as to the processes which these compounds may undergo in metabolism.

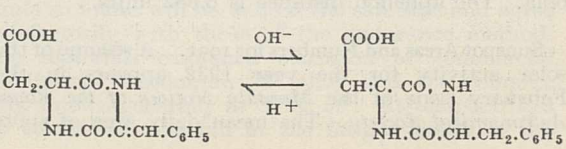
A particularly surprising example is provided by pyridylacetylphenylalanine, which is a dipeptide closely related to glycylphenylalanine; this compound, when treated with acetic anhydride and pyridine at the ordinary temperature, is converted into acetyldehydrophenylalanine with liberation of pyridine and water:





The phenylalanine is thus dehydrogenated and the liberated hydrogen is employed to hydrogenate the pyridylacetic acid to pyridine and acetic acid[2]. Here, therefore, we have in one half of the molecule the first example of the direct transformation of an amino-acid into a fatty acid, accompanied by simultaneous unsaturation of the amino-acid constituting the other half to give a dehydroamino-acid. According to the theory of Wieland, a dehydrogenation of this character would require the activation of the amino-acid and the presence of an acceptor for the liberated hydrogen; the activation of the phenylalanine is brought about by its combination in peptide linkage with transient formation of a cyclic anhydropeptide whilst the pyridylacetic acid residue serves as hydrogen acceptor.

According to the prevailing view, the biological degradation of an amino-acid to a keto-acid begins with a dehydrogenation, and conversely the biological synthesis of an amino-acid from a keto-acid ends with a hydrogenation. It is possible to combine examples of both these processes in a single experiment[3] *in vitro*. The introduction of the dehydrophenylalanyl residue into aspartic acid yields a cyclic anhydride; dissolution of the latter in normal sodium hydroxide causes transference of two hydrogen atoms from the aspartic acid to the dehydrophenylalanine:



* Substance of three lectures on "The Chemistry of Proteins" delivered at University College Hospital Medical School, London, on January 20, 23 and 24, 1933.

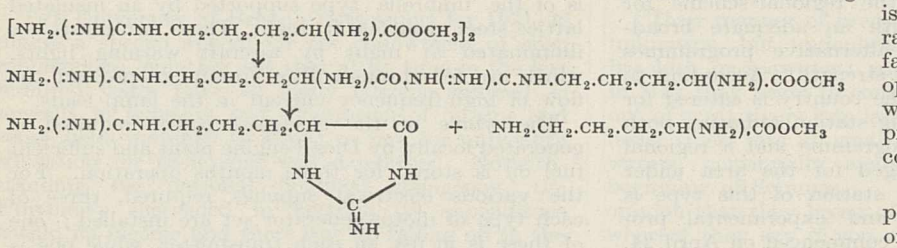
whilst in acid solution the reverse transformation may be accomplished. In the first case, therefore, degradation of the aspartic acid has begun and in doing so has completed the synthesis of phenylalanine from its unsaturated precursor. These experiments show that the hydrogenation: dehydrogenation potentials of the individual amino-acids are different; in metabolism there must indeed exist among the amino-acids a constant competition for hydrogen, the outcome of which will vary with circumstances.

By similar facile reactions it is possible to convert serine with elimination of water and cysteine with elimination of hydrogen sulphide into dehydroalanine and thence into pyruvic acid; serine and cysteine are thus brought into genetic relationship with the simple amino-acids and their nitrogen-free transformation products[4].

Of all the amino-acids, the most widely distributed is arginine, which occupies a special position also by virtue of its guanido group. Arginine can be converted into a peculiarly reactive condition by complete acetylation with simultaneous elimination of water. The triacetylanhydroarginine so formed has a strong tendency, in presence of water and of hydroxy or amino compounds in general, to lose the cyanamide residue, which is itself transferred to the accompanying compound; a mixture of sarcosine with triacetylanhydroarginine, for example, yields creatine together with a derivative of ornithine[5].

The latter result is of interest in relation to two physiological processes: (1) the creatine synthesis *in vitro* shows how creatine-nitrogen can be derived from two different amino-acids; it is probable that in the course of metabolism creatine is formed in a similar manner from two amino-acids of which one is arginine; (2) the conversion of arginine into ornithine by the enzyme arginase demands that the latter be attached to the arginine molecule in such a manner that the arginine is activated and hydrolysed to ornithine even by cold water; this process is imitated by the ease of hydrolysis of triacetylanhydroarginine to acetyl derivatives of ornithine and of urea.

There remains to be discussed yet another noteworthy transformation of arginine which has long caused confusion in the literature; if arginine be esterified with methyl alcohol, the resulting ester passes spontaneously into ornithine methyl ester and *bis*guanidovaleric acid:



This reaction must occur in the metabolism of those shell-fish from which Kutscher, Ackermann and Flössner[6] have isolated arcaine (1:4-diguanidobutane).

The few examples which have been given indicate what an abundance of unsuspected reactions can be elicited from the amino-acids if their zwitterionic character is destroyed by combination in peptide linkage. Almost every amino-acid is affected differently in this respect; conversely, therefore, every amino-acid must have a different influence on the peptide bond.

