NATURE

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H. J. BUTCHART,
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NATURE

No. 3450 SATURDAY, DECEMBER 14, 1935 Vol. 136

CONTENTS

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No. 3450 SATURDAY, DECEMBER 14, 1935 Vol. 136

Nazi-Socialism and International Science

EVENTS of the past few years have accustomed us to the knowledge that the position of 'non-Aryan' scientific colleagues in official positions in the German Reich has become intolerable, even in the few cases where they have not been expelled from office. Now a new situation is developing which may be fraught with considerable danger to the continued co-operation of workers in other countries with their German colleagues. This new development carried to the limit can only result in the isolation of German men of science in all matters of international organisation.

The unwelcome move, to which attention has been directed in a recent issue of the *Basler National Zeitung*, is the use that the Nazi authorities intend to make of international congresses for their own purposes. The Reichsminister of Propaganda has created a 'Science Congress Centre' (Wissenschaftliche Kongres-zentrale), one of the objects of which is to use scientific congresses as opportunities to influence public opinion through the medium of the important persons attending. No longer is this to be left to the chance of personal and friendly relations between the foreigners and the Germans present, but, where possible, steps are to be taken to introduce ideas of a Nazi-socialistic stamp into the discussions of matters of world moment.

For meetings held in Germany, the new centre would act as an intermediary between the Government and party officials on one hand, and the president and officers of the congress on the other. The programmes of the meeting and the lists of speakers would be subject to the approval of the centre : thus international conferences held in Germany are to be sifted of undesirable elements by the authorities beforehand and to survive as meetings approved by the Nazi party. For meetings held outside Germany the control must necessarily be much less, but here too it is possible to influence matters by sending German members to a meeting as a delegation under an appointed leader chosen for his reliability as a member of the Nazi party.

The meeting of the Astronomische Gesellschaft held at Berne last summer may be cited as an example of the working of the new machine. The Astronomische Gesellschaft is a long-established body with headquarters in Germany but with strong international affiliations, which have been particularly stressed by the Germans in recent years. One of the valued secretaries of the Astronomische Gesellschaft came up for re-election at the meeting and in the ordinary course of events would have been re-elected without question : on purely scientific grounds there was every reason for his continuance in office. This was, however, against the views of the German delegation, whose members were instructed not to vote for a Jew : alternative names were put forward and it became clear in the course of the meeting that something more vital was at stake than the question as to the holder of a particular office ; in fact, nothing less was at issue than the question whether an organisation of international standing and repute should come under the control of an anti-Semitic clique. When the vote was ultimately taken by secret ballot, it was found that the Nazi element had failed in its attempt, and the threatened secession of non-Germans from the Astronomische Gesellschaft was averted for the time. But the danger of subsequent development remains a source

of anxiety to those concerned in international scientific relations.

It should be added in fairness to the Germans that internal persecution of a minority is not limited to their country, nor even the use of international gatherings to spread nationalist political propaganda. Both these undesirable practices are to be found in more than one country: we have no sympathy for either. But when these tendencies spread and a nationalistic movement tries to secure the control of international scientific work, it is time to call a halt.

Health and Safety in Industry*

THE report of the Chief Inspector of Factories and Workshops for 1934 gives some interesting illustrations of the part which science has still to play in the prevention of industrial accidents and the safeguarding of industrial health. Scientific investigation is, of course, a main factor in the continuous improvement of processes so that operating conditions more and more eliminate dangers to health from noxious fumes or poisonous substances.

It is not, however, the field for further investigation which is here presented or the lack of exact knowledge of the effects of many well-known substances, particularly their cumulative effect, that is most impressive in the present report. Welcome as may be the evidence of the painstaking effort in this field to track down causes and to foresee possible dangers, a good deal remains to be done to secure effective co-operation and co-ordination between different branches of science, as well as between employer and employee.

The further we advance in this field of industrial health, the more important voluntary effort and the less effective legal compulsion become to secure the ends in view. Scientific research must supply the exact knowledge upon which effective action is based. Then comes the problem of securing that effective action is taken, and in this matter the co-operation of the employer and employee is essential. Once more, however, the report provides evidence that only continuous and expert supervision can ensure that co-operation is unbroken either by ignorance, indifference or neglect, whether studied or involuntary.

What is required is not merely the supervision exercised by inspectors of factories, but also the close and continuous oversight which can only be exercised by a scientific personnel in industry. Where in this way expert knowledge and a trained mind can be brought to bear on the design of plant or development of processes from the point of view of the health and safety of those operating them, and still more on any unforeseen emergency which may arise, the risk of untoward injury to health is largely reduced. Where scientific personnel is absent or too heavily charged with other duties to exercise such oversight, the risks are correspondingly greater; the report refers, for example, to a factory in which all the processes entailing the most serious risks, were carried out by a proprietor who had a scientific training and the necessary knowledge and skill to avoid serious injury. So long as this process (the manufacture of hydrogen cyanide) can be kept in the hands of persons with the requisite knowledge it appears that the danger of the process can be controlled; but as a result of increased demand for the acid, the manufacture may possibly fall into the hands of inexperienced persons, with consequent risk.

This reference alone demonstrates sufficiently that it is not only in the manufacture of pharmaceutical preparations intended for the internal treatment of human ailments that properly qualified supervision is required in the public interest. There are many other processes and operations which equally demand the personal control of a properly qualified chemist, engineer, physicist or other scientific worker or technician, and this is a matter which demands the continuous attention of the professional organisations of chemists and others.

Equally impressive, however, is the picture the report supplies of the need for co-operation, and particularly on the medical side. Much of the value of medical supervision is lost because of the lack of knowledge of many general practitioners of the work of the medical inspectorate of factories, of factory legislation and of diseases of industry. The psychological effects of ill-founded sickness certificates "due to employment" are far-reaching

* Annual Report of the Chief Inspector of Factories and Workshops for the Year 1934. (London: H. M. Stationery Office, 1935.) (Cmd. 4931.) 2s.

and as serious to the individual as they are embarrassing to industry and to the scientific investigation of the incidence and causes of industrial disease. Any efforts at educational work such as the inclusion of appropriate lectures in the medical curriculum which facilitates co-operation should be of immense ultimate benefit.

Another direction in which co-operation is called for is between different classes of scientific workers. Notably is this true of the work of the medical officers now to be found in most large works or firms on a part-time or full-time basis. While it is essential that, with the medical man as with the chemist or engineer or other professional worker, his own professional associations and traditions should come first, professional independence should not be allowed to stand in the way of team work. It is only as the medical man takes his place in the industrial team in this field in the same way as the engineer, the chemist, the biologist, physicist or administrator, and knowledge and experience gained from many angles is pooled for the general advantage, that we can hope to secure the maximum elimination of industrial risks.

The possibilities in this field indeed have scarcely been glimpsed, although Dr. L. Teleky has directed attention to the opportunities and need for co-operation in research, and Dr. H. E. Collier in a recent address before the Industrial Welfare Society's Advisory Medical Committee gave an inspiring vision of the place of a university in an industrial hygiene service. Certain of the functions outlined, such as training the personnel of such a service, propagating existing knowledge and establishing or maintaining organic contact with those actually engaged in health work in industry, have scarcely yet been touched.

The training of personnel for industrial health work is closely allied to a matter on which special stress is laid by the Chief Inspector's report. The high incidence of industrial accidents among juvenile workers is not generally realised, and although the accidents themselves are less serious, as indicated by a lower fatality rate, the situation is one which demands every effort to remedy. Certain qualities of youth probably render the young entrant to industry specially susceptible to accidents, and it is as incumbent on us to give him an apprenticeship in safety as in his productive work, and to see that he is adequately forewarned of the dangers inherent in all industrial life. Pre-eminently this is a field in which goodwill and voluntary efforts of employers and of responsible officers are far more valuable than legislation which would be equally difficult to draft and to enforce.

Sir Donald MacAlister

Sir Donald MacAlister of Tarbert
By his Wife. With Chapters by Sir Robert Rait and Sir Norman Walker. Pp. vii+392. (London: Macmillan and Co., Ltd., 1935.) 12*s*. 6*d*. net.

WHEN in January 1934 Sir Donald MacAlister died at Cambridge, there passed from among us one of the most influential men of our time. He had been for forty-four years a member of the General Medical Council, and for twenty-seven its president. He had also been principal and Vice-Chancellor of the University of Glasgow for twenty-two years, and its Chancellor for the last five years of his life. It is a remarkable record, particularly when we remember the numerous and varied official and unofficial public duties fulfilled within the same period of life. Both these official posts were concerned with what is called administration, but in MacAlister's career, the administrative faculty was combined with exceptional, not to say extraordinary, capacities in other directions. Here was a man who began as Senior Wrangler at Cambridge in 1877, and was teacher and tutor in his College, linguist, poet, mathematician, physician, physiologist, pharmacologist, biologist, and even moralist. He could apparently have excelled alike in the medical, administrative, judicial or ecclesiastical spheres—an 'Admirable Crichton', or a model for Angus Sutherland in William Black's yachting novel, "White Wings".

The story which Lady MacAlister tells is full of interest, happiness and inspiration, and most of the many readers who will turn to it, old students of Cambridge and Glasgow and medical men the world over, are likely to find its 390 pages all too short for their desire. Donald MacAlister deserved indeed to become the titular head of

British medicine, for added to his natural gifts he lived a life of immense diligence and devotion to the task in hand. Public service was his native breath, and strenuous toil his daily lot. He was born in Perth in 1853, the son of a publisher's agent and manager, of good Presbyterian stock; he was at school first in Aberdeen and, when ten years of age, in Liverpool, whither his parents had removed. It was at the Liverpool Institute that Sir Henry Roscoe learned the elements of chemistry as MacAlister those of mathematics, but the latter obtained more material reward in the nature of prizes and scholarships, which took him to St. John's College, Cambridge. After winning the senior wranglership he taught mathematics at Harrow, then under Dr. Montagu Butler, afterwards returning to Cambridge and St. Bartholomew's Hospital to study medicine. He took his M.B. in 1881 and his M.D. in 1884, supporting himself, both as student and after qualification, by literary work for the *Journal of Education*, *The Times*, and the *Pall Mall Gazette* in the days of Mr. John Morley. After a few months physiological work under Karl Ludwig at Leipzig, and having been awarded a fellowship of St. John's, he settled down at Cambridge, filling a number of medical posts, including a lectureship and tutorship at St. John's, a medical appointment at Addenbrooke's hospital, and private medical practice. He married a 'Highland cousin' in 1895.

It was during his early days at Cambridge that MacAlister became interested, with several of his fellow students, in the education of adults, becoming a teacher in the Nelson Street Adult School. "From an early age the things of the spirit meant much to Donald"—then, and afterwards, he became a student of the Bible in various languages, a practice which widened his interests and qualified him in exceptional degree for his public reading and exposition in after days at Glasgow. This particular interest was doubtless the mainspring of his social interest in Toynbee Hall, university extension work with Prof. James Stuart, the physical training of youth, his work for the Carnegie Foundation, his devotion to the welfare of university students, the Workers' Educational Association, and the School of Social Study. He was both cosmopolitan and catholic in spirit, and always the friend of well-designed schemes of social reform.

In 1907, MacAlister's intention of writing the biography of Prof. John Couch Adams, the discoverer of the planet Neptune, and for 'going round the world' were frustrated by his appointment, by the Prime Minister, as principal of the University of Glasgow. He accepted this high post with some hesitation, "for seven years and no longer". But he stayed there for twenty-two years. Something of what he accomplished is described in the book by his successor, Sir Robert Rait. Though never physically strong, since an attack of rheumatic fever in childhood, and often suffering pain, he carried through the immense and ever-extending burden of routine administrative work involved in such an onerous appointment. Particularly, of course, his advent strengthened the faculty of medicine, extending the hospital teaching provision, enlarging the professoriate, providing for women medical students, reorganising the curriculum of study, introducing new research facilities and making larger arrangements for the social life and well-being of the students. Not the least of his labours was that of piloting a great and growing university through the years of the Great War. Yet in the ten years after the War, so solid was the reconstruction that no fewer than fifteen new professorships were founded in the University.

It is perilous to compare the values of the achievements of a man's life. Sir Donald MacAlister was for a whole generation one of the outstanding figures in the public and educational life of Great Britain. As principal, and finally as Chancellor, after Lord Rosebery, of a large university sending its alumni all over the Empire, his influence was ever widening and deepening; as president of the General Medical Council for twenty-seven years his wise guidance of the medical profession is not less immeasurable. His consummate learning, his versatility, his extraordinary circumspection, his lucidity and understanding, his wisdom and judgment were placed for this long period at the service of the profession he had chosen. It was accompanied, almost invariably, by patience, courtesy and good humour —"never hurried, never annoyed, never out of temper, never bored, never at a loss". What a temperament and what a testimony such words truly represent!

One of MacAlister's duties, first and last, was to clear up and dissipate misconceptions about the Medical Council. "It is scolded for doing what the law says it *shall* do. It is bitterly reproached for leaving undone what the law gives it neither power nor means to do". Its purpose is not to protect doctors but the public. It is a council of *education*; a board of *registration* of the qualified men; a professional court of justice, the only sentence of which is erasure from such register. From 1889, when he was elected to represent the University of Cambridge, until 1933, when he retired from the representation of Glasgow, MacAlister devoted his mind and his energy to the guidance and service of the Medical Council. He began as the wise reformer of the medical curriculum, which is recommended by the Council

to the teaching and examining bodies; he was one of the principal designers and critics of the "Pharmacopœia" issued by the Council; he reorganised the procedure and finance of the Council; he strengthened mutual 'reciprocity' between medical men throughout the Empire; above all, he laboured for a 'clean' register, by regularising the arrangements for ensuring justice. Every complaint against the conduct of doctors must be properly explored, and proved to the satisfaction of their peers on the Council. There must be nothing arbitrary, accusative or capricious, and the doctor must be fully and fairly heard. All this was carried through, year after year, within the requirements of the Medical Acts, under the supervision of the Privy Council, and before the eyes of the public. The honour and dignity and usefulness of the healing art must always be safeguarded. Little wonder that confidence in the Council has steadily increased in the profession, among the public, and by the courts of justice. Much of this achievement was part of MacAlister's life-work.

Lady MacAlister has given us an admirable record, lucid and business-like as MacAlister himself would have wished, but happily warmed with many homely touches of his humanity and lovable character. The two great positions which he adorned had inevitably a tendency to separate him from his fellows, a differentiation already marked by his great abilities and learning, but to those who knew him personally he was a charming, faithful and affectionate friend. To all men his life was indeed a noble example. G. N.

The Botanist in the Garden

The Living Garden:
or the How and Why of Garden Life. By Dr. E. J. Salisbury. Pp. xi+338+17 plates. (London: G. Bell and Sons, Ltd., 1935.) 10*s*. 6*d*. net.

FIFTY years ago botany, so far as the class-room was concerned, was very much a matter of definitions, just as field botany was concerned almost wholly with the making of a herbarium of local species. The student found himself set to learn a new language—dichasial inflorescences, gynandrophores, campylotropous ovules—as though designed to inculcate the advantages of a classical education. This conception survived pretty well to the end of the nineteenth century. Towards the close of the 'nineties, when examining a school which professed botany, and turning over the notebooks, I found this sentence, evidently taken down by the whole class from dictation, or rather copied from the blackboard, for the spelling would otherwise have offered variants: "Amaryllis—fruit a bilocular loculicidal capsule, a diplotegium". One of my co-examiners breathed his gratitude that he had been introduced to the lady under a happier star and had been learned instead "to sport with Amaryllis in the shade".