In order to be able to study this influence on representative material, it is necessary to prepare different peptide combinations artificially and to test the action of enzymes upon them. To carry this task to its logical conclusion would be a formidable undertaking; fortunately, however, it suffices to prepare peptides containing representative members of the most important types of amino-acids.

Chemists have striven for more than thirty years to discover suitable methods for the synthesis of peptides containing the more complex amino-acids, but until recently only isolated successes have been obtained[7]. Quite lately, however, a general method has been developed[8], the essential feature being the nature of the acid residue used to block the amino group.

The acid chloride of benzylcarbonic acid is readily obtained by the interaction of benzyl alcohol and phosgene and can be condensed with any amino-acid to yield the corresponding benzylcarbonato derivative. The benzylcarbonato-amino-acids are beautifully crystalline substances which can be easily transformed into their acid chlorides or azides and these in turn can be condensed with other amino-acids to yield benzylcarbonatopeptides. Most important, however, is the fact that the benzylcarbonato residue can be split off without the employment of a hydrolytic agent, so that it can be eliminated from a benzylcarbonatopeptide without danger of scission of the peptide bond. The removal of the benzylcarbonato residue is accomplished by catalytic hydrogenation in presence of palladium black, under which conditions the benzyl residue is eliminated as toluene and the resulting carboxy-amino derivative loses carbon dioxide spontaneously to give the free peptide. The last step of the process proceeds not only with ease but also in most cases almost quantitatively:

$$C_6H_5.CH_2.O.CO.Cl + NH_2.CHR.COOH \longrightarrow C_6H_5.CH_2.O.CO.NH.CH.R.COOH$$

$$C_6H_5.CH_2.O.CO.NH.CHR.COCl + NH_2.CHR^1.COOH \longrightarrow C_6H_5.CH_2.O.CO.NH.CHR.CO.NH.CH.R^1.COOH$$

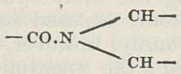
$$C_6H_5.CH.O.CO.NH.CHR.CO.NH.CHR^1.COOH + H_2 \longrightarrow NH_2.CHR.CO.NH.CHR^1.COOH + C_6H_5.CH_3 + CO_2$$

A further advantage of the benzylcarbonato method is that it involves no risk of racemisation; with its aid, in fact, the preparation of many optically active peptides, which have hitherto been practically inaccessible, becomes a trivial matter.

A complete picture of the possibilities of the new method of peptide synthesis cannot be given here, but it is possible to indicate some of the new lines of research which it opens up; in particular it may be of interest to mention certain hitherto unobtainable peptides which have been prepared by the benzylcarbonato method and to describe their behaviour towards enzymes.

As representative peptides we may mention: d-*Glutamyl*-d-*glutamic acid*, a substance with three carboxyl groups and one amino group and therefore strongly acidic in character; d-*Lysyl*-d-*glutamic acid*, the first example of a dipeptide of a diamino-acid

and an amino-dicarboxylic acid; d-*Lysyl*-l-*histidine*, a dipeptide of two strongly basic amino-acids; l-*Asparagyl*-l-*tyrosine* and d-*glutamyl*-l-*tyrosine*, two closely related dipeptides which, however, differ remarkably in their behaviour towards enzymes (see below); l-*Tyrosyl*-l-*tyrosine*, a dipeptide containing two phenolic groups; *Glycyl*-l-*proline* and d-*alanyl*-l-*proline*, which occupy a distinctive position owing to the nature of the peptide linkage :—



For comparison with these proline peptides another dipeptide in which the nitrogen of the peptide linkage is tertiary in character, namely, glycylsarcosine, has been prepared.

In the following table, the behaviour of these dipeptides is shown towards dipeptidase, towards aminopolypeptidase, and towards trypsin (that is, a mixture of proteinase and carboxypolypeptidase):

	Dipeptidase.	Aminopolypeptidase.	Trypsin (Carboxypolypeptidase + proteinase).
d-Glutamyl-*d*-glutamic acid	++	−	−
d-Lysyl-*d*-glutamic acid	+	−	−
d-Lysylglycine	++	−	−
d-Lysyl-*l*-histidine	++	−	−
l-Asparagyl-*l*-tyrosine	−	−	−
d-Glutamyl-*l*-tyrosine	++	−	−
l-Tyrosyl-*l*-tyrosine	++	−	+
d-Tyrosyl-*d*-arginine	−	−	+
Glycyl-*l*-proline	−	++	−
d-Alanyl-*l*-proline	−	++	−
Glycylsarcosine	−	0	−

With glutamylglutamic acid the result is as one would expect; this dipeptide, in spite of its strongly acidic character, is hydrolysed by dipeptidase after suitable buffering.

Lysylglutamic acid on the other hand is attacked only with difficulty by dipeptidase; lysylglycine is readily hydrolysed by this enzyme and the same is true of the strongly basic lysylhistidine. These examples show that the preponderance of acidic or of basic groups does not interfere with dipeptidase action, since the most strongly acidic and most strongly basic dipeptides are both attacked by the enzyme. Surprising differences of behaviour between closely related compounds are exemplified by asparagyl- and glutamyl-tyrosine, of which the first is resistant to all intestinal proteolytic enzymes whilst the second is readily hydrolysed by dipeptidase.

l-Tyrosyl-*l*-tyrosine presents an anomaly inasmuch as it is hydrolysed not only by dipeptidase but also by trypsin, whilst *d*-tyrosyl-*d*-arginine is actually not affected by dipeptidase but is hydrolysed by carboxypolypeptidase.

The behaviour of the proline peptides towards proteolytic enzymes is especially illuminating. Neither glycylproline nor alanylproline is attacked by dipeptidase whilst both are hydrolysed by aminopolypeptidase; here therefore we have two dipeptides for which dipeptidase is not the appropriate enzyme, and it becomes clear that the accepted definitions of dipeptidase and aminopolypeptidase are unsatisfactory. More important still is the conclusion which emerges from the experiments with the proline peptides that 'dipeptidase' can only attack a normal peptide linkage (.CONH.), whilst at least one constituent of 'aminopolypeptidase' can hydrolyse a peptide linkage in which the nitrogen atom is tertiary. This view is confirmed by the fact that glycylsarcosine is also resistant towards dipeptidase.

[1] Bergmann and Zervas, *Biochem. Z.*, **203**, 280; 1928.
[2] Bergmann, Zervas and Lebrecht, *Ber. deutsch. chem. Ges.*, **64**, 2315; 1931.
[3] Bergmann and Ensslin, *Z. physiol. Chem.*, **174**, 76; 1928: Bergmann and Stern, *Liebigs Ann.*, **448**, 20; 1926: Bergmann, Kann and Miekeley, *Liebigs Ann.*, **449**, 137; 1926: Bergmann and Miekeley, *Liebigs Ann.*, **458**, 40; 1927.
[4] Bergmann and Delis, *Liebigs Ann.*, **458**, 76; 1927: Bergmann and Stather, *Z. physiol. Chem.*, **152**, 190; 1926.
[5] Bergmann and Köster, *Z. physiol. Chem.*, **159**, 179; 1926: Bergmann and Zervas, *Z. physiol. Chem.*, **172**, 277; 1927: **173**, 80; 1928.
[6] Zervas and Bergmann, *Ber. deutsch. chem. Ges.*, **61**, 1195; 1928: also *Z. physiol. Chem.*, **201**, 208; 1931: Kutscher, Ackermann, Flössner and Hoppe-Seyler, *Z. physiol. Chem.*, **199**, 273 and 277; 1931.
[7] Bergmann, Stern and Witte, *Liebigs Ann.*, **449**, 277; 1926: Bergmann and Köster, *Z. physiol. Chem.*, **167**, 92; 1927: Bergmann, Zervas and du Vigneaud, *Ber deutsch. chem. Ges.*, **62**, 1905; 1929.
[8] Bergmann and Zervas, *Ber. deutsch. chem. Ges.*, **65**, 1192; 1932: Bergmann, Zervas and Greenstein, *Ber. deutsch. chem. Ges.*, **65**, 1692, 1932: Bergmann, Zervas, Schleich and Leinert, *Z. physiol. Chem.*, **212**, 72; 1932.

West Regional Broadcasting Station in Great Britain

IT will be remembered that a few years ago the British Broadcasting Corporation engineers evolved what is known as the 'regional scheme' for covering Great Britain with an adequate broadcasting service providing alternative programmes of approximately the same strength. According to this scheme, each part of the country is catered for by a twin-wave transmitting station radiating both a national broadcasting programme and a regional programme specially arranged for the area under consideration. The fourth station of this type is now practically complete and experimental programme transmissions were commenced on April 24. The following details of this West Regional Station are taken from an article in *World Radio* of April 21.

The station has been built near the Somerset coast at Washford Cross, two miles from Watchet and six miles east of Minehead. The site was chosen as being suitable for the provision of a good service to the important centres of population in the west of England and to South Wales in addition. The design of the station follows closely the general arrangement of the regional stations, and includes some of the modifications recently introduced at the Scottish Regional Station. Each of the two aerials employed is of the 'umbrella' type supported by an insulated lattice steel mast 500 ft. high. These two masts are illuminated at night by aircraft warning lights, which are fed through filter circuits to prevent the flow of high-frequency current in the lamp leads.

The whole of the electrical power required is generated locally by Diesel engine plant and sufficient fuel oil is stored for three months operation. For the various electrical supplies required, three of each type of motor-generator set are installed; one of these is in use on each transmitter, while one is spare. The national and regional transmitters are similar and of a standardised type of construction comprising five separate units. Modulation is carried out at an early stage following the drive oscillator. Two stages of high-power amplification follow, while the fifth unit contains the tuning and coupling circuits for the final power stage. In each stage it is possible to switch in a spare valve without interrupting the power supply. A studio for testing purposes is fitted up in the station buildings, although the programmes will normally emanate from the

Cardiff studios. Entirely new studio premises at Bristol are now in course of erection.

The regional transmitter radiates on a wave-length of 309·9 metres, while the national programme is on 261·6 metres. The latter wave-length is already in use by the London national transmitter, and equipment is being installed by means of which the two sets may be exactly synchronised. The new service from this station will be introduced gradually in order to give listeners every opportunity of becoming accustomed to it, and of making any necessary modifications to their receivers so that they may take full advantage of the improved service.