As a youngster keen on wild flowers and tasting all sciences that came within reach, I made two attempts to read botany, but each time fell back repelled by the mere cataloguing that was presented for study. It was only on reading Darwin, and in a lesser way Lubbock and Grant Allen, that one discovered a purpose in plant structure; the translation of Sachs appeared in 1875, and with it botany was reborn as the study of the living plant.

Then as time went on and I became more and more engrossed with the wholesale aspects of plant nutrition in agriculture and horticulture, I began to pick up a notion or two about plants of all kinds—wild as well as cultivated. I was always hoping that someone would produce a British 'flora' that would tell me not merely the habitat of a given plant but also whatever was known about its mode of life; how the *Colchicum* remakes its corm every year, how the *Arum* works the flytrap and uses contractile roots to draw its seedlings down to the proper depth. That 'flora' is still to seek, but Prof. Salisbury has produced for the garden the very thing I had dreamt of for the wild. It is a book not only for the young botanist or the gardener who is trying to obtain a scientific foundation for his art, but also for that ever-increasing number of intelligent amateurs who want to have an understanding of their garden and to find a reason for the practices that the professionals inculcate.

Prof. Salisbury begins by telling what the soil does, and then expounds the prime fact that the plant is a machine driven by light, able to move in one direction or another in response to differences of illumination. In his excellent discussion of the natural history of a lawn, he explains how the leaves of the rosette plants—the plantains and dandelions—press downwards because of the more

rapid growth of the illuminated upper surface. Has he ever noticed how these plants will be found sticking upright after the removal of a marquee that had been erected on a lawn for a couple of days? The effects of cold, frost and fog are dealt with at length, though he seems to hesitate a little between the winter killing due to sheer cold and the more usual destruction due to drying out when the soil temperature is too low to allow the roots to function. A mulch of stable manure over the lower part of a tea-rose cannot keep it warm, but prevents a dangerous loss of water.

There are very useful chapters on root development ("The Garden under the Soil"), and on vegetative propagation, which discusses the rooting of cuttings, budding and grafting, with a digression on graft-hybrids and chimæras, where Prof. Salisbury might have extended his illustrations to the relatively frequent cases of chimæras in the variegated hollies, *Euonymus*, and privets of our shrubberies. There is a delightful chapter on the "Spring Emergence"; how the shoot may form a spear that can push through a gravel path or even a layer of asphalt. The chapter on the sources from which our garden plants have been brought might bear expansion, though it would be difficult to know where to stop with so fascinating a subject. Again, the chapter on fertility and inheritance, which begins with an excellent account of the process of fertilisation, might well be extended. So many amateurs want to know a little more about the raising of new varieties, hybridisation and selection. The germination of seeds is well treated, and will introduce to many readers the fact that an initial chilling or freezing may be helpful in inducing 'difficult' seeds to start. The sequence of events during the year, and the daily responses to the rhythm of temperature and light, provide material for another stimulating chapter, and the book concludes with a discussion of the end of the chain—the death of the individual—a remote conclusion with some plants since the Saffron crocus, the actual individual, for the countless corms form but one clone, must be more than four thousand years old.

The book is delightfully illustrated with photographs by the author and with drawings by Mrs. Caroe, which bring out the points at issue as well as any diagram, but yet preserve the aspect of the plant and are enjoyable as drawings. Altogether Prof. Salisbury has produced a notable book; the critical reader may demur to a statement here and there, and have an illustration or two to suggest; let him send them to the author for the benefit of future editions. Finally, let us hope that Prof. Salisbury's book may be the means of leading some of our young botanists out of their laboratories into the garden.

A. D. HALL.

Origin of the Solar System

The Solar System and its Origin

By Henry Norris Russell. Pp. vii+144. (New York: The Macmillan Co., 1935.) 8*s*. 6*d*. net.

THE spectroscopic study of the planets has made great advances in the last ten or fifteen years, and in the present book a distinguished astrophysicist gives a summary of the results and their application to the problem of the origin of the solar system. We now know that Neptune's rotation is direct, though the revolution of its satellite is retrograde, so that the satellite must be approaching the planet, like Phobos. The temperatures of the planets have been measured and found to be in fair agreement with those that would be maintained by solar radiation; the surfaces of the great planets are at liquid air temperatures or less, as was predicted by me in 1922. The compositions of the visible parts of the sun and planets are now known; the great planets have atmospheres consisting mainly of ammonia and methane, and Venus one of carbon dioxide.

Prof. Russell shows that these results are such as would be expected if the planets had been generated at high temperatures from the sun, the lighter ones losing their volatile constituents at an early stage owing to their small gravitation. At this point he overlooks a difficulty about the compositions of the terrestrial planets. The increase of density towards the centre of the earth is too great to be attributed to compression, and demands a large central core of some heavy material, probably iron. But the densities of the moon and Mercury forbid such a core of any appreciable size; Venus resembles the earth, and Mars is intermediate. It is very hard to see how the moon and Mercury can have lost all their iron and retained silicates, and this seems to me to be a great difficulty in every theory of the origin of the solar system yet proposed, not excepting my own. The author devotes a good deal of attention

to the comets, but reaches no definite conclusion as to whether they originated within the system or outside it.

The last third of the book deals with theories of the origin of the planets, and is a very careful and critical treatment. It may be said at once that every theory has to meet a difficulty of the same type: all require some agency to separate the planets from the sun or the parent nebula, and all need to explain how the planets managed to hold themselves together immediately afterwards. Disruption has to be followed by condensation in any case, and while it is fairly easy to make theories to explain either separately, it is very hard to make one cover both. All forms of the nebular theory fail completely here. The tidal and collision theories, while very incompletely worked out, offer some hope, not that the whole of the ejected matter would be condensed, but that enough of it would be retained to make planets of reasonable sizes.

Prof. Russell insists on p. 109 that the resisting medium (formed of the escaped constituents), which the last two theories use to explain the later rounding-up of the planetary orbits, would be collected by the planets. This seems to me definitely wrong. Such a medium would have to be mainly hydrogen, with a density of the order of 10^{-15} gm./cm.^{3}, and a mean free path of some kilometres. He considers seriously the possibility that the free path may be long compared with the diameters of the planets, for which I can see no justification. But his main point is that molecules of the medium would be entangled in the atmosphere and ultimately added to the body of any planet influenced by them. It seems to me, on the other hand, that close to each planet the ordinary theory of gaseous atmospheres must apply. There will be a definite limit to the density attainable, and any addition will be prevented by elastic forces. How great this limit would be depends on the general motion of the medium as disturbed by the planets, which offers a definite though still unsolved problem of hydrodynamics. Permanent addition to the body of the planet requires something to combine with the gas and give a liquid or solid; only oxygen appears to be available for the purpose, and much too little of that; besides, the earth seems to be the only planet that can ever have had an appreciable amount of free oxygen in its atmosphere. It would be expected that the density of the medium near the planets would be greater than elsewhere, but not that this excess would increase indefinitely with the time.

Prof. Russell gives what looks like a serious objection to the tidal and collision theories when he considers the angular momentum that would have to be communicated to the ejected matter. He points out that the angular momentum is closely connected with the perihelion distance; it is strictly connected with the semi-latus rectum, but in elliptic orbits this can range only from one to two times the perihelion distance. Consequently the original perihelion distances of the planets must have been at least half the present ones. But the original supply of angular momentum can be attributed only to friction during the passage of the star and to transverse attraction while the star was within a distance of a few solar diameters, and it is difficult to see how the distance of the matter from the sun at this stage can have been more than a few times the sun's diameter.

If this objection is valid, and I can see no reply at present, we have no satisfactory theory of the origin of the solar system. The objection is in the opposite sense to the one that various writers have made to the nebular hypothesis; the conditions needed to make this hypothesis lead to disruption imply too much angular momentum in the system, while those needed for the tidal and collision theories imply too little. We cannot escape by assuming a greater diameter for the sun at the time, for it is now clear that the sun 2,000 million years ago must have been in very nearly its present state. Incidentally, this point disposes of the nebular hypothesis by itself.

Towards the end of the book, Prof. Russell considers the possibilities that the sun may have been a binary or a nova when the planets were formed, but shows little satisfaction with either.

The book was printed before the publication of the recent theory of Lindblad[1]. There seem to be objections to this theory also, but it contains at least one feature that calls for attention. Previous theories considered the primitive planets and satellites as held together only by gravity. But if the pressure of a gas exceeded the vapour pressure corresponding to the temperature at the surface of a solid, the gas would proceed to condense on the solid, however small the latter might be. Such a mechanism may well account for the formation of meteors in interstellar space, and should be relevant to part of Russell's book. But if the planets were formed in this way it is difficult to see how their orbits failed to be perfectly circular from the start.

It appears that the problem of the origin of the solar system is still unsolved; and perhaps the intermediate stage covered by the resisting medium and tidal friction is the most hopeful for investigation at present. Prof. Russell's book will be indispensable to all interested in our system.

HAROLD JEFFREYS.

[1] NATURE, **135**, 133–135; 1935.

An Introduction to Atomic Physics

By Dr. John Thomson. Pp. ix+228+4 plates. (London: Methuen and Co., Ltd., 1935.) 10*s*. 6*d*. net.

THIS clear and systematic presentation of the fundamental facts and theories of atomic physics consists of three parts, each complete in itself. The first part deals with the experimental basis of the subject; starting with the atomic nature of electricity and the carriers of the atomic charge, the composition of the elements is developed with special reference to the contribution of the mass-spectrograph and Wilson cloud-track methods. The elementary quantum is introduced through Einstein's photo-electric equation and Millikan's verification, after which the work of Planck, and the quantum in X-rays and spectral series are described, concluding with a survey of critical potentials. Part II, on the theory of atomic structure, opens with a detailed survey of the Bohr atom, the deficiencies of which lead to a systematic derivation of the Hamiltonian functions used in general dynamics, as an introduction to a good account of the Schrödinger and de Broglie wave mechanics. This is illustrated by detailed application to the hydrogenic atom and to the theory of radiation. The compression of such a survey of wave mechanics into 40 pages naturally presupposes a good knowledge of mathematics. Part III is devoted to further applications and to molecular, atomic and nuclear radiations. Each part ends with a short summary, and an appendix gives a simple derivation of the leading results of relativity theory as used in atomic physics.

The author's aim is stated to be "to help the reader to gain a clear idea of the essential simplicity of atomic phenomena, and to see in their proper perspective the new principles which modern investigations have brought into being". There can be little doubt that this aim has been very satisfactorily fulfilled so far as the more advanced reader is concerned; in addition, there has been compressed into an easily accessible and digestible form a vast amount of modern experimental and theoretical work.

N. M. B.

Albert Einstein: a Picture of his Life and his Conception of the World.

By David Reichinstein. Pp. 255. (Prague: Stella Publishing House, Ltd.; London: Edward Goldston, Ltd., 1934.) 12*s*. net.

As an intimate friend of Einstein, the author of this work is in a position to reveal some interesting details of Einstein's life and mental outlook. The great scientific work of the founder of general relativity is thus placed in its proper setting as an aspect of the remarkable development of its author. The liberal spirit of Prof. Einstein is stressed; and in giving an account of his clashes with Prussianism and Nazism, Prof. Reichinstein shows much feeling for the persecutions to which Einstein has been subjected by his fellow-countrymen. There is little doubt that this book is a valuable source of information for any future biography of Einstein. T. G.

Potlatch and Totem: and the Recollections of an Indian Agent

By W. M. Halliday. Pp. xvi+240+24 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1935.) 15*s*. net.

MR. HALLIDAY has a personal experience of the Indians of British Columbia which goes back to 1873. He has been in personal contact with them for thirty-eight years, of which twenty-six were spent in charge of the Canadian Government Indian Agency of the Kwawkewlth (Kwakiutl), of Vancouver. His reminiscences of Indian custom fall into two parts. In the first, he describes an imaginary potlatch ceremony, that remarkable custom by which position and prestige was made to depend upon the lavishness with which gifts were distributed by the head of a clan at a feast; and in the second he records such of his experiences among, and impressions of the Indians, while acting as a Government official, as will serve to throw light on Indian character and mentality as expressed in religious belief, attitude to law and authority, and achievement under the white man's system of education. Mr. Halliday's views on racial origins are not to be taken seriously.

The author's outlook is that of a sympathetic official, whose duties and views of Indian character and custom coincide. Thus the potlatch, now forbidden by law, is regarded as detrimental to the interests of the Indian, because, involving a return with interest, often so high as two hundred per cent, it reduced the individual and his immediate group to penury, and was an increasing burden on the community. His account of the institution, however, is sufficiently objective to make it obvious that the potlach was the integrating factor in the community, and its abolition the death knell of Indian tribal society. The Indians themselves, or at least the younger men, being shrewd and progressive, welcomed a change which set them free from tribal obligations. The tribal disintegration which has followed is a typical example of the results of the application of White philanthropic and moral ideas to the administration of the affairs of a non-European culture. That the results in this instance have not been universally unfortunate is to be attributed to a sympathetic administration, as well as to the abilities and character of the Indians themselves, though the author is inclined to assign their achievement to the infusion of white blood.

Law and the Social Sciences

By Huntington Cairns. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xiv+279. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1935.) 12*s*. 6*d*. net.

WHAT comes out clearly in Mr. Cairns's study of the relations of jurisprudence to anthropology, psychology, political theory, economics and sociology is that law, regarded more especially as the judicial process, has become increasingly sociologically minded, and that if it is to achieve full power in ordering human society, "it must join with the other

social sciences in a united effort to solve the problems common to all". These are not novel conclusions, and yet the task the author set himself was well worth doing. For it is often forgotten that only as late as the sixteenth century did jurisprudence escape from theology, philosophy and ethics, and became a separate discipline. This emancipation was undoubtedly necessary at the time. But once achieved, it became even more necessary, with the growing complexity and interconnectedness of society, to bring law back into the totality of social life. Society is one, and each of the social sciences, including law, studies and attempts to manipulate but one aspect of it. They cannot therefore remain isolated from each other if they are to be useful instruments for theoretical understanding and practical manipulation.

Every topic here touched upon would require a separate volume for full treatment, and it says much for the author's wide reading and large equipment that he has been able to concentrate so much in such a narrow compass. At the same time, a certain discursiveness and lack of criticalness (see, for example, the discussion on intelligence tests and criminal responsibility) are evident, and no doubt the author would be the last person to claim that he has exhausted the field. The book is a pioneer work, and from that angle deserves close study.

J. R.

The Dorset Coast: a Geological Guide

By G. M. Davies. Pp. vii+126+8 plates. (London: Thomas Murby and Co., n.d.) 6*s*. net.

PRACTICALLY the whole of the Dorset rock consists of formations of Mesozoic age, and it has, moreover, a wonderfully extensive and various catalogue of fossils. Whereas one may traverse the greater part of Cornwall without finding fossils at all, here in Dorset one cannot go into any little bay or cove without finding an abundant and extensive fauna. Few portions of our Jurassic rocks can be studied in such detail and admirable sequence as the Dorset coast line, which forms a very distinct opposite to the neighbouring coast of Devon.

The numbers of photographs in this book, and the meticulous care with which these have been chosen, and the care with which various details have been picked out, all add immensely to the value of the book.