University and Educational Intelligence

CAMBRIDGE.—Dr. M. Dixon has been appointed to the University lectureship in biochemistry, established in connexion with the scheme for the employment of the Rockefeller benefaction, and Dr. E. G. Holmes has been appointed to the University lectureship vacated by Dr. Dixon.

A. D. Thackeray, scholar of King's College, has been elected to the Sheepshanks exhibition.

LEEDS.—At the opening ceremony on April 25 of the Algernon Firth Pathological Institute, it was stated that the new building could not be brought fully into use owing to the lack of funds to equip the Museum which is essential to pathological teaching and research. Mr. Charles Ratcliffe Brotherton promptly offered £1,000, which will permit of the equipment of the Museum in a manner appropriate both to the fine architectural character of the room and to the importance of the work.

The West Yorkshire Coal Owners' Association has decided to renew its annual subscription of £1,000 to the Mining Department for a further period of seven years.

An offer by Mr. Bernard Scattergood to present to the University a transit theodolite for the Observatory has been gratefully accepted.

WALES.—The degree of D.Sc. has been awarded to Dr. Alan Edwin Bradfield, for research in the Department of Chemistry, to Miss Emily Dix, for research in the Department of Geology, and to Mr. Frederick Daniel Smith, for research in the Department of Physics.

THE University of Bristol in its report for 1931–32 makes a special appeal for the endowment of open scholarships, pointing out that at no time in the last hundred years have so many citizens suffered so severely in taxation and diminution of income and consequent inability to afford to pay for university education for their sons and daughters. Notwithstanding the national financial stringency, the University succeeded in keeping its expenditure within its income and there was no falling off in the number of its students (day 973, evening 340). Extra-mural work continued to make satisfactory progress. Among new developments mentioned are the growth of confidence of farmers, fruit growers, market gardeners, willow growers and cider and canning industrialists in the value of the University's research and advisory work, the wide utilisation of the recently organised veterinary advisory service and the establishment of a special section to deal with poultry diseases. The Italian Government placed the services of Dr. Benvenuto Cellini at the disposal of the University for the session to encourage the revival of the study of Italian, which has been re-instated as a subject for the Intermediate Examination. Appended to the report is a list of 176 publications by members of the staff, chiefly those of the departments of science, pure and applied. It is announced that the Department of Zoology is to be re-organised and a professor appointed.

Calendar of Nature Topics

Third 'Buchan Cold Spell'. The Ice Saints

May 9–14. The period May 9–14, selected by Dr. A. Buchan as the third of his six annual cold spells, includes the three days of St. Mamertius, St. Pancras and St. Gervais, May 11–13, who are associated with May frosts in the folk-lore of a large part of Europe and are generally known as the 'Ice Saints'. This supposed cold spell has been attributed to a monsoon-like inflow of cold winds from the north, caused by the rapid warming-up of Central Europe in spring, and also to the obstruction of the sun's rays by a swarm of meteors. Another legend associates the cold spell with May 17–19, the latter being St. Dunstan's Day. There are frequently large fluctuations of temperature during May, and it is highly probable that a cold spell will occur some time during the month. During the present century, Buchan's period has frequently been marked by a drop of temperature in London, but from 1871 to 1900 it was generally warm, and on the whole there is no definite bias in favour of low temperatures at this time.

Breeding of Pearl Oysters coincident with Full Moon

Two additions to the records of the association of breeding with the state of the moon, were made by the Great Barrier Reef Expedition of 1928–29. The workers, stationed at Low Reef off the Coast of Queensland, found that the only pearl oyster which grew upon their island, the 'black-lip', had, like the larger 'gold-lip' which furnishes the greatest supply of mother-of-pearl, two breeding periods in the year, at the time of full-moon in May and in November. The second case, that of the madrepore coral *Pocillopora*, was described by Prof. T. A. Stephenson in NATURE of April 29, p. 622.

Eels—an Early Hypothesis

"Their manner of breeding is very uncertaine and unknowne, but undoubtedly they are bred in the brackish or seawater: and at the first full Moone in May they begin to come into all great rivers, and out of great rivers into lesser rivers, and out of those lesser rivers into all small brookes, rils, and running waters, continually against the streame all the beginning of Sommer. . . . I know that some holde opinion that they breed of the May deaw, for proofe whereof they say if you cut up two turfes of grass in a May morning and clap the grassie sides of those turfes together and so lay them in a river, you shall the next day find small young Eeles between the sayd turfes: and so you shall indeede. . . . The reason is, at that time of the yeare that river being full of such young Eeles, they will creepe into every thing that is sweete and pleasant." (John Taverner, 1600.)