We regret that so little has been said about the Chesil Bank, which still remains a problem. The Palæozoic pebbles are by no means so few as Mr. Davies suggests, and their persistent appearance has yet to be explained. For even supposing these erratics to have travelled all the way from their home in the St. Just cliffs, just around the Land's End, it still remains a problem as to why they should be piled up here, and yet why the beaches of Cornwall and South Devon contain so few.

We heartily congratulate Mr. Davies on having produced a book the clearness and simplicity of which make it a pleasure to read. Not only the tyro in geology but also many a professional geologist will take this with him when he travels the Dorset coast.

F. J. STEPHENS.

A World Production Order

By Dr. F. M. Wibaut. Translated from the Dutch by R. W. Roame. Pp. 240. (London: George Allen and Unwin, Ltd., 1935.) 6*s*. net.

THERE is much in this unpretentious book to commend it to the attention of the scientific reader. Its indictment of our present system of production and distribution as obsolete and inadequate, leading to a chronic condition of chaos in which unemployment on a large scale is endemic, is characterised by common sense and moderation. No less noteworthy for the complete absence of denunciation and class hatred or bitterness is its condemnation of the private monopolies which are the inevitable result of the present system and which control, in their own interest only, prices of the necessities of life. Its resolute attempt at fundamental thinking on the situation and to secure the economic conditions which will enable the scientific and technical triumphs of mankind to benefit the whole race has a sure claim on the sympathy of scientific opinion, and this claim is reinforced by the many years of administrative experience in Amsterdam from which Dr. Wibaut is able to speak.

Dr. Wibaut sketches for his readers no Utopia, nor does he make the mistake at this stage of outlining ways and means too closely. He defines with some certainty a fundamental change in the world's organisation and the improvements required to effect that change. He indicates too that in the League of Nations and the International Labour Organisation there already exist the germ of international and national councils and institutes required for building up ordered production on the basis of democracy. He is most concerned, however, to provoke thought, above all creative thought, through which alone can be worked out the details of a new production system based on the collective satisfaction of human needs.

The Geographic Pattern of Mankind

By John E. Pomfret. Pp. xv+428+22 plates. (New York and London: D. Appleton-Century Co., Inc., 1935.) 15*s*. net.

DR. POMFRET views his 'geographic pattern' as an essential background for the comprehension of economics, politics, history and the other social sciences; and in surveying the modern world as composed of areas each exhibiting a preponderant type of climate or physiographic influence, he consistently maintains this point of view. His aim is to show in detail how this main factor has determined the social organisation, utilisation of resources, character of industries and type of occupation, incidentally bringing out with no little point and emphasis the differences in character and achievement of regional forms of culture which have developed under these varying influences. The differentiation, social and psychological, of China and Japan, or the characterisation of South America, with particular reference to its economic and political development, may perhaps be regarded as particularly successful examples of his understanding of the interplay of the forces involved.

The Deep-Water Circulation of the Indian Ocean

By A. J. Clowes and G. E. R. Deacon

UNTIL very recently, it has been generally assumed that the deep-water circulation in the Indian Ocean was very similar to that of the Atlantic ; in certain features, such as the Antarctic bottom current and the Antarctic intermediate current, the close resemblance between the two oceans is still undisputed. It has, however, been suggested that the north Atlantic deep current—the highly saline deep current which Merz and Wüst (1922, p. 23) showed to flow southwards between the intermediate and bottom currents in the Atlantic Ocean—has no parallel in the southern part of the Indian Ocean.

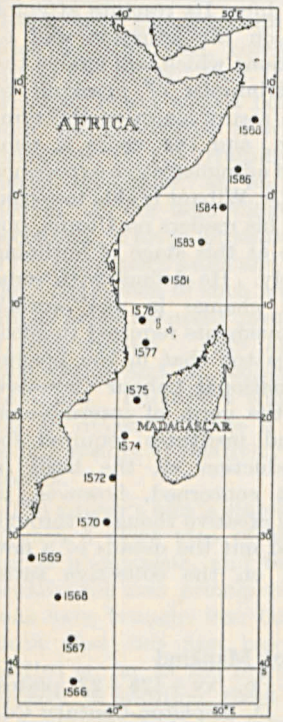

FIG. 1. Chart showing positions of hydrological stations made by the R.R.S. *Discovery II* in April 1935.

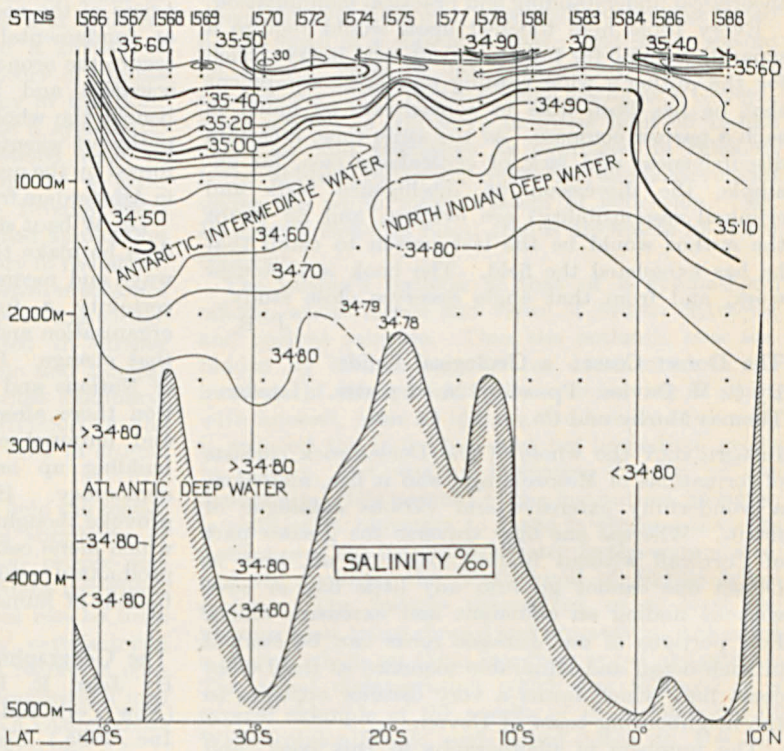

FIG. 2. Salinity at the stations shown in Fig. 1.

The existence of a southward deep current of highly saline water in the northern part of the Indian Ocean was demonstrated very clearly by Schott (1926), Matthews (1927) and Möller (1929), and it was found to be composed of highly saline surface water sinking from the coastal regions of the Arabian Sea and the neighbouring gulfs, particularly from the Red Sea. The observations made by the *Challenger*, *Valdivia*, *Planet* and *Gauss* also showed that there was a highly saline warm deep layer in the Antarctic and sub-Antarctic regions ; and since the data from the intervening part of the ocean were very scanty, it was reasonable to suppose that the warm deep layer found in the south was a continuation of the deep current which spreads southwards from the north. It was therefore assumed by L. Möller (1929, p. 37) that the north Indian deep current filled the deep layer in the western part of the Ocean with water of salinity more than 34·80 per mille almost as far as the Atlantic-Indian cross ridge in about 50° S.

Thomsen (1933) has, however, used the observations made by the *Dana* (1932), and the *Willebrord Snellius* (1932) in the southern tropical and subtropical parts of the ocean to show that the assumption that the highly saline deep layer in the south was a continuation of the deep current in the north was, after all, not justified. He found that the north Indian Ocean deep current did not carry water with a salinity greater than 34·80 per mille south of a line from the northern end of

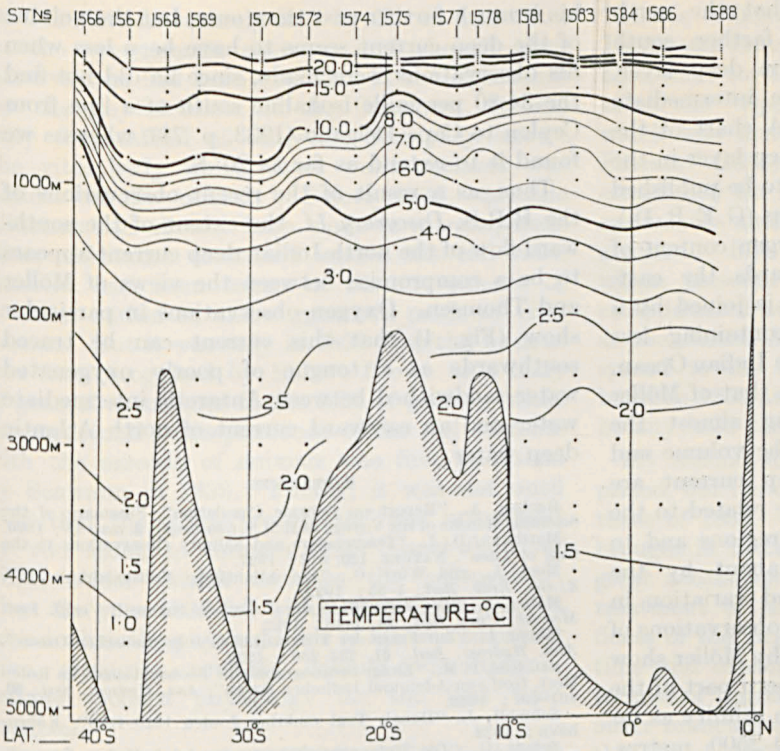

FIG. 3. Temperatures at the stations shown in Fig. 1.

Madagascar to Ceylon. L. Möller (1933) was not convinced that the new data which Thomsen used justified at present a reversal of her former conclusions. In a later paper, Thomsen (1935, p. 299) states that at stations on a line between Ceylon and Cape Delgado he found no traces of a deep current between 2000 m. and 3000 m., but that it is possible that a rudimentary, southerly-directed current exists with a nucleus at about 800 m. in the north and about 1200 m. in the south.

Further light has been thrown upon the problem by a series of observations made by the R.R.S. *Discovery II* in her recent voyage from the Antarctic in 1935 on a line from Marion Island through the Mozambique Channel to the Gulf of Aden. The positions of the stations and preliminary salinity, temperature and oxygen content sections are shown in Figs. 1–4. The north Indian deep water is clearly distinguished at the northern end of the sections by its high temperature and high salinity, and low oxygen content. The salinity section (Fig. 2) shows that it has a salinity of 34·80 per mille as far as 20° S. approximately. South of this latitude there is a second body of highly saline water with a salinity of more than 34·80 per mille, but it is clear from the salinity, temperature and oxygen content that this second body of highly saline water is not merely a continuation of the north Indian deep current. It is approximately 2° C. colder and 2 c.c. per litre richer in oxygen, and is therefore derived partly from another source, plainly from an eastward current of Atlantic deep water. The existence of such a current is in fact generally agreed upon. It was inferred by Merz and Wüst (1922, p. 23) from the temperature chart for 1500 fathoms given by Buchan (1895) in the *Challenger* reports, and also recognised by Wüst (1926, p. 250) and Möller (1929, p. 37).

Although there is this body of Atlantic deep-water in the southern part of the sections, our observations suggest that the north Indian deep current does not come to a sudden termination in 20° S. The oxygen

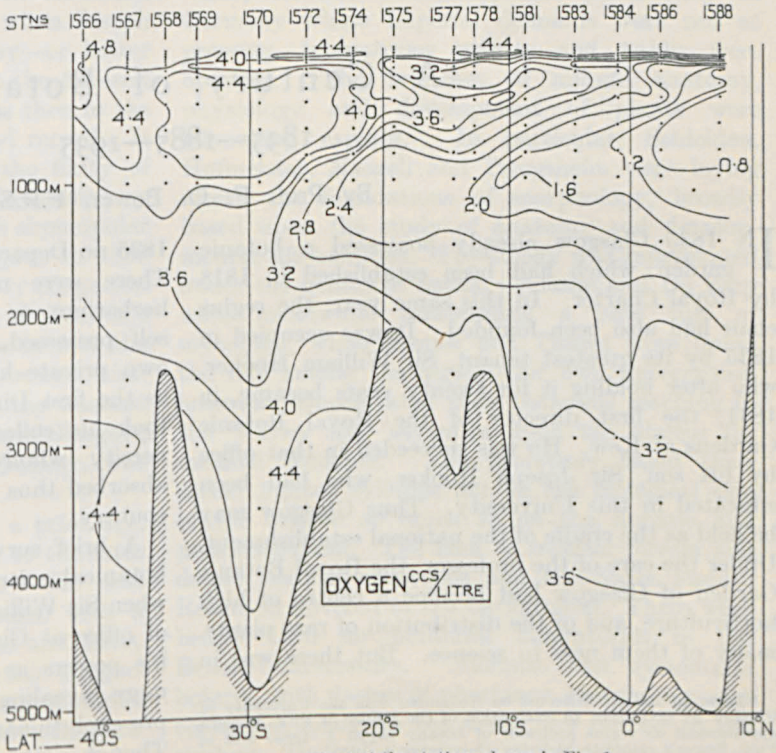

FIG. 4. Oxygen content at the stations shown in Fig. 1.

distribution, especially, suggests that the north Indian deep water flows much farther south in the upper stratum of the warm deep layer, sandwiched between the Antarctic intermediate current and the Atlantic water. A chart of the oxygen distribution in the warm deep layer in the southern part of the Indian ocean, to be published in a forthcoming report by one of us (G.E.R.D.), shows that south of Africa the oxygen content of the deep layer falls rapidly towards the east, indicating that the Atlantic water is joined by a southward movement of water containing less oxygen from the northern part of the Indian Ocean.

A comparison of our section with that of Möller (her Mozambique section is along almost the same line as ours) suggests that the volume and salinity of the north Indian deep current are subject to large variation, probably related to the changes of salinity in the coastal regions and to the current differences brought about by the changes of the monsoon winds and variation in the south Equatorial current. The observations of the *Valdivia* and the *Ormonde* used by Möller show that the deep current fills the northern part of the Ocean with water of 35·00 per mille salinity as far as 8° S. and to a depth of 2000–2500 metres, while our section (Fig. 2) shows that this isohaline is not found south of the equator or deeper than 1500 metres. A strict comparison cannot be made between Thomsen's and our section, since his is much farther east than ours, but the volume of the deep current seems to have been less when his observations were made, since he did not find the 34·80 per mille isohaline south of a line from Ceylon to Cape Delgado (1933, p. 78), whereas we found it to extend as far as 20° S.

Thus, as a result of the recent observations of the R.R.S. *Discovery II*, the extent of the southward flow of the north Indian deep current appears to be a compromise between the views of Möller and Thomsen. Oxygen observations in particular show (Fig. 4) that this current can be traced southwards as a tongue of poorly oxygenated water sandwiched between Antarctic intermediate water and an eastward current of north Atlantic deep water.

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A Century of Botany*

1835—1885—1935

By Prof. F. O. Bower, F.R.S.

IN 1835 Glasgow already possessed a botanic garden, which had been established in 1818 by Royal Charter. In this same year, the regius chair had also been founded. It was occupied in 1835 by its greatest tenant, Sir William Hooker, who after holding it for twenty years became, in 1841, the first director of the Royal Botanic Gardens at Kew. He was succeeded in that office by his son, Sir Joseph Hooker, who had been educated in this University. Thus Glasgow may be held as the cradle of the national establishment. Under the care of the professor, the Royal Botanic Garden of Glasgow had become a centre of high horticulture, and of the distribution of rare plants, many of them new to science. But there was in 1835 no Department of Botany in the old College. There were no laboratory, botanical museum, herbarium, or library, beyond what Hooker himself possessed, which was accommodated in his own private house. So when he was appointed as the first Director of Kew in 1841 he naturally took his collections with him, leaving the University wholly denuded; though Kew itself absorbed thus the finest private collections in the country.