Sun-Fish in British Waters

May is the earliest month in which the sun-fish (*Orthagoriscus mola*) has been recorded in British waters, but the number of records rises throughout

the summer to a maximum in September. The sun-fish is an inhabitant of the warmer parts of the open ocean and its appearance in British waters is due partly to a process of drifting in the great Atlantic current which washes our western and north-western shores, for the sun-fish appears to have limited swimming activity (see Calendar, January 7). But from an analysis of many records, Prof. D'Arcy Thompson suggests another factor in the appearance of the sun-fish in northern waters (*Scot. Nat.*, 1918, p. 46). The leptocephalus larvæ of the fresh-water eel have been found, often in multitudes, in its stomach, and are believed to form a substantial part of its food (NATURE, **93**, 166; 1914). These larvæ, after their three-years journey from the western side of the Atlantic Ocean, reach British waters about the month of June, and afterwards pass round the northern coast of Scotland until they reach the eastern coasts in November and December, ready to ascend the rivers in spring. Prof. Thompson points out that there appears to be a close and even precise correspondence between this periodic annual migration of the leptocephali and the appearance of the sun-fish in British home waters. Food, therefore, would seem to be a prime governing factor in the movements of these summer invaders, and the fact that the food is drifting in the oceanic plankton gives a false impression of drift also to the appearances of the sun-fish.

Showers of Frogs and Fishes

In "The Story of San Michele" Dr. Axel Munthe makes Turi, the Lapp, tell of toads that "came from the clouds, when the clouds were low the toads fell down in hundreds on the snow. You could not explain it otherwise for you would find them on the most desolate snow-fields where there was no trace of any living thing" (p. 127). Perhaps Turi was recounting fact, perhaps he was but repeating a tradition derived from that chapter of the "Historia" of Olaus Magnus of Uppsala which in 1555 was written "Concerning the Rain of Fishes, Frogs, Mice, Worms and Stones".

Yet there are many well-authenticated records of the fall of frogs and fishes from the clouds, and the two most recent occurrences happened in the month of May. On May 15, 1900, on the outskirts of Providence, Rhode Island, a heavy downpour of rain brought with it so many living perch and bullpouts, from two to four and a half inches long, that children gathered them by the pailful and sold them; and on May 18, 1928, a rain of fishes, hundreds of them, fell on a farm in North Carolina, three quarters of a mile from the nearest water-course, which did not contain any number of fishes.

From many sources Dr. E. W. Gudger has collected, and in several papers has published the records of about seventy-one accounts of rains of fishes ranging from 300 A.D. to 1928, and from all parts of the earth. A great number of the stories come from the United States (15), but more from Great Britain (17), from the rest of Europe about 16, from Asia 19, Australia 7, South Africa, South America and the South Seas one each.

The explanation of these showers of frogs and fishes is the same in every case. High winds, particularly whirl-winds, pick up water in the form of water-spouts with such aquatic organisms as the water contains and carry them until the velocity of the air and clouds becomes relatively lowered and the organisms, alive or dead, fall to earth.

Societies and Academies

DUBLIN

Royal Irish Academy, Jan. 23. JOSEPH ALGAR, ISABELLA M. MCCARTHY and EVELINE M. DICK: The synthesis of diflavones. When diacetoresorcinol is heated with benzoic anhydride and sodium benzoate and the product is isolated without prior hydrolysis, the substance obtained is 3·3′-dibenzoyl-diflavone I (colourless needles, m.p. 292° C.). Hydrolysis of I with alcoholic potash gives yellow needles of 4·6 dibenzoylaceto-resorcinol II (m.p. 203°–204° C.) and II is converted into diflavone III (m.p. 281° C.) by heating with alcoholic hydrochloric acid. Condensation of diacetoresorcinol with anisic anhydride and sodium anisate appears to give the anisate of 7-hydroxy-6-anisoylaceto-3-anisoyl-4′-methoxy-flavone IV (pale yellow needles, m.p. 233°–235° C.). The hydrolysis of IV gives 4·6 dianisoylaceto-resorcinol V (yellow needles, m.p. 203°–204° C.) and V on heating with alcoholic hydrochloric acid gives 4′·4″-dimethoxy-diflavone VI (colourless needles, m.p. 321°–322° C.). III exhibits a brilliant blue, and VI a green, fluorescence in sulphuric acid solution.

PARIS

Academy of Sciences, March 20 (*C.R.*, **196**, 821–880). The president announced the death of Jules Andrade, *Correspondant* for the Section of Mechanics. L. CAYEUX: The constitution of the Devonian phosphates of Tennessee (United States). The remains of echinoderms are of more importance in the Devonian phosphate rocks of Tennessee than in other sedimentary phosphates, and it is their degree of frequency which gives the fundamental characteristic of the deposit. The importance of coral in this formation has been overestimated. GABRIEL BERTRAND and YÔNOSUKE OKADA: The existence of lead in arable soil. The quantities found were of the order of 0·2 gm. of lead per kgm. of dry soil. PAUL PASCAL and MME. RÉCHID: The preparation of the dimetaphosphates. Full details of the method of preparation of sodium dimetaphosphate, free from polymers. Its distinctive reactions are given. M. GIGNOUX and L. MORET: The external structural units of the Alpine chain between the Pelvoux and Durance. G. PFEIFFER: The expression of a system of functions containing two parameters. V. NIEMYTZKI: Non-linear integral equations. ARNAUD DENJOY: The integration of total differentials and the metric of curves. V. A. KOSTITZIN: The asymptotic solutions of the differential equations of the theory of the growth of organisms. F. E. MYARD: A general theory of all joints transmitting rotations. M. MENDES: A particular case of the problem of n bodies with variable masses. M. PICARD and A. STAMPA: A new form of silver voltameter. A special form of glass cup is used to prevent particles of silver from the anode reaching the cathode. Recent determinations of the E.M.F. of the cadmium cells at the Bureau of Standards give 1·01827 international volts: using the modified silver voltameter described the author deduces the value 1·01830. J. VERHAEGHE: The Faraday effect of a camphor derivative. A repetition of Pfleiderer's experiments on the correlation between the magnetic and natural rotatory dispersions of diphenylmethylenecamphor. The strong anomaly found by Pfleiderer in the neighbourhood of the absorption band was not

found. G. RIBAUD : A solution of the problem of heterochrome photometry of incandescent lamps. A method of measuring in international candles the light-intensity of tungsten lamps without the mediation of a black body or of a filter, by a simple spectrophotometric measurement on a single wave-length. PRIVAULT : Study of the *M* level of magnetised iron. M. VALADARES : The spectrography, by crystal diffraction, of the γ- and X-rays of the thorium family. N. MARINESCO and J. J. TRILLAT : The action of ultra-sounds on photographic plates. Plates and papers sensitised with silver salts are acted upon by ultra-sounds (frequencies 428,000 and 1,435,000 cycles per second). This action is probably due to the ultra-sounds facilitating the oxido-reduction process occurring in the sensitised layer. MME. RÉCHID : The plurality of the metaphosphoric acids. H. BIERRY, B. GOUZON and MLLE. C. MAGNAN : The application of the iodometric method to the estimation of sugar in the blood. Bougault's method is applicable to the estimation of the free sugar in the plasma of blood from the horse. The results suggest that the copper-reducing power is due to an aldehydic sugar only. P. CARRÉ and D. LIBERMANN : The reaction of phosphorus pentachloride on the neutral aryl sulphites. The aryl sulphites react with phosphorus pentachloride giving thionyl chloride, aryl chloride and aryl phosphate : the reaction between alkyl sulphites and phosphorus pentachloride described in an earlier paper is different. JEAN DÉCOMBE : The condensation of the phenols with dimethylamine and formaldehyde. YANG KIEH : The age of the two principal series of granites of the north-west of the French Central Plateau. A. MARIN and P. FALLOT : The constitution of the whole of the limestone chain of the Spanish Rif from Ceuta to Punta Pescadores. G. GRENET : An apparatus for determining the magnetic properties of rocks. An improvement of Chevallier's method leading to increased sensitivity. HENRY HUBERT : The comparison, from the point of view of the climatic characters, of the meteorological stations of the French tropical domain. MLLE. M. FRIANT : The regression of the upper lip in the course of individual ontogeny in the elephant. CHARLES TAGUET : The treatment of tumours and pain by cobra poison.

SYDNEY

Royal Society of New South Wales, Dec. 7. C. A. SUSSMILCH : The association of the Tertiary alkaline rocks of New South Wales with late Tertiary tectonic lines. The akaline rocks of New South Wales lie mainly on two belts, an eastern belt and a western belt. In all cases they are situated right on the margin of, or close to, tectonic scarps produced during the Koscuisko uplift of late Tertiary age. The extinct volcanoes of the Canobolas, Dubbo, Warrunbumble and Nandewar district all lie on the western margin of the main tableland of New South Wales where it breaks away rather suddenly by faulting towards the low lying western plains. The alkaline laccolites of the Rylstone area lie along the line of east-west faulting which marks the northern margin of the Blue Mountain Tableland. The alkaline laccolites and lava cones of the Mittagong district lie on an east-west tectonic line (a monoclinal fold) which forms the southern margin of the Sydney *senkungsfeld*. The alkaline rocks of the Taree district occur along a line of monoclinal folding and faulting which forms the eastern margin of the Comboyne Tableland. The same conditions exist in south-eastern Queensland. All of these volcanic occurrences are older than the faulting but it would appear that the outbursts took place along lines of tension which had already developed before the Koscuisko Epoch of uplift actually took place. This would suggest that the volcanic outbursts, although older, are very little older than the Koscuisko uplift, which would make them of late Tertiary age. W. R. BROWNE : A possible correlation of certain pre-Cambrian granites of Australia and some deductions therefrom. Two periods of plutonic intrusion accompanying orogenic movement may be recognised in the pre-Cambrian of Australia. Those of the first epoch (closing Archæozoic) were essentially gneissic but without distinctive mineral characteristics : the second series (Middle Proterozoic) was of far greater extent and volume, and from their mineralogical peculiarities and associated ore-deposits it is inferred that much of Australia was in Proterozoic time a petrographical and metallogenetic region. The present distribution of these granites is taken to imply the former existence of a very wide extent of Lower Proterozoic strata in Australia, now mostly removed by erosion. A. E. BRADFIELD, A. R. PENFOLD and J. L. SIMONSEN : The essential oil from the wood of *Eremophila Mitchelli*. The tree is commonly known as 'buddah' and is one of the strongest scented woods of the western districts of New South Wales and Queensland. The wood yields from 2–3 per cent of a viscous dark red oil of pleasant odour and containing three crystalline substances of ketonic character. WARNFORD MOPPETT : An examination of the validity of conclusions drawn from experiments in which the allantoic membrane of the chick is exposed to X-radiation. Prepared eggs were exposed to mixed radiation generated by various potentials (90–150 kv.) and selective effects were observed. Equal incident doses were measured with a thermal radiometer. New energy estimate for homogeneous radiation is given and an investigation of dehydration infection, etc., on controls is discussed. J. C. EARL and N. F. HALL : The chemical changes involved in the formation of aminoazo-compounds. (2). Aniline nitrite. Aniline nitrite is present in methanol solutions of equimolecular proportions of aniline hydrochloride and sodium nitrite. Under the influence of acids and heat, chemical changes occur which are made evident by irregularities in the volume–temperature curves of the reaction mixture. Under carefully controlled conditions, aniline nitrite can be isolated in a crystalline state ; it dissolves in water, methanol or ether, and in aqueous solution readily undergoes change into diazoaminobenzene. Methanol solutions of the crystalline material with acids show the typically irregular volume–temperature curves. M. B. WELCH : (1) Experiments on the daily shrinkage and swelling of wood. A series of measurements was made thrice daily over an extended period to determine the daily lateral shrinkage and swelling of six different woods exposed to varying conditions. Short sections 1 in. in length and 4 in. wide were used to obtain the maximum size variation. In inside and outside positions the maximum size variation in any one day in tallowwood, *E. microcorys*, was only 0·002 in. and 0·007 in. respectively and in Baltic *Picea excelsa*, 0·013 in. and 0·043 in., the other woods falling between these extremes. The sizes and moisture contents are correlated. (2) The longitudinal variation of timber during seasoning. Longitudinal measurements were made at regular intervals