A brief survey may be made of the state of botanical science in the world at large in 1835, when Sir William Hooker was in his fifteenth year of office at Glasgow, and in the full plenitude of his powers as a man of fifty. Nothing can be more revealing of the time than that while it was pre-evolutionary, it was also pre-protoplasmic. Though plant anatomy was well advanced, with

* From an address delivered on November 8 in the University of Glasgow by invitation, in celebration of the jubilee of Prof. Bower's appointment as regius professor of botany (April 1, 1885) and of Prof. Bower's eightieth birthday (November 4, 1935).

its foundations securely laid by Hooke and Grew in the seventeenth century, and though their observations had been extended in the eighteenth by the phytotomists of the Continent, it was only the scaffold of cell-walls that they knew: the vital body which those walls enclosed was almost wholly missed. Before 1835, sporadic allusions had already been made to a transparent slimy substance contained within the cell-walls. Interest had been taken in the movements of granules within it, and suggestions made of vital motion. But it was only in 1831 that the nucleus was first recognised by Robert Brown as a body of general occurrence in the cells of plants: while the structural correspondence of the cell contents with the sarcode of animals was first published by Schwann in 1839. Finally, it was not until 1846 that the word 'protoplasm' was introduced by von Mohl, to connote that "viscid fluid—of white colour—which occupies the cell-cavity". Thus the year 1835 fell within that short nascent period when the physical basis of life was emerging from obscurity towards definite visualisation, making modern physiology for the first time possible.

On the other hand, 1835 fell within the heroic age of scientific exploration: and Glasgow, through Sir William Hooker's son Joseph, took her full share. We may well hold the years from 1831 when the *Beagle* sailed with Darwin on board, or 1839 when Ross, with Joseph Hooker as a young medical officer, penetrated the Antarctic with the *Erebus and Terror*, to 1851 when Joseph Hooker completed his Indian journey—or better still 1852 when Wallace returned from the Amazon—as its golden period. Discovery was then in the air, with its handmaids collection and record. It opened with a tacit acceptance of the fixity of species, but it bore within the germ of evolutionary theory. Sir Joseph, in working out his circumpolar collections into the Antarctic flora, gave in 1859 expression to his belief in the mutability of species. This was the year of publication of Darwin's "Origin of Species". Sir Joseph was in fact the first of the great group who stood round him. Thus not only did 1835 fall within the nascent period of evolution, but also an alumnus of Glasgow, son of the some-time professor of botany, was himself deeply involved.

Sir William, however, belonged to a prior age. He never publicly committed himself to the later view of the mutability of species. He was essentially an old-fashioned systematist, with a particular leaning towards the mosses and ferns. He had already published his "British Jungermanniaceæ" in 1816, as well as important memoirs on mosses. But it was during the period in Glasgow that he produced with Greville the sumptuous "Icones Filicum" (1851), and with the artist Ferdinand Bauer the preparatory work was being done there for the "Genera Filicum" (1842). Later came the "Species Filicum" (1846–64), a work which was finally condensed into the "Synopsis Filicum" (1865). These and other of his writings established Sir William's position as the leading systematic authority of his time on the Archegoniatæ. But he was also a general botanist, whose personal influence moulded the scientific establishment at Kew. Robert Brown still reigned at the British Museum. The effect of their work spread to the universities, with the result that between 1835 and 1885 descriptive and systematic botany held the field in Britain.

My second date, 1885, also marks a nascent period, but the conditions were very different from those of 1835. The intervening half century had brought in Britain, as the result of foreign travel, great accessions to its herbaria. The systematic treatment of these, particularly as published in floras of the British possessions, had occupied the time and capacities of our professional botanists to such a degree as almost to paralyse efforts in other branches of the science. Not only Kew and the British Museum, but the universities as well, were drawn into the floristic vortex. In Glasgow itself a notable result was the "Flora Indiae Orientalis", in which Prof. Walker Arnott described the rich Indian collections made by Wight. It was published in their joint names. But, meanwhile, on the Continent, and particularly in Germany where imperial demands were not so pressing, laboratories private and public were opening. The branches of minute anatomy, physiology and development of plants were advancing rapidly. In particular, Schleiden, Hofmeister, Naegeli and Pringsheim were laying afresh the foundations of morphology, broadly based upon the study of anatomy and developmental life-histories. Physiology was rejuvenated under the genius of Sachs. Tulasne and De Bary were meanwhile establishing a new cult of mycology, while Bornet and Thuret were doing the like among the algæ. Our own universities, however, concentrated their botanical teaching in the 'sixties and 'seventies upon the classes for medical students. The professors based their rather limited syllabus not on the biological side of the science so much as on the floristic and pharmaceutical. The idea of tropical forests and desert islands, of Crusoe and the Swiss Family Robinson hovered in the background. There were before 1870 no botanical laboratories in the British universities. Floristic and systematic botany, with dashes of pharmacy, morphology and economics made up the usual fare offered to the student. The individual professor might take what

special branch of study he pleased : but this rarely filtered through, as a private act of grace, to the individual pupil. In point of fact, Britain had fallen behind in all branches excepting systematic botany, in which she excelled.

The revival of biology, and of its branches of zoology and botany, was initiated in Britain by Huxley, Michael Foster and Thiselton-Dyer : but an important preliminary step was taken by Dean Farrar, himself at the time a public-school master. He advocated the teaching of science in schools, at the British Association meeting at Nottingham in 1866, with Huxley in the chair. Little result followed at first in the old public schools or in the universities. It was, in fact, through the national schools that the revival began. If science was to be taught there, the teachers must themselves be taught first. This led to the classes for teachers at South Kensington, organised under Huxley from 1871 onwards. The essential feature of his method was a daily preparatory lecture, followed by personal observation by each student. Thiselton-Dyer undertook the botanical side and Vines, originally a medical student in London, assisted him : by his election as a scholar of Christ's College, Vines formed the connecting link with Cambridge. Marshall Ward soon stood out among the early pupils at South Kensington, and later he also was entered as a scholar of Christ's. He and I, as fellow students at Cambridge under Vines, soon found places on the demonstrating staff to the summer classes at South Kensington.

This revival in the 'seventies spread with varying success to the English universities : but Huxley's methods caught on less readily in Scotland. The northern lag was, however, made up in Glasgow by the appointment of Bayley Balfour, fresh from foreign travel and visits to German laboratories, as professor of botany there in 1879. When I succeeded him in 1885, also having experience of foreign universities, and after three years' experience as lecturer at South Kensington, elementary practical classes of Huxley's type were already in being in London and elsewhere for the study of the 'New Botany' : my duty was to develop them in Glasgow.

All this sounds very easy now : but the revival that spread from South Kensington found opposition like any other missionary effort. "The Cause", as Marshall Ward used to call it, involved a change over from the dead to the living plant : from the herbarium, supported by study in the garden and field, to observation at the laboratory table by each student himself. Structure, function, development and life-history were to be examined, and that not only in flowering plants, but in the cryptogams as well.

In 1885 there were in the Scottish universities no faculties or degrees in science : nor were there any advanced classes under ordinance. In Glasgow, botany was studied officially only in the summer. Not only was the time then devoted to botany in Glasgow limited, but also the space available for its study. The Department in 1885 consisted of two small rooms used as voluntary laboratories, and dusty attics for the herbarium. There was no lecture room, but such as could be borrowed from another department. I paid my own assistant and laboratory attendant. There was no official staff, not indeed any department at all in the modern sense. In theory this was corrected under the Act of 1889 : nevertheless, for sixteen years after my appointment the accommodation remained the same. It was not until 1901 that the new building was opened.

Great as were these official and material defects in Glasgow in 1885, that date again fell within a nascent period in the history of botany in Britain. The first English edition of Sachs's "Textbook" had been published in 1875 : the translation of De Bary's "Anatomy" followed in 1884, and that of Sachs's "Lectures on Physiology" in 1887. Thus the student of the British revival was supplied with fresh textbooks. His observational work was also vivified by the experience of teachers who had studied personally under these great men. Beyond this, many new starts were already in the air. Tangl had demonstrated in 1880 the continuity of protoplasm from cell to cell, and Gardiner extended these results so that Sachs found himself able in 1882 to state that "every plant, however highly organised, is fundamentally a protoplasmic body forming a connected whole".

On the other hand, in 1874, Schwendener had given a new aspect to anatomy by demonstrating the mechanical principles that underlie structure : while Haberlandt further stimulated the functional study of tissues by his "Physiologische Pflanzenanatomie" of 1884. At the same time, from the Buitenzorg garden, Treub was revealing the wonders of Lycopod embryology, with their bearing upon the morphology of the Archegoniatæ. At Bonn, Strasburger had already laid the foundation for cytology by his inquiry into the minute details of nuclear division. The third edition of his "Zellbildung und Zelltheilung" had appeared in 1880, while statistical hybridisation, the experimental correlative of nuclear division, had already been initiated by Mendel in 1865, though the world did not know of his results until 1900. Finally, it was in 1885 that Weismann's pronouncement on germplasm was published. Thus at our second period many new lines of advance were being opened up.

Such was the developmental phase of the science of botany when I accepted the Glasgow chair in 1885. Botany was no longer a valley of dry bones: a progressive and living aspect had been given to it. But at Kew and the British Museum great systematists still upheld the old classificatory traditions: and there appeared to be some danger of British botanists separating into two camps—as systematists or as physiologists. On the Continent, however, an ameliorating influence sprang from the work of Warming, who combined under the name of ecology the records of function and of distribution: thus presenting to systematists a living aspect of their study. Here at home Sir Joseph Hooker was the Colossus who had a foot down in both camps. It was, in fact, a forecast of ecology that he had practised in the Antarctic. But he was never a teacher, nor did Kew compete with the colleges, which had drifted off with a dangerous and almost exclusive bias towards the 'New Botany'.

(*To be continued.*)

Progress of Food Investigation

AS in previous years, the report of the Food Investigation Board for 1934* describes the researches carried out at the various research stations of the Board by the members of the food investigation staff and emphasises the ways in which laboratory results have been applied commercially. Sir Frank Smith was appointed chairman of the Board, in succession to Sir Joseph Broodbank, who resigned; Mr. E. Barnard was appointed director of food investigation and Dr. Franklin Kidd superintendent of the Low Temperature Research Station, in succession to the late Sir William Hardy. That the work of the Board is of value to all parts of the Empire has been signally recognised by the contributions made by Dominion Governments, which amount to nearly £10,000 a year, and show the wide extent to which Imperial co-operation in this field of research has already grown.

The discovery that beef can be stored in the chilled state for 60–70 days when the atmosphere contains 10 per cent of carbon dioxide has quickly led to the importation of considerable amounts of chilled beef from Australia and New Zealand; during 1934, no less than 4,400 tons were imported in gas storage from these two Dominions, and it is now practicable to secure the necessary gas-tightness in the holds. At the same time, the careful preparation of the meat and the hygiene of the slaughterhouse floor are probably of even more importance than control over the conditions of transport.

A number of problems, however, remain for solution, including the correct storage to prevent chafing, and the proper conditions as regards cooling, humidity and air circulation for the preservation to the fullest extent of the natural appearance or bloom of the meat. Loss of bloom is largely due to the oxidation of hæmoglobin to methæmoglobin; the reaction is monomolecular with respect to the concentration of reduced hæmoglobin and roughly monomolecular with respect to the partial pressure of oxygen; the rate is maximal at a partial pressure of about 23 mm. of carbon dioxide. The results show that 10 per cent of carbon dioxide in the atmosphere has a negligible effect, but with this concentration that of oxygen must be increased to more than 60 per cent if the production of methæmoglobin is to be appreciably retarded.

Important developments have taken place during the year in the application of refrigeration to the herring industry. Experiments had shown that herring, although containing much more fat than white fish, could be brine frozen at the usual temperature of −5° F., and would make good kippers after at least five months' storage at that temperature. 800 tons of herrings were then frozen in one of the East Coast factory ships with the view of using them for kippering, for canning and for consumption fresh during the early months of this year (1935) when home-caught herrings are not normally available.

The gas-storage of home-grown fruit has gone on apace. During 1934 the number of commercial gas-stores in Great Britain increased from 12 to 40, and the number has probably doubled in the course of the succeeding twelve months. It has been found that the winter temperatures of English warehouses are too low for the satisfactory ripening of several varieties of imported pears and plums. Conditioning for a brief period at a temperature of 70° F., however, greatly improved the quality of South African and Australian William pears and of South African Kelsey plums. The best conditions for commercial conditioning have yet to be ascertained, but there is little doubt that conditioning will soon be considered essential for the successful marketing of certain varieties of imported pears and plums.

* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the year 1934. Pp. 261+x. (London: H.M. Stationery Office, 1935.) 4*s*. net.

The use of wrappers treated with a solution of iodine in potassium iodide has been found to retard the development of fungal rotting in grapes, tomatoes and oranges. Brown rot of plums and peaches has also been reduced by iodised wraps. The appearance and flavour of the fruit are not impaired, nor is ripening hastened. On the other hand, certain varieties of plums and peaches are adversely affected; they fail to ripen properly or may even turn black. When iodine is successful, it is because spores and young mycelium at the critical stage of infection are far more susceptible to its action than are old mycelium and the tissues of the fruit; it can thus be used in concentrations sufficient to retard the development of moulds without causing damage to the fruit.

Further results of interest have been obtained from the continued study of the critical changes occurring in the apple at the climacteric, the most important of which is the identification of the active substance which is given off by apples at their climacteric change, and which itself stimulates this change in other apples. It was identified by absorbing it in bromine at −65° C., afterwards preparing a crystalline derivative identified as diphenylethylenediamine. The suggestion that the active substance is ethylene was, therefore, confirmed. About 1 c.c. is apparently given off during the whole of an apple's senescence.

An accidental discovery of great practical interest was made in the course of gas-storage trials of the 1934 season; a set of ripe, strongly-smelling, post-climacteric apples was included in some of the experimental cabinets among several other varieties in the pre-climacteric condition. The ripe fruit caused a considerable amount of physiological damage to the rest of the fruit in the form of spotting round the lenticels.

Progress is recorded in the study of two common diseases of stored apples, namely, scald and low temperature breakdown. Scald is produced by changes in the tissues of the fruit occurring weeks or months before the injury becomes apparent; prevention by oiled paper wrappers is chiefly efficient during these early predisposing changes. Scald was also almost completely prevented in Newton Wonders stored at 3° C. by brief intermittent warming of the fruit at 15° C. Scald is probably due to an excessive accumulation in the superficial tissues of the fruit of some volatile substance.

Among other points in the report to which attention may be directed is the investigation into the stability of synthetic vitamin C (ascorbic acid) during canning. It was added to runner beans, which do not naturally contain much vitamin C, to spinach and to apples and apple jelly; in no case was the loss greater than 25 per cent during the canning.

This brief summary of some of the investigations described in the report will give some idea of the range of the researches carried out by the Board, and their importance for the nation's food supply.

Obituary

Dr. Griffith Evans

DR. GRIFFITH EVANS, whose death on December 7 we regret to announce, was a pioneer in the study of protozoology in connexion with infections, and the first man to associate trypanosomes with the production of disease. He was born at Tymawr, near Towyn, Merionethshire, on August 7, 1835. After studying medicine for a short time with a medical practitioner at Towyn and Aberdovey, he entered the Royal Veterinary College, London, where he qualified as M.R.C.V.S., and later passed into the Royal Artillery, with which regiment he served in Canada during the American Civil War. During his years of service in Montreal he registered in the Medical Faculty of McGill University, and graduated M.D., C.M. in 1864.