during the air seasoning of a number of woods from a green to an air dry condition. The shrinkage ranged from 0·00 to 0·26 per cent. Actually a slight swelling was found to take place in some timbers; other woods showed both shrinkage and swelling. O. U. VONWILLER: Diffraction gratings used with grazing incidence. A discussion on the use of very wide slits in a diffraction grating spectrometer when the angle of incidence is nearly 90° and the angle of diffraction small. Photographs are given of spectra of various orders from sodium flames, weak and intense, using a slit of width 1·1 mm. and collimator focal length 23 cm., illustrating expressions for the intensity, sharpness and resolving power. The effect of dispensing with a collimator is shown and discussed. A simple method, based on this effect, for making the focusing adjustment of a spectrometer, is described. WINIFRED R. MANKIN: Application of optical spectroscopy to analysis of tumor tissue. A method is described of determining qualitatively the presence of metals in a specimen of dried tumor tissue. Besides the metals iron, magnesium, sodium, potassium and calcium which are commonly known to occur in such tissue, there is evidence of the presence of aluminium, chromium, copper, lithium and strontium, manganese and zinc. Quantitative aspects of the problem are being undertaken.

Forthcoming Events

Monday, May 8

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 2.—C. F. White: "Port Work" (succeeding lecture on May 10).

ROYAL GEOGRAPHICAL SOCIETY, at 5.—A. M. Champion: "Soil Erosion in Africa"; G. W. Hobley: "Soil Erosion: A Problem in Human Geography".

UNIVERSITY OF LONDON ANIMAL WELFARE SOCIETY, at 5.30—(at the Institute of Education, Southampton Row, W.C.1).—Dr. R. T. Beatty (Admiralty Research Laboratory, Teddington): "The Sense of Hearing in Animals".

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY, at 6—(at the London School of Economics, Houghton Street, W.C.2).—S. E. W. Taylor: "Morale in Office Work and the Will to Work".

Tuesday, May 9

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. B. Mirkine-Guetzévitch: "The New Tendencies of Modern Constitutions" (succeeding lectures on May 10 and 11).

ILLUMINATING ENGINEERING SOCIETY, at 7—(in the Hall of the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Annual General Meeting. Discussion on "Principles of Directive Street Lighting".

INSTITUTION OF CIVIL ENGINEERS, at 6.—Annual General Meeting.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Dr. L. S. B. Leakey: "New Evidence of the Antiquity of the Kenya Forms of Aurignacian and Mousterian Cultures".

Wednesday, May 10

GEOLOGICAL SOCIETY, at 5.30.—Sir Douglas Mawson: "The Geology and Glaciation of some Islands of the Southern Ocean and the newly discovered Antarctic Mainland."

INSTITUTE OF METALS, at 8—(Annual May Lecture at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Albert M. Portevin: "Quenching and Tempering Phenomena in Alloys".

ROYAL SOCIETY OF ARTS, at 8.—Albert Abbott: "Education for Industry on the Continent and in this Country".

Thursday, May 11

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

Friday, May 12

CHEMICAL SOCIETY, at 4–6 and 8–10—(at the Chemistry Department, University of Leeds).—Discussion on "Substitution in Aromatic Systems". Papers by Prof. R. Robinson, Prof. C. K. Ingold, Prof. G. M. Bennett, Prof. H. M. Dawson, and others.