On his return to England in 1871, Evans was transferred to the Army Service Corps and continued his medical studies at King's College, London, and elsewhere until 1877, when he was sent to India. It was there that his great work on blood parasites was carried out. Microscopy had been his hobby since his earliest student days, and an important part of the equipment which accompanied him to India was a portable microstand, the best lenses which he could obtain up to 1/12th immersion, a suitable condenser, etc.

On arrival in India, Evans was appointed to investigate an endemic disease which for many years had been fatal to cavalry and artillery horses; by microscopic examination of the blood, which revealed the specific bacillus in the blood of every patient, Evans at once proved the disease to be anthrax fever. What surprised him most in his investigations was the fact that the first change in the blood seen under the microscope was a great increase in the number of the large white corpuscles before the bacillus could be seen; moreover, when the bacilli came, they appeared to be closer to the white corpuscles than to the red. He reported his conviction that the large

granular corpuscles had an important relationship to the bacilli, though he was unable to prove what that relationship might be. This was in 1878, six years before Metchnikoff discovered them to be phagocytes, and at a time when Evans himself did not know even how to fix and stain microbes in the blood for microscopic observation.

In 1880 Evans began his work on surra. He was requested to proceed to Dera Ismael Khan, where surra had been fatal to horses and camels for many years; and upon studying the reports which had already been made upon the disease he at once reached the opinion that it was due to a parasite of the blood—an opinion which had never before been formed. After much opposition, he gained permission to carry out his investigations with a free hand, to make what experiments he wished upon sick and healthy animals, and to kill the animals at any stage of the disease. His first act was to examine microscopically the blood of a surra patient: it was swarming with parasites. Though Koch had not yet made his classical postulates, and though Evans did not know the nature of the microbes revealed to him, he immediately associated them with the production of the disease. They were the parasites which, at first called *Trichomonas evansi*, are now known as *Trypanosoma evansi*.

Evans at once took steps to show his newly-discovered microbes to Dr. Timothy Lewis, the discoverer of the parasite in the blood of the brown sewer rat—now called *Trypanosoma lewisi*. Without hesitation Lewis declared that the two parasites were, with some slight difference, morphologically alike; but he emphatically denied that they were pathogenic. His rats were, in his opinion, healthy, and he did not believe that Evans's microbes were the cause of surra. Nevertheless, Evans continued his investigations eagerly, seeking to prove that a definite relationship existed between the variable number of the parasites present in the blood and the course of the symptoms. Official opinion was strongly against him. In fact, in Evans's own words, the Surgeon-General, the Chief Sanitary Officer and all the senior medical officers "sat upon me heavily", but the Government printed his reports, and he had the gratification of knowing that his statements spurred on a number of younger men to continue investigations along lines which he had laid down.

Evans returned to England in 1885, and after further work in Crookshank's laboratory, King's College, London, retired from the army in 1890. In 1917 he was awarded the Mary Kingsley Medal by the Liverpool School of Tropical Medicine, in recognition of his distinguished scientific work, and on that occasion he wrote a short autobiographical memoir, which was published in vol. 12 of the *Annals of Tropical Medicine and Parasitology*. A year later the Royal College of Veterinary Surgeons awarded him its John Steel Medal.

Dr. Griffith Evans celebrated his hundredth birthday in August last, when he was the recipient of a presentation scroll from the Royal Veterinary College and of many congratulatory messages (see NATURE, August 3, p. 173 and August 17, p. 251).

Dr. J. H. Breasted

WE regret to record the death of Dr. J. H. Breasted, the well-known Egyptologist, founder and director of the Oriental Institute of the University of Chicago, which took place on December 2, in the Medical Center Hospital, New York, at the age of seventy years. Dr. Breasted, who had returned to the United States from Italy only a few days previously, was thought to be suffering from an attack of the tropical malaria to which he had been subject for some years; but his illness proved to be due to hæmolytic streptococci, and terminated fatally.

James Henry Breasted was born on August 27, 1865, and was educated at the Chicago Theological Seminary and the University of Berlin. At the latter, he devoted himself particularly to Egyptological studies; and, indeed, the abiding influence of the Berlin school of thought was apparent throughout his work. In 1894, he became assistant in Egyptology in the University of Chicago, and in 1901 was made director of the Haskell Oriental Museum. Among other university appointments, he occupied the professorial chair in Egyptology from 1905 until 1933. His more important activities outside the University included a mission to the museums of Europe in 1900 to prepare documents for the Imperial Egyptian Dictionary for a commission of the Royal Academies of Germany, and the direction in the field of the expedition of the University of Chicago to Nubia in 1905–7.

By the close of the first decade of the present century, Breasted's international reputation as an Egyptologist and an ancient historian stood high, owing in no small measure to his attractive, and at the same time scholarly, "History of Ancient Egypt" (1905), and his excerpts from original documents of the Egyptian historical records, of which he had published five volumes. His strength, however, as was proved by his later activities, was even greater in the organisation of research than in his quality as a research worker. His interests had transcended the bounds of Egyptology and at a comparatively early stage of his career he had begun to formulate plans for a scheme of research into the origins and growth of civilisation on a grand scale, the theatre for its operation—the ancient East—being determined by the fact that here the lengthy span and the continuity of man's existence as a member of organised society could be investigated on archæological sites with a wealth of detail that was impossible in any other part of the world.

These plans did not attain fruition until after the Great War. As the result of an expedition of reconnaissance through the Near East in 1919–20, Breasted mapped out a plan of campaign for research in the field which covered all the main historical, geographical and chronological strategic points in Egypt and Western Asia, extending from the time of palæolithic man in the Nile Valley and Mesopotamia down to the days of the Persian Empire. As a necessary complement and accompaniment was an institute for the interpretation of results and further research at headquarters in Chicago, which so far as library and laboratory work were concerned was to be duplicated on a reduced scale at headquarters

in the field. Thanks to the generous assistance of Mr. J. D. Rockefeller, Jr., who accompanied Breasted on a tour of the chief pivotal sites of his scheme, it became possible to put the plan into operation; and it took material form as the Oriental Institute, which, as Breasted stated, at the time of the formal dedication of its own building in December 1931, in addition to its activities in Chicago, had no less than eleven expeditions at work in the field at one time. The placing of these expeditions in reference to the respective phases of historical and cultural research which Breasted anticipated that each would elucidate, showed a masterly grasp of the essential movements of ancient history, a quality conspicuous in what are perhaps his best known works "The Development of Religion and Thought in Ancient Egypt" (1912) and "A Survey of an Ancient World", "Ancient Times: a Survey of the Early World" (1916), and "The Dawn of Conscience" (1933).

WE regret to announce the following deaths:

Prof. J. S. Mackenzie, emeritus professor of logic and philosophy in the University College of South Wales and Monmouthshire, Cardiff, on December 6, aged seventy-five years.

Prof. Charles Richet, professor of physiology in the Faculty of Medicine, University of Paris, on December 4, aged eighty-five years.

Sir Alfred Sharpe, K.C.M.G., C.B., formerly governor of Nyasaland, who was well known as a traveller and big-game hunter, author of "The Backbone of Africa" (1921), on December 10, aged eighty-two years.

Lieutenant-Colonel E. W. White, C.B.E., emeritus professor of psychological medicine in King's College, London, on November 28, aged eighty-four years.

News and Views

The Ultimate Value of Science

IN a recent address on "Ultimate Values of Science" before the Commonwealth Club of San Francisco, Dr. J. C. Merriam, president of the Carnegie Institution of Washington, discussed the question whether, by reason of science or research, the world has been made a better place in which to live, or life has become more worth while. Referring first to the way in which better use is being made through science of natural resources, Dr. Merriam pointed out that though we have still a long way to go in learning to control the living world, the way has been marked out, and mankind may be expected to follow it. Moreover, organisation of society has made possible the transmission of knowledge from one generation to another, and science in particular has made possible the recording and continuous development of knowledge in a way which no one generation could achieve alone. The whole capacity for constructive work has been increased, and science is gradually giving us a new outlook over the universe, with ampler opportunity for appreciation of life and a new attitude towards its problems. The scientific point of view and the humanistic point of view require adjustment, if the full value of science, art, philosophy and religion is to be secured for mankind.

DR. MERRIAM urged that science, by reducing the uncertainties of life, increasing the assurance of progress and broadening the possibilities of achievement, has increased the opportunity for constructive living and thus favoured the development of the individual. He insisted that the problem of leisure should be considered primarily in terms of opportunity, and that it is essential to guard against a narrow vision in facing this and other problems of citizenship. The direct facing of the issues, the honest use of all the knowledge gained, is the surest way to recovery, and the wide acceptance of an attitude of mind illustrated by the pattern of scientific thought with its persistent search for facts upon which to base judgment and its broad vision over the world of things and events is an urgent need. The building of a better world depends upon the quality of intelligence used and upon clarity of vision, as much as upon thorough investigation and correlation of the facts.

Romanticism and the Modern World

AT the Royal Institution on December 6, Mr. F. L. Lucas, fellow and librarian of King's College, Cambridge, delivered a discourse on this subject. Romanticism, he said, may perhaps be called the literature of intoxication and dream. Freud has pictured the human ego as living a harassed life between the conflicting claims of the instinctive, animal 'id', the 'super-ego' or sense of social obligation, and the 'reality-principle' or sense of fact. Eighteenth-century classicism shows above all a too tyrannical control, by the two last, of the dreams and impulses that rise from the less conscious depths of personality. The Romantic revival was a revolt of dreamers against those twin sleepless dragons—'good sense' and 'good taste'. Though the Romantic Empire declined and fell, at its heart remains an eternal city. Romance is not dead. The science of the nineteenth century seemed to expel her with a brandished test-tube; the science of the twentieth re-opens the door to her with a bow. Yet this should not be exaggerated. The recently expressed view that poetry is independent of truth, a mere alcohol to stimulate 'emotional attitudes', is in its turn

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a mystical excess. The world about us grows, it is true, more and more a dance of phantom formulæ on the points of dial-needles—the very stuff of dreams. Yet there are dreams and dreams. Some cohere and work; others do not. Incoherence was the weakness in the romanticism of Shelley or Victor Hugo; it is the romanticism of Homer or Hardy that is more enduring. Though dreaming, they imposed order and consistency even on their fantasies. Classicism, realism, romanticism, are all extremes—the three points of a triangle within which lies inscribed the magic circle where walk the greatest masters.

Parliamentary Science Committee

AT the annual meeting of the Parliamentary Science Committee held at the House of Commons under the presidency of Sir Arnold Wilson on December 5, the following officers were elected: *President*, The Right Hon. the Earl of Dudley; *Chairman*, Sir Arnold Wilson, M.P.; *Vice-Chairman*, Prof. B. W. Holman; *Deputy-Chairman*, Mr. Alan E. L. Chorlton, M.P.; *Hon. Secretary and Treasurer*, Mr. H. W. J. Stone. The honorary secretary's annual report discloses that representative scientific and technical institutions continue to affiliate to the Committee. During the 1934–35 session, questions were asked in Parliament concerning agricultural and horticultural research, interchangeability of water supplies, the International Locust Conference, milk pasteurisation, aeronautical engines (output), the gas grid scheme, the possibility of constructing earthquake-proof buildings in India, the research powers of the agricultural marketing boards, technical education and grants for industrial and agricultural research. Members of the Committee took an active part in the debates on the Herring Industry Bill and the Metropolitan Water Board General Powers Bill. Looking to the future, the Committee contemplates consideration in the near future among other things of such widely diverse subjects as the endowment of research, the finance of industrial research, income tax exemption on industrial research, patent legislation reform and the remission of death duties on bequests for research. The Committee compiles from Hansard and other sources a monthly summary of all scientific and technical matters considered in Parliament. The third volume of "Science in Parliament" has just been completed, and issued with a cross-reference index. Owing to the coming demolition of the Adelphi, the Committee is moving to Granville House, Arundel Street, Strand, W.C.2, on January 1.

The Imperial Cancer Research Fund

AT a meeting of the General Committee of the Imperial Cancer Research Fund held on December 4, the Duke of Bedford presiding, the thirty-third annual report of the Fund, dated 1934–35, was presented. A tribute was paid to Dr. J. A. Murray, who retired on October 1 after holding the directorship of the Fund since 1915, and who is succeeded by Dr. W. E. Gye. Dr. Gye in his report surveyed the scientific activities of the Fund since its inception, and referred to the work now in progress. The bearing of the researches upon tar cancers of mammals, and of the malignant sarcoma of fowls, the virus of which is a filterable one, on problems of human cancer was discussed, and Prof. J. McIntosh's experiments upon tar cancers of the fowl were summarised. The last-named tumours can at first be transmitted only by transplantation of a portion of the growth, but after transmission by this method for a few generations, it appears possible to transmit them by means of cell-free filtrates, that is, the virus becomes a filterable one comparable to that of the fowl sarcoma. The honorary treasurer, Sir H. J. Waring, reported that the Fund had a surplus of £7,568 for the year, and that legacies, donations and subscriptions all showed an increase over 1934. At the same time, the work is expanding, and expenses are likely to increase in the future, and he, therefore, made an appeal for additional contributions to the Fund. Dr. Gye, in summarising the present position of cancer research, said: "So far from there being any justification for pessimism, laboratory workers can all feel hopeful that the rapid progress now being made will lead to the solution of the primary problems of cancer".

Minerals and their Utilisation

SIR THOMAS HOLLAND, principal and vice-chancellor of the University of Edinburgh, propounded some very pertinent questions in proposing the toast of the profession of chemistry at the Ramsay Chemical Dinner held in Glasgow on December 6. Sir Thomas said that some of the problems which have been baffling geologists for a long time are really problems for the chemist. In the early days, geologists were content with a knowledge of the principal constituents of minerals, and based their classifications on these. But it has become evident that, in some cases, it is the smaller constituents of a mineral which are the most important. With civilisation has grown the desire for the use of metals, and this desire has increased and will continue to increase until the supply of metals has been exhausted. What the geologist is most interested in and what he wants the help of the chemist to solve are, therefore, the laws which control natural deposits. These reactions of Nature have gone on for countless ages of time, and have produced local concentrations of minerals. We produce annually about 50,000 tons of nickel and 1,500,000 tons of copper, and yet the crust of the earth contains about twice as much nickel as copper. Our production of lead is about the same as that of copper, and the available supplies of lead are only one fifth of those of copper and therefore one tenth of those of nickel. Zinc, of which we produce more than 100,000 tons a year, is only half as abundant as copper, and we use three times as much tin as nickel, though the supplies of nickel are 50–100 times those of tin. There is surely something wrong in this relationship. The different habits of rocks in showing that varying tendency towards rearrangement of their constituents open up problems in physical chemistry which are still largely obscure.

Physics in Industry in the United States

THE Advisory Council on Applied Physics of the American Institute of Physics met at the University Club, Pittsburgh, Pa., on November 16. This was the inaugural meeting of this Council, the purpose of which is to stimulate the application of physics by recommending suitable actions and policies to the Institute and the founder societies. Dr. Paul D. Foote, executive vice-president of the Gulf Research and Development Corporation, presided during the morning session and Dr. Lyman J. Briggs, director of the Bureau of Standards, during the afternoon. A discussion was held on the university education and training of men whose careers are to lie in industrial research. This discussion was opened with reports by Dr. Saul Dushman (presented by Dr. A. W. Hull) of the General Electric Co. and Prof. George H. Harrison of the Massachusetts Institute of Technology. Further discussion was devoted to the services which are rendered by the founder societies and the Institute to physicists employed in industrial laboratories. Reports on this topic were presented by Dr. L. O. Grondahl, director of research, Union Switch and Signal Co., and Prof. John T. Tate, of the University of Minnesota. In this connexion, the Council passed a resolution encouraging the formation by such physicists of a division on applied physics of the Physical Society. It is strongly felt that, while the Optical Society, the Acoustical Society and the Society of Rheology furnish splendid facilities for meetings and publications in their fields, other general applications of physics are neglected. The opinion of the Council is opposed to the formation of new specialised societies, since only through close integration with the Physical Society can the community of interest and interchange of ideas between the general applications and the basic fundamentals of physics be conserved.

South Indian Bronzes at South Kensington

BRONZE figures of the members of the Hindu Pantheon in their various manifestations are a conspicuous feature in the art of southern India. Of these, there is a large collection in the Madras Government Museum, which is perhaps not so widely known in detail as it deserves. The iconographic value of these bronzes is great: they are an important source of information for Hindu religious and cosmological conceptions; but, as a rule, their artistic merit is not high. It is now announced that, by a bequest of the late Lord Ampthill, formerly Governor of the Madras Presidency, the Victoria and Albert Museum, South Kensington, has acquired five of these bronzes, which are both of high artistic merit and of interest for their religious significance. Of these the most important is a figure of Siva as the Cosmic Dancer, which expresses the idea that the god himself is both performer and audience, while the universe is his theatre. The figure is four-armed, and appears in a dancing attitude in an encircling flaming nimbus. In its upper hands are a drum and fire as the symbols of creation and destruction respectively, while the lower hands are in the conventional attitudes of protection and assurance. The headdress includes a crescent moon, a human skull, cobras and flowers. The male and female principles are signified by a man's ear-ring in the right ear and a woman's ear-ring in the left ear. With this figure is shown one of his consort Parvati, in the manifestation of Gauri. These figures were found buried near a temple in the Tinevally District of the Madras Presidency. They were made by the *cire perdue* process; and from their stylistic affinities it is concluded that they belong to the late tenth or early eleventh century of our era. Lord Ampthill's bequest, part of which had previously been on loan in the museum, includes, in addition to the five bronzes, a number of other objects of great interest, illustrative of Brahmanical and Buddhist beliefs.

Vision in Optical Instruments

IN his Thomas Young Oration of the Physical Society on December 6, Prof. Charles Fabry discussed "Vision in Optical Instruments". Classical theory gives the *resolving power* of an optical instrument as determined by diffraction phenomena, but the result so obtained takes no account of the properties of the eye. Consequently, it does not indicate exactly what will actually be perceived with an instrument. What can actually be seen with such an instrument depends considerably on the brightness of the object examined, and on the degree of contrast between its parts and between the object and the background. In order to examine these questions, it is necessary to commence with the properties of the eye, and in particular, its ability to distinguish objects, not under the ideal conditions reached in the laboratory, but under conditions similar to those met with during observations. The effect of brightness is particularly large: for the greatest brightness the limit of resolution is about 1′, whilst it is 250 times as large (about 4°) for barely perceptible brightness. Contrast also has a very large effect. With these data, it becomes possible to determine what the eye will really see in a given instrument, assumed to be of perfect geometrical construction. The optimum size of exit-pupil can be calculated, and is found to be 0·7 mm. for the highest illumination, in agreement with experience. For an instrument with geometrical imperfections, an efficiency can be defined characterising the qualities of this instrument as compared with those of a perfect instrument. Stray light (fog) is another cause of inferiority in instruments, and the effect of this factor was discussed by Prof. Fabry.

Automatic Fire and Burglar Alarms

A DEVICE, invented in France, which can be used either as a fire alarm which will give automatically a telephone message to the fire brigade, or as a burglar alarm which will summon the police, is described in *The Times* of December 7. The apparatus is called a 'signaphone', and is already installed in about forty buildings in Paris. When used as a fire alarm, the device is operated either by thermostats fixed near the ceiling, or by push buttons so that a watchman has only to press the nearest button. The thermostats are operated by hot air rising to the

ceiling when fire breaks out. This breaks a closed electric circuit, and an electrical relay at once starts a clockwork motor. The motor drives a small dialling drum, the small metal discs on which correspond to the letters and figures of the telephone number of the nearest fire station. The station is thus called up and a gramophone record then comes into action giving, in a verbal message, the location of the fire and all essential details. This message is repeated continuously for 3½ minutes. If necessary, also, it can be made to ring up a second number—for example, that of the owner of the building—and repeat its message. When used as a burglar alarm, the signaphone is connected with an electric circuit in the building. In this case, a burglar who opens a door or window, takes down a picture or tries to open a safe or desk, without knowing it thereby summons the police, who learn from the the gramophone message what is happening. Anyone who desires to have both a fire and burglar alarm must have two signaphones installed. The Post Office has given permission for these devices to be attached to telephones on automatic exchanges. It has also met with the approval of the Metropolitan Police, to whom it has been demonstrated.

Equalising Supply and Demand

IN the first number of *Trends—A Monthly Graphical Review of Business Movements* (H. Whitehead and Staff, 20 Buckingham Gate, S.W.1, October 1935), Mr. Harold Macmillan contributes an interesting article on "Equalising Supply and Demand" in which he emphasises the importance of planning an adjustment of productive effort, so as to ensure the production of all goods and services in the quantities which will enable them to exchange for one another at prices covering their production costs. The regulation of production in relation to demand for the products of each industry requires that some common policy should be pursued by all the units collectively, for example, in regard to scientific research, observance of standard wages and conditions, maintenance of standards of quality or standardisation of the range of patterns. But as things are, a common policy must depend on voluntary agreements, and in the great majority of cases voluntary agreements break down because, when they have created conditions of stability and profitability, other producers are attracted who can exploit the market by the old methods. Mr. Macmillan therefore urges that it is necessary to give industry legal powers to enforce upon a recalcitrant minority decisions which have been approved by a large majority of the producers and have been sanctioned by Parliament. It is essential, however, that there should be adequate safeguards to defend the general public interest and the special interests of consumers and workers affected in each case.

Despotic and Democratic Governments

THE question as to whether parliamentary democracy can survive its present crisis and whether the rise of dictatorships in Italy, Germany and Russia does not indicate the decline of a long epoch of parliamentary government, is discussed by Mr. Herbert W. Stewart in an article in the *Hibbert Journal* (April, 1935). Mr. Stewart definitely rejects the modern scepticism, although he is far from denying many of the difficulties and real dangers involved in the parliamentary system, such as party intrigues, the corruption of the free but corruptible Press, the demagogic misuse of public institutions under parliamentary control. The unavoidable dilemma of this system seems to be that current affairs are run either by expert commissions, more or less on account of the initiative of the electorate and its parliamentary representatives—or by the masses themselves, and this involves the danger of delicate political matters becoming dependent on the issue of demagogical party activities and political bargainings.

COMPARING these dangers with those of Fascist States, however, Mr. Stewart concludes that Fascist State policy is apt to replace a comparative evil by a much more radical one ; for an oligarchy controlling the key positions of the State is worse than the personal power of local cliques under parliamentary government. Parliamentary corruption is the smaller evil as compared with the possible and hidden corruption under a despotic government. The disadvantages of democratic governments should not be over-stressed. In the United States, Canada and Great Britain, after all, the individual voter does not feel that the electoral victory of any one of the existing parties might jeopardise the country. Parliamentary institutions are capable of adapting themselves to new circumstances and of modifying themselves. In the long run, the masses do not wish to be without these means of self-expression.

Solar Activity and Radio Transmission

RECENTLY, Dr. J. H. Dellinger, head of the radio section of the Bureau of Standards at Washington, suggested that a close watch should be kept to see whether there was a fade-out of radio transmissions at any time between October 21 and 25. He was led to make this suggestion by the discovery of severe fading occurring on March 20, May 12, July 6 and August 30, which indicate a 54-day cycle. According to a report issued by Science Service, Washington, D.C., certain short wave-lengths were wiped out by eruptions of the sun for the single day October 24. This fade-out sheds new light on the difficult problem of the connexion between radio transmission, sunspots and magnetic storms. Ordinary transmissions having wave-lengths approximately the same as those used in domestic broadcasting were not affected ; but experimental radio transmission was completely wiped out, and the sending of commercial and amateur radiograms was greatly hampered.

THE Bureau of Standards describes the occurrence on October 24 as a wiping out of radio transmission above a certain frequency. It is also stated that there was probably some eruption in the sun much more sudden than the growth of a sunspot, and that this abruptly changed the rate at which the sun

sent certain waves or particles into the earth's atmosphere. Previously there has been no way of identifying the magnetic disturbances associated with such eruptions. As the radio effects are easily identified, it is hoped to get a closer insight into the connexion between them and solar disturbances. In a later report by Prof. H. G. Gale of Mount Wilson Observatory, it is stated that on the morning of October 24 a group of dark granular flocculi was observed on the sun's disk. This group was observed frequently during the day, and at its maximum it was the largest object on the sun's surface as observed by the hydrogen spectroheliograph. The increased solar activity paralleled the strange radio fade-out. Technical details are given in the November 15 issue of the *Physical Review*.

Science and Vegetable Production

MR. F. A. SECRETT lectured before the Royal Society of Arts on November 27, the subject of the discourse being "Modern Methods of Vegetable Production and Marketing". Mr. Secrett, as the owner of Holly Lodge Farm, Walton-on-Thames, is well qualified to speak on this topic (see NATURE, May 25, p. 866). Mr. Secrett's outlook combines the enthusiasm of the amateur with business acumen and scientific discrimination. One of the problems of intensive culture is to obtain sufficient humus for the soil. Sewage waste and town refuse may possibly fill the need, but Mr. Secrett insisted that fresh or green manure has a denitrifying effect on the soil. The technique of irrigation by overhead sprays, and of heating the soil by hot water pipes laid in troughs of water below the soil, were described in detail, for Mr. Secrett is an authoritative exponent and pioneer in the application of these practices. Particular attention was given to methods of aerating the irrigation water, and of incorporating soluble fertilisers. The section on marketing dealt with the use of non-returnable packages, the reorganisation of commission sales, and the revision of railway rates. Much criticism of the work of marketing boards was given, and Mr. Secrett showed, by reasoned argument and without caustic remark, that the unvaried edict of bureaucratic control is often opposed to the best interests of a dynamic and changeable industry such as vegetable growing.

Mount Everest Expedition

IN preparation for the new Mount Everest expedition of 1936, a reconnaissance party was at work last year. At the Royal Geographical Society on December 2, Mr. E. E. Shipton gave an account of this expedition. The main objects were to investigate snow conditions at high altitudes and decide on the best season for the attempt on the summit, to examine the possibility of alternative routes either by the north-west ridge from the head of the Central Rongbuk glacier or by the unknown Western Cwm, and to test equipment. An exploration of the western approaches to Mount Everest revealed no possible way of approach to the summit. Moreover, it was found that the ice slopes of the North Col were in a very dangerous condition during the whole of the monsoon, and always liable to be swept by avalanches the occurrence of which it was impossible to foretell. The expedition scaled numerous hitherto unclimbed peaks in the district in the course of its work.

Housing and Overcrowding

THE Ministry of Health has recently issued several circulars dealing with the subjects of housing and overcrowding, all published by H.M. Stationery Office. "Housing" (2*d*. net) summarises the principal provisions of the Housing and Public Health Acts in relation to maintenance of dwellings in a reasonably fit condition. "Housing, England" (Statutory Rules and Orders 1935 No. 1115. 1*d*. net) relates to the appointment of a committee, to be called the Central Housing Advisory Committee, for the purpose of advising the Minister on questions relating to overcrowding. "Circular 1507" deals with Section 1, Housing Act, 1935, and fixes dates for (1) the completion of inspection—April 1, 1936, (2) submission of report—June 1, 1936, and (3) submission of proposals—August 1, 1936. "Statutory Rules and Orders 1935 No. 1086" (3*d*. net) makes regulations applying to polls of local government electors in connexion with the promotion of bills by councils other than councils of metropolitan boroughs. The Central Housing Advisory Committee appointed by Sir Kingsley Wood includes among other prominent members the names of Lord Balfour of Burleigh, the Earl of Crawford and Balcarres and the Earl of Dudley, the Bishop of Winchester, Miss Megan Lloyd George, Sir Francis Fremantle, Dr. Greenwood Wilson and Mr. Silkin.

A Long Barrow in East Anglia

IT has been supposed that no long barrows exist in Norfolk and Suffolk, and various theories have been put forward to account for the absence of the long-barrow culture in these counties. Some have supposed that it never existed in these areas, while others have thought that the non-existence of the burial mounds is to be accounted for by their removal through ploughing or other agricultural operations. It now seems that the latter is the more likely explanation as, recently, Mr. J. E. Sainty, of The Hedges, West Runton, near Cromer, and his friend Mr. A. Q. Watson, of Holt, have discovered, in west Norfolk, what has every appearance of being a long barrow, surrounded by a ditch. This is a noteworthy find and the discoverers hope to be able to excavate the site in the near future.

Science in the Public Press

WE are glad to direct attention to a series of eight articles on scientific problems of particular human interest now being contributed to the *Evening Standard* by competent authorities on the subjects with which they deal. The first article, by Prof. H. Levy, in the issue of December 9, presents a philosophic picture of the universe. Succeeding articles in the series are "What is Death?", Prof. J. B. S.

Haldane; "Is There an After-life?", the Bishop of Birmingham; "Can We Create Life?", Prof. F. G. Donnan; "Is There Life on the Planets?", Dr. H. Spencer Jones; "Why Do I Dream?", Prof. Cyril Burt; "Can We Harness the Atom?", Prof. E. N. da C. Andrade; and "What Is My Conscience?", Prof. J. C. Flügel.

New Research Laboratory of the L.M.S.

ON December 10, Lord Rutherford opened the new L.M.S. Railway research laboratory at Derby in the presence of many well-known scientific workers and industrialists. Before the special train left St. Pancras, Pat Rutherford, grandson of Lord Rutherford, had the honour of naming the new Crewe-built engine of the special train. Sir Josiah Stamp first introduced him to the leading guests and then lifted him on to the running-plate of the engine. A purple cloth covered the name-plate. Pat pulled the cord to unveil the plate and called out, "I name this engine 'Lord Rutherford of Nelson'". We propose to print an account of the speeches made at the opening of the new laboratory at Derby in our next issue.

The 200-inch Disk for the Mount Wilson Observatory

ACCORDING to the New York correspondent of *The Times*, the second two hundred inch pyrex glass disk which has been made at the Corning Works for the California Institute of Technology has been accepted as satisfactory by the scientific representatives of that institution. The disk has been annealing for twelve months, and it is expected that the process of grinding and figuring, which will take place at Pasadena, Cal., will occupy five years. There are said to be some flaws on the surface of the disk: these were caused through the floods of this summer, which shut off the heating apparatus for forty-eight hours, but they will be removed during the grinding process. Astronomers and others on the east of the Atlantic who have followed the not uneventful history of the manufacture of the mirror for the two hundred inch telescope with great interest, will be glad to hear that the present disk is satisfactory, and will wish their American colleagues a little luck, of which perhaps they have not yet had their share, in their delicate and long-continued operations on this large disk.