ROYAL SOCIETY OF ARTS, at 4.30—(Sir George Birdwood Memorial Lecture).—Sir Walter Morley Fletcher: "India and Medical Progress".

ROYAL ASTRONOMICAL SOCIETY—(George Darwin Lecture).—Dr. V. M. Slipher: "Spectrographic Studies of the Planets".

ROYAL INSTITUTION, at 9.—Prof. W. T. Gordon: "Gem Stones".

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 1, No. 7: On the Measurement of Spatial Distance in a Curved Space-Time. By Dr. H. S. Ruse. Pp. 79–88. 1*s*. Vol. 53, Part 2, No. 8: A Case of Non-disjunction in the Fowl. By Prof. F. A. E. Crew. Pp. 89–100+5 plates. 2*s*. 3*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Journal of the Royal Technical College, Glasgow. Vol. 3, Part 1, January. Pp. iv+199. (Glasgow.) 10*s*. 6*d*.

Proceedings of the Royal Society. Series A, Vol. 140, No. A840, April 1. Pp. 240. (London: Harrison and Sons, Ltd.) 12*s*.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 62, July to December 1932. Pp. 193–396+20+plates 15–33. (London: Francis Edwards, Ltd.) 15*s*. net.

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 4, No. 2, September 1932. Compiled by Agnes Elisabeth Glennie. Pp. iv+182. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

OTHER COUNTRIES

Field Museum of Natural History. Anthropological Series, Vol. 22: The Tanala, a Hill Tribe of Madagascar. By Prof. Ralph Linton. (Marshall Field Expedition to Madagascar, 1926.) (Publication 317.) Pp. 334. (Chicago.) 2.25 dollars.

Department of Marine, Canada. Monthly Record of Meteorological Observations in the Dominion of Canada, and in Bermuda and Newfoundland. October 1930. Pp. 53. November 1930. Pp. 53. December 1930. Pp. 53. (Ottawa: F. A. Acland.) 1 dollar per annum.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 5, No. 3, Mars. Pp. 93–138. (Prague: Regia Societas Scientiarum Bohemica.)

The House of the People: an Account of Mexico's New Schools of Action. By Katherine M. Cook. Pp. vi+73+3 plates. (Washington, D.C.: Government Printing Office.) 10 cents.

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 27, 1931, No. 1. Pp. 181+10 plates. (Calcutta.) 8.4 rupees.

Transactions of the Mining and Geological Institute of India. Vol. 27, Part 4, March. Pp. 261–322+x+plates 6–8. 4 rupees. List of Members, 1932–33. Pp. 27. (Calcutta.)

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Edited by K. K. Sen Gupta. Vol. 4, No. 3, December 1932. Pp. 69–118+plates 3–8. (Calcutta: Presidency College.) 6 rupees.

Journal of the Indian Institute of Science. Vol. 15A, Part 9: i. Studies in Enzyme Action, Part 5: Ageing of Amylases in Aqueous Solution, by K. Venkata Giri and V. Subrahmanyan; ii. Studies in Enzyme Action, Part 6: Heat Inactivation of Pancreatic Amylase, by K. Venkata Giri; iii. Studies in the Proteins of Indian Foodstuffs, Part 4: The Proteins of Fenugreek (*Trigonella Fœnum Græcum*), by Y. V. Sreenivasa Rau and M. Sreenivasaya. Pp. 107–124. 1.8 rupees. Vol. 15A, Part 10: Studies in Bridge Formation, Part 1: Attempts to Synthesise Bicyclic Terpene Derivatives by a New Method, by P. P. Patel and P. C. Guha; Part 2: Formation and Stability of a Bridged *Cyclo*hexenone, 1-Dimethylethane-$^{1\cdot2\cdot2}$III$^{1\cdot4\cdot4}$-*cyclo*butane-2-one, by P. S. Mayuranathan and P. C. Guha. Pp. 125–137. 1 rupee. (Bangalore.)

Ministry of Finance, Egypt: Survey of Egypt. Paper No. 42: An Ancient Subterranean Aqueduct West of Matruh. By G. F. Walpole. Pp. 40+10 plates. (Giza: Survey of Egypt.)

Association for the Preservation of Game in the U.P. Annual Report 1931–1932. Pp. 35. (Shahganj, Agra.)

The Rhodesian Museum, Bulawayo. Thirty-first Annual Report, 1932. Pp. 14. (Bulawayo.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 83: Weitere Untersuchungen zum vergleich der Fangfähigkeit verschiedener Modelle von vertikal Fischenden Plankton-Netzen. By Cl. Künne. Pp. 36. 2.00 kr. Vol. 84: Rapport Atlantique 1931 (Travaux du Comité de Plateau Continental Atlantique) (Atlantic Slope Committee). Pp. 103. 4.00 kr. Bulletin hydrographique. Appendice du Volume pour l'année 1931: Expedition Internationale du Cattegat du 10 au 17 août 1931. Pp. 63. 3.50 kr. (Copenhague: Andr. Fred. Høst et fils.)