Announcements

THE honorary membership of the Royal Asiatic Society has been conferred upon Prof. Wilhelm Geiger, of the University of Munich, in recognition of his eminent services to Indian and Iranian philology.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. J. C. Cater, to be assistant conservator of forests, Trinidad; Mr. H. E. C. Lewys-Lloyd, stock inspector, Tanganyika, to be assistant live stock officer, Uganda.

DR. WILBUR A. SAWYER has been appointed director of the Division of International Health of the Rockefeller Institute, New York.

THE fourth International Congress of Cytology will be held in Copenhagen in 1936. The exact date has not yet been fixed, but the Congress will probably take place in August. Further information can be obtained from the General Secretary, Nassaustrasse 17, Berlin-Wilmersdorf.

THE Iron and Steel Institute is offering a number of grants from the research fund founded by Mr. Andrew Carnegie in aid of metallurgical research. Candidates for grants must be less than thirty-five years of age. Applications should be made before January 10 to the Secretary, Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

THE first International Congress of Criminal Anthropology and Psychiatry will be held in Rome next April, when the following subjects will be discussed: etiology, diagnosis and prognosis of criminality in minors; prophylaxis of crime in relation to penal laws; fundamental conception of criminal biology; and prophylaxis of crime and criminal anthropology. Visits will be paid to the various Italian institutions for the prevention of criminality and re-education of delinquents in Rome, Naples, Orvieto and elsewhere. Further information can be obtained from the general secretary, Prof. B. di Tullio, via Giulia 52, Rome.

A PRACTICAL brochure entitled "Instructions for Collectors: No. 4—Insects", published by the British Museum (Natural History), has recently appeared in its eighth edition. It gives instructions, intended chiefly for persons travelling abroad, as regards the best methods for collecting insects and the essential apparatus. It is obtainable from the Museum or through booksellers, price 3*d*. (postage 1*d*).

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

A part-time lecturer in practical mathematics in East Ham Technical College—The Secretary for Education, Town Hall, East Ham, E.6 (Dec. 17).

A scientific officer at the Building Research Station, Garston—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (Dec. 19).

An assistant instructor in dairying to the Wilts County Council—The Clerk of the Council, County Offices, Trowbridge (Dec. 19).

Pharmacist-inspectors to the Pharmaceutical Society of Great Britain—The Secretary of the Society, 17 Bloomsbury Square, W.C.1 (Jan. 1).

A professor of mathematical physics in the Indian Institute of Science, Bangalore—The Director (Jan. 15).

A professor of physiology in the University of Queensland—The Secretary, Universities Bureau, 88A Gower Street, W.C.1 (Jan. 25).

An assistant lecturer in mathematical physics in University College, Hull—The Registrar.

An assistant lecturer in chemistry in the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield.

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 956.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Chemical Detection of Artificial Transmutation of Elements

IT has been our aim for years to prove the result of transmutation experiments by chemical analysis, and in a brief report[1] we have described our failure to find chemical evidence for the production of hydrogen or neon by bombardment with α-rays. In the meantime, many new ways of artificial transmutation have been found, and the discovery of artificial radio-elements has enabled Curie and Joliot[2] to use the methods of radio-chemistry, that is, the combination of radioactive measurement with chemical operations, for the investigation of the chemical character of products of artificial transmutation. This line of work has been extended by Fermi and his collaborators and by many others. The quantity of newly formed matter has in general been much too small for any attempt at a purely chemical detection; the claim[3] of having separated and spectroscopically observed helium of atomic weight 3, made from heavy hydrogen, has been disproved by later work[4].

At present, for various experimental reasons, the best choice for the chemical detection of an artificially-produced element seemed to be helium originating from boron according to the reaction[5]

$$_5B^{10} + {}_0n^1 = {}_3Li^7 + {}_2He^4.$$

In a closed copper vessel we bombarded the methyl ester of boron with neutrons. These were produced near the centre of the spherical vessel by the decay of radon, mixed with beryllium, and were slowed down by the hydrogen atoms of the ester and of the water surrounding the metal flask. In a first experiment, by the decay of 450 mC. of radon, sufficient helium was produced for a spectroscopic observation. During a second experiment, lasting seven weeks, we procured enough radon to allow 2,200 mC. of it to decay in our apparatus. This time we were able not only to observe spectroscopically the helium produced but also to measure it; we found, to an accuracy of about 20 per cent, $1{\cdot}3 \times 10^{-7}$ c.c. helium. A blank test run afterwards for nine weeks under exactly the same conditions, but without radon-beryllium tubes, showed not the slightest sign of helium production.

The copper vessel was a sphere of only 7·5 cm. radius; it is unlikely that more than half of the neutrons formed in the beryllium tubes were caught by the boron inside the vessel. A new experiment, making use of a larger flask, is in progress; but it can already be concluded from our preliminary figures (as one helium atom, according to the above equation, needs for its production one neutron) that a millicurie of radon, mixed with beryllium, produces more than 3,000 neutrons a second[6].

In this experiment—for the first time, so far as we are aware—an artificially produced element has been separated, spectroscopically observed, and measured. We presume that the old alchemistical goal can be achieved to-day in other cases also.

We wish to express our sincere thanks to Prof. F. L. Hopwood, director of the Radium Department, St. Bartholomew's Hospital, London, to Prof. S. Russ, director of the Radium Department, Middlesex Hospital, London, and to Prof. Stefan Meyer, director of the Institute for Radium Research in Vienna, for kindly supplying the radon-beryllium tubes; and also to Dr. E. Glückauf for assistance in the experiments.

F. A. PANETH.
H. LOLEIT.

Imperial College of Science
and Technology,
London, S.W.7.
Nov. 28.

[1] F. A. Paneth and P. L. Günther, NATURE, **131**, 652; 1933. See also *Z. phys. Chem.*, *A*, **173**, 401; 1935.
[2] I. Curie and F. Joliot, *C.R.*, **198**, 559; 1934.
[3] G. P. Harnwell, H. D. Smyth and W. D. Urry, *Phys. Rev.*, **46**, 437; 1934.
[4] H. D. Smyth, G. P. Bleakney and W. W. Lozier, *Phys. Rev.*, **47**, 800; 1935. F. A. Paneth and G. P. Thomson, NATURE, **136**, 334; 1935.
[5] J. Chadwick and M. Goldhaber, NATURE, **135**, 65; 1935. *Proc. Cam. Phil. Soc.*, **31**, 612; 1935. H. J. Taylor and M. Goldhaber, NATURE, **135**, 341; 1935. E. Amaldi, O. D'Agostino, E. Fermi, B. Pontecorvo, F. Rasetti and E. Segrè, *Proc. Roy. Soc.*, A, **149**, 522; 1935.
[6] The ordinarily assumed yield of neutrons under these conditions is 1,000 neutrons per sec. (See, for example, E. Fermi and collaborators, *Proc. Roy. Soc.*, A, **146**, 483; 1934.) According to R. Jaeckel's observations (*Z. Phys.*, **91**, 493; 1934) the value 10,000 neutrons per sec. is more likely.

Absorption of Residual Neutrons

AMALDI, D'Agostino, Fermi, Pontecorvo, Rasetti and Segrè have discovered that certain elements strongly absorb neutrons which have been slowed down by paraffin wax[1]. They report, for example, that thin sheets of cadmium or indium of 0·013 gm./cm.² and 0·3 gm./cm.² thickness respectively cut down the intensity of a beam of slow neutrons to half its value and find for iodine a half-value thickness of 4 gm./cm.².

Thick sheets of a strongly absorbing element, such as cadmium, will, however, still transmit an appreciable fraction of the incident heterogeneous beam, and in these circumstances it appeared to be of interest to investigate the absorption of such residual neutrons in some elements.

In one set of experiments, I filtered slow neutrons by a sheet of cadmium, 1·6 mm. (1·4 gm./cm.²) thick, and determined the absorption of the residual neutrons in several elements, using radioactivity induced in indium (54 min. period) as an indicator of the neutron intensity. The residual neutrons from the thick cadmium filter are scarcely absorbed by cadmium itself—a 0·5 mm. thick cadmium absorber will absorb perhaps less than 10 per cent of the residual neutrons. Yet I find that these residual neutrons are strongly absorbed by some elements—for example, a thin indium absorber of less than

0·3 gm./cm.² (0·4 mm.) thickness absorbs more than two thirds of the intensity.

Cadmium absorbs the bulk of the unfiltered beam much more strongly than indium, but as we see, it is transparent for some component of the unfiltered beam which in its turn is strongly absorbed by indium. This fact is in contradiction to the current conclusions drawn from the theory of radiative capture.

Fermi *et al.*, Bethe, Perrin and Elsasser attempted to explain the observed large absorbing cross-sections of elements such as cadmium without assuming long-range forces of the nucleus. They have assumed that the range of these forces is small compared with the wave-length λ of the slow neutron and that the neutron is captured in a deep energy level of the nucleus, the excess energy of several million volts being carried away by an emitted photon. They have demonstrated that large effective absorbing cross-sections result if resonance occurs, and it can be shown that the degree of this resonance will not change appreciably with the neutron energy between thermal energies and some 10,000 electron volts. Consequently, if an element has an absorbing cross-section larger than another element for one particular neutron energy, it should not have a smaller absorbing cross-section for any other energy within this energy range.

The present observation on indium contradicts this conclusion. It cannot be argued in defence of the theory that the observed effect might be due to neutrons of energies higher than some 10,000 volts, since the observed very large absorbing cross-section of the indium atom for the residual neutrons would then have to exceed λ^2/π—the limit set by the theory.

In our experiments, use was made of the fact that slow neutrons will diffuse through a paraffin wax tube in much the same way as a gas will diffuse through a tube, if the mean free path in the gas is large compared with the diameter of the tube. The neutrons were led from a radon-beryllium source of about 200 mC. through a paraffin wax tube of 13 cm. inner diameter and 20–40 cm. in length to filter, absorber and indicator sheets and passed only once through these sheets.

Control experiments show that the observed absorption is not due to reflection (back scattering) from the indium absorber. Reversal of the position of cadmium filter and indium absorber produces no change in the transmitted intensity, and this fact indicates that the observed highly absorbable residual neutrons are not produced in our cadmium filter but form part of the unfiltered beam. We are thus led to the conclusion that we have to deal in these experiments with types of absorption spectra for which the present form of the theory cannot account.

There were earlier observations[2], especially those reported some time ago by Moon and Tillman, which did not seem to fit in with the theory. Tillman and Moon showed that the absorption of slow neutrons in an element appears to be different if different elements are used as indicators, and that it often appears to be comparatively high, if the same element is used as absorber and indicator.

In the present experiments, the residual neutrons from cadmium show such selective absorption effects with some combinations of indium, silver and iodine, and show them much more markedly than the unfiltered beam. Moreover, some elements show, if one and the same element is used as absorber and indicator, a larger absorption for the residual neutrons than for the unfiltered neutrons; for example, less than 1 gm./cm.² of iodine absorbs more than half of the residual neutrons if iodine is used as indicator. It would therefore seem that some elements have fairly sharp regions of strong absorption in an energy region for which cadmium is transparent.

It would be interesting to know the energy values which correspond to these absorbing regions. An attempt is now being made to determine them by studying the absorption in boron and lithium of the 'highly absorbable' components of the residual beam.

The observed strong absorption of residual neutrons makes it possible to construct efficient slits or shutters for the purpose of stopping out a well defined beam.

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Nov. 19.

[1] *Proc. Roy. Soc.*, A, **149**, 522; 1935.
[2] Artsimovitch, T. Kourtschatov, Miccowskii and Palibin, *C.R.*, **200**, 2159; 1935. Bjerge and Westcott, *Proc. Roy. Soc.*, A, **150**, 709; 1935. Amaldi, D'Agostino, Fermi, Pontecorvo and Segrè, *Ric. Sci.*, (vi), **1**, No. 11–12. Moon and Tillman, NATURE, **135**, 904; 1935. Tillman and Moon, NATURE, **136**, 66, July 13, 1935. Ridenour and Yost, *Phys. Rev.*, **48**, 383; 1935.

The Slowing Down of Neutrons by Collisions with Protons

FERMI and others[1] showed that neutrons, passing through substances containing hydrogen, loose their energy by collisions with protons. It is of interest to discuss this process of slowing down somewhat further. So long as the energy of the neutron is higher than the energy with which the protons are bound in the molecules of the substance through which the neutrons pass, it seems evident that the latter give, on the average, half their energy to the proton at every collision. But when the neutrons are slowed down below this binding energy, they must excite rotation and oscillation of the hydrogen atom in the molecule in order to lose energy.

It is not certain whether the cross-section of protons for neutrons is a uniform function of the velocity of the neutrons, or if it shows discontinuities for energies comparable with the molecular bindings. In the latter case, it is possible that two substances, containing hydrogen held by different linkages, would show differences in slowing down the neutrons. We have carried out some experiments which indicate the existence of such differences.

Spheres with different radii (5–15 cm.) were alternately filled with water (0·11 gm. H/cm.³), ethyl alcohol (0·10 gm. H/cm.³), benzene (0·067 gm. H/cm.³) and a liquid paraffin (0·14 gm. H/cm.³). In the centre of the sphere a neutron source (radon + beryllium) was placed. The activation of a silver plate, which was fixed on the surface of the spheres and exposed for five minutes to irradiation, served as a measure of the intensity of slow neutrons.

Fig. 1 shows the number of slow neutrons per unit of the solid angle plotted against $r\,d$, where r is the radius of the sphere and d the quantity of hydrogen contained by 1 cm.³ of the liquid in question. The general aspect of these curves is already known. For small radii a rapid increase of the intensity with increasing radius is observed, due to the slowing down of neutrons by collisions with protons. After a certain point, an increase of the radius causes a reduction of the intensity. This clearly shows that not all neutrons which pass the surface of a sphere are reaching the next bigger sphere. The vanishing of slow neutrons must be ascribed to absorption.

The absorption of slow neutrons by paraffin and other substances containing hydrogen has been studied in detail by Bjerge and Westcott[2], who found that the number of slow neutrons is reduced to a half after diffusion through 1·6 cm. of water. By a different method we obtained the value of 2·5 cm. for paraffin in a preliminary experiment. A source of neutrons was placed in the centre of a paraffin wax cube of 14 cm. side. Five plates of paraffin wax, each 1 cm. thick, and finally a small silver plate were placed upon this cube. A screen of cadmium was interposed between the paraffin plates at different distances from the silver plate. The activity of the silver, obtained for equal times of irradiation, increased when the distance between the silver and the cadmium was increased. A curve was obtained which showed that influence of the absorption of the cadmium decreased to a half when the distance between the silver plate and the absorber was increased by 2·5 cm.

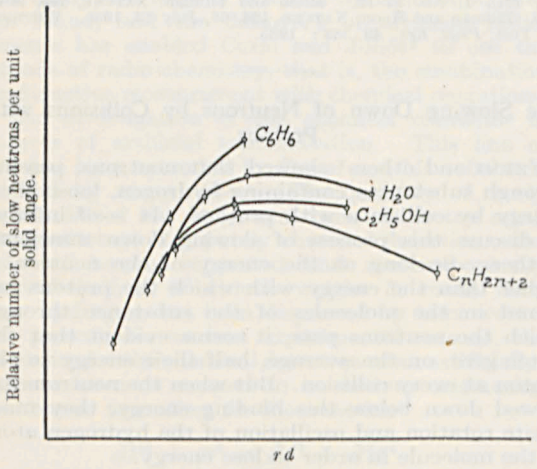

FIG. 1.

Fig. 1 shows that the maximum values of intensity are different for different liquids; these differences cannot be ascribed to the quantities of hydrogen contained by the liquids alone. Also, it is not possible to explain these results by absorption of slow neutrons by oxygen or carbon nuclei. A neutron has, for the same number of collisions with protons, passed twice the number of carbon atoms in benzene as in the liquid paraffin, and we see that the maximum value for the latter is much lower than for benzene, where the maximum seems to be just reached with the biggest sphere.

The differences in the influence of the four liquids examined, on the intensity of slow neutrons, cannot be ascribed to differences in the quantities of hydrogen, carbon or oxygen these liquids contain. Other differences between these liquids depend upon their molecular structure. Thus different probabilities for the slowing down of neutrons by excitation of rotation and oscillation of the hydrogen atoms in the different molecules may account for the discrepancies observed.

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Nov. 5.

[1] Fermi and others, *La Ricerca scientifica*, (v) **2**, 1; 1934. (vi) **1**, 1; 1935.
[2] T. Bjerge and C. H. Westcott, *Proc. Roy. Soc.*, A, **150**, 709; 1935.

Quantised Field Theory and the Mass of the Proton

THE new theory of the electromagnetic field which I have proposed[1] seemed to allow an interpretation of the spin of the electron as a real electromagnetic angular momentum. Prof. W. Pauli was so kind to direct my attention to the fact that the quantisation of the field equations determines the total electromagnetic angular momentum as an integral multiple of $\hbar$; hence this interpretation is impossible.

My collaborator, Mr. M. H. L. Pryce[2], has, therefore, proposed a modification of the quantised field theory, in which there is ascribed to each singularity a spin, represented by non-commuting matrices of the Dirac type. Pryce remarked that this assumption may explain the existence of two different kinds of charged particles, electrons and protons, both with the spin $\frac{1}{2}$. For the electromagnetic angular momentum can have the values $j = 0, 1, 2, \ldots$ (in units $\hbar$). As the spin with the momentum $s = \frac{1}{2}$ may be parallel or anti-parallel to the electromagnetic moment, its component in this direction being $\sigma = +\frac{1}{2}$ or $\sigma = -\frac{1}{2}$, there exist two states with the total momentum $\frac{1}{2}$, namely, $j = 0$, $\sigma = \frac{1}{2}$, and $j = 1, \sigma = -\frac{1}{2}$. Pryce suggested that the latter state might have a much higher energy than the first one.

This conjecture of Pryce is strongly confirmed by an estimate of the relation of the energies or masses. The necessary formulæ have already been given by Schrödinger and myself in a note in NATURE[3]. There we started from the assumption (which I now consider as wrong) that the spin is the electromagnetic momentum; then the principal part of the energy of the electron would not be electrostatic but electromagnetic, and we showed that this would make the radius of the electron about 10 times larger than is usually assumed. Now I apply the same method for an estimate of the mass of the proton.

I assume that the chief part of the energy of the state $j = 1$, $\sigma = -\frac{1}{2}$ is electromagnetic and can be represented by $\frac{1}{2}\mu^2/r_0^3$, where $r_0 = e^2/mc^2$ is the conventional radius of the electron and $\mu = er_0/2\alpha$ the Bohr magneton ($\alpha = e^2/\hbar c = 1/137$).

Putting $Mc^2 = \mu^2/2r_0^3$, one gets by introducing the value of μ:

$$M = \frac{e^2}{r_0c^2} \times \frac{1}{8\alpha^2}.$$

In the non-rotating state $j = 0$, $s = \frac{1}{2}$, one has

$$m = \frac{e^2}{r_0c^2}.$$

Therefore

$$\frac{M}{m} = \frac{1}{8\alpha^2} = \frac{18{,}770}{8} = 2{,}400,$$

in sufficient agreement with the experimental value 1,840.

The use of the Bohr magneton μ for calculating the energy does not imply the assumption that the total magnetic moment is μ, which would contradict the facts. The spin contributes to the magnetic moment just a Bohr magneton of the opposite direction, and the resultant ought to be zero if the compensation were complete. It seems not surprising that there is a non-compensating part of the order $\mu/1{,}000$, as the experiments show.

If it is true that a proton and a positron (or a negative proton and an electron) are different states of the same system, there should be transitions from one to the other, for example, a transformation of a

proton into a positron under emission of light quanta of the order of magnitude $Mc^2 \sim 2{,}000\ mc^2$ or 1,000 millions of electron volts, as are actually found in cosmic rays.

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Bangalore.

[1] M. Born, NATURE, **132**, 282; 1933. *Proc. Roy. Soc.*, A, **143**, 410; 1934.
M. Born and L. Infeld, *Proc. Roy. Soc.*, A, **144**, 425; 1934. A, **147**, 522; 1934. A, **150**, 141; 1935.
[2] Pryce's paper has not appeared yet. As we are now widely separated, he in America, I in India, I publish this confirmation of his idea without asking his consent.
[3] M. Born and E. Schrödinger, NATURE, **135**, 342; 1935.

Frequency of Collision of Electrons in the Ionosphere

MESSRS. FARMER and Ratcliffe[1] criticise my results on this subject[2] on the ground that I have neglected the effect of a possible variation of the E layer attenuation during the three-quarters of an hour or so in which the observations were taken. Such a variation of E layer attenuation would involve a spurious contribution to the slope of the log ρ, P' curve, which would invalidate the calculation of the collision frequency. But where the reflection coefficient ρ decreases to a minimum and rises again (as in all cases observed), there are two branches to the log ρ, P' curve, one corresponding to ρ decreasing and the other to ρ increasing, and the effect of a continuous variation of E layer attenuation would be to increase the slope of one branch and decrease that of the other by the same amount. The effect of the variation of E layer attenuation is therefore automatically eliminated in taking the mean of the slopes of the two branches.

In actual results obtained where both branches are clearly defined, there is no significant difference between the slopes of the two branches (so far as the accuracy of the observation allows) so that the effect of the variation of E layer attenuation is certainly small.

Prof. Appleton's criticisms[3] are more fundamental, for he considers the formula from which the collision frequency is derived to be unjustified. My formula $\log \rho = \frac{-\nu_c}{2c} P'$ is contrasted with the more accurate formula $\log \rho = \frac{-\nu_c}{2c}(P'-P)$, and Prof. Appleton considers that the neglect of P may introduce considerable error, especially when P is of the same order of magnitude as P'.

It should be noted, however, that in the application to the determination of ν_c by my method, I am not so much concerned with the total reflection coefficient or equivalent path P', as with the changes $\delta \log \rho$ and $\delta P'$ occasioned by alterations in the layer as the maximum critical frequency ν_m approaches the frequency ν of transmission. As ν_m approaches ν, P' rapidly increases, if not to an infinite value at least to a very large value, while P tends to a definite limit. It follows that in the limit, as the critical frequency is approached, $\delta P'$ tends to a large value compared with δP, and the relation $\delta \log \rho = \frac{-\nu_c}{2c} \delta P'$ is accurately satisfied for the ordinary ray, while $\delta \log \rho = \frac{-\nu_c}{2c} \frac{\delta P'}{1-\tau/2}$ for the extraordinary ray. Thus the slope of the log ρ, P' curve gives ν_c quite accurately.

In order to test the accuracy of this relation, some examples have been worked out in which no approximation is made other than that involved in the assumption that $\alpha = \frac{\nu_c}{\beta \pi \nu}$ is small. The attenuation and group time derived from the real and imaginary parts of the refractive index were integrated by quadratures, and the relation between log ρ and P' was determined. The distributions of electronic concentrations in the layer considered were those which start from zero, reach a maximum at a height z_0, and then decrease. A typical example is shown in Fig. 1, in which $\log \rho \Big/ \frac{2\tau\alpha z_0}{\lambda}$ is plotted against $\frac{P'}{2z_0}$. In accordance with relation (1) the curve should, for large values of P', tend to a straight line the slope of which is unity for the ordinary ray and $1/(1-\tau/2)$ for the extraordinary ray.

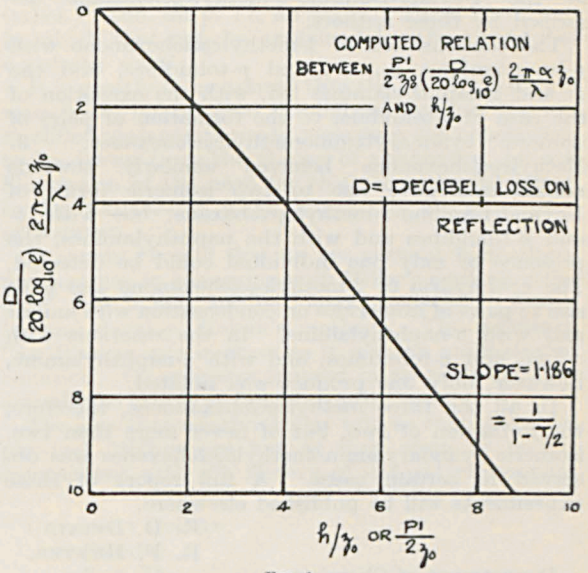

FIG. 1.

This is actually the case for the curve, which is calculated for the extraordinary ray with $\tau^2 = 0{\cdot}1$. The slope of the curve is constant for values of $P'/2z_0 > 4$ and agrees with $1/(1-\tau/2) = 1{\cdot}187$ within the errors of the graphical representation.

This general theoretical reasoning, backed by numerical examples, demonstrates clearly that the method given is quite accurate for the purpose of determining the collision frequency.

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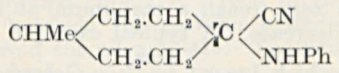
[1] NATURE, **135**, 585; 1935.
[2] NATURE, **135**, 435; 1935.
[3] NATURE, **135**, 618; 1935.

Multiplanar Cyclohexane Rings

THE claim of Dr. Qudrat-i-Khuda[1] to the isolation of the four stereoisomeric forms of 1-carboxy-4-methyl*cyclo*hexane-1-acetic acid required by the Sasche-Mohr hypothesis which it has not been possible to substantiate in this laboratory[2] led us to search for further possible examples of this

phenomenon in reactions involving the methyl*cyclo*hexanones. Attention was directed, therefore, to the condensation of the cyanhydrins of methyl*cyclo*hexanones with arylamines, by an extension of the method used by Walther and Hubner in the case of the simple *cyclo*hexanone[3].

If, for example, 4-methyl*cyclo*hexanone were to react with potassium cyanide and aniline in the stabilised strainless forms, the production of four isomeric 1-cyano-1-anilino-4-methyl*cyclo*hexanes



would be anticipated. This reaction was actually studied by Betts and Plant some years ago, from quite another point of view[4]. Fractional crystallisation of the condensation product led, however, to the isolation of a more easily fusible isomer in addition to the 1-cyano-1-anilino-4-methyl*cyclo*hexane described by these authors.

The condensation of 4-methyl*cyclo*hexanone with *p*-bromoaniline, *o*-, *m*-, and *p*-toluidines, and the α- and β-naphthylamines led, with the exception of the case of *o*-toluidine, to the formation of pairs of isomeric cyanoarylaminomethyl*cyclo*hexanes. 3-Methyl*cyclo*hexanone behaved similarly towards aniline and gave rise to two isomeric forms of 1-cyano-1-anilino-3-methyl*cyclo*hexane, but with *o*- and *p*-toluidines and with the naphthylamines, the presence of only one individual could be detected. The cyanhydrin of 2-methyl*cyclo*hexanone also gave rise to pairs of isomerides on condensation with aniline and with β-naphthylamine. In the reactions with *o*-, *m*- and *p*-toluidines, and with α-naphthylamine, however, only one product was isolated.

In all the three methyl*cyclo*hexanones, therefore, the formation of two, but of never more than two, isomeric cyanoarylaminomethyl*cyclo*hexanes was observed in certain cases. A full report of these experiments will be published elsewhere.

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NATURE, **136**, 301; August 24, 1935.
NATURE, **136**, 608; October 12, 1935.
J. prakt. Chem., **93**, 124; 1916.
J. Chem. Soc., 2073; 1928.

Breeding in Captivity of the South American Lung-fish

IN view of the advantages of the South American lung-fish, *Lepidosiren paradoxa*, as a laboratory animal on account of the large size of its cells and of its vitality, the first record, so far as I am aware, of a successful attempt to breed the fish is of general interest.

At the suggestion of Professor Graham Kerr, a double tank was installed in this Department in 1929, having a wooden lining fitted to float in a large outer tank of galvanised iron. The latter, erected over gas burners, serves as a water-jacket by means of which the temperature of the water in the inner wooden tank is maintained at 20° C. The inner tank, 9 ft. × 2 ft. 9 in. × 4 ft. 3 in., contains water to the depth of 1 ft. 8 in., and in addition about 30 cwt. of mud which was collected from a nearby loch. The mud is piled on an inclined plane diminishing in depth from 2 ft. 6 in. to 1 ft. It forms a narrow platform above the water-level on which an extensive growth of ferns has developed in the last eight months, and the water-surface itself supports a carpet of *Salvinia*. The temperature of the mud increases with depth, reaching a maximum of 26° C. at the bottom of the tank.

An adult female *Lepidosiren* has lived in this tank for the past six years. Until the spring of this year, she had as partner a male specimen which showed breeding signs from time to time; for example, enlargement of the filaments on the posterior appendages, burrowing and taking down vegetation to support the burrow walls. Young, however, were not forthcoming. This male died and was replaced in August by another adult which had lived in a separate tank in the Department for several years. Disturbance of the fish was reduced to a minimum. Maintenance of the water-level by means of two large shower sprays permanently mounted over the tank and connected to the main water supply was permitted, and also the regular introduction of food in the form of sliced beef every second day. No other disturbances were allowed and breeding must have begun very soon after the second male had been placed in the tank. On October 21–22, twenty-two post-larval young (that is, older than stage 36[1]) appeared at the surface amongst the *Salvinia* and were collected.

The *p*H of the water is 6·6 and the oxygen content at the surface 2·3 c.c. per litre, diminishing to 2·0 c.c. per litre at the bottom of the tank.

I am indebted to Mr. H. H. Brown for the oxygen estimations.

C. W. PARSONS.

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[1] J. Graham Kerr, "Normal Plates of the Development of *Lepidosiren paradoxa* and *Protopterus annectens*". Keibel's "Normentafeln zur Entwicklungsgeschichte der Wirbeltiere", 10; 1909.

The Species Problem

MAY I add a few words as a contribution to the species concept discussion which was touched upon in a recent article[1] in NATURE? The ideal species definition has not yet been given, and probably never will be given, the problem being of too complex a nature to be condensed into a single definition.

There is, however, one aspect of the theoretical problem, which I discussed some years ago[2], to which I wish to direct attention here, as I think that special point has not been sufficiently emphasised. Accepting the evolution theory, as we do to-day, we have definitely precluded the possibility of treating the species as the basal unit of taxonomy. The unit must be the different *lines of evolution*. I defined a line of evolution thus: "A taxonomical-phylogenetic line of evolution is a sequence of generations, the individuals of which descend from the individuals of the preceding generation and within each generation group themselves according to the law of probability with regard to all essential features, and further, form a closed sphere of combinations, reacting avitally or incompatibly with all other spheres of combinations with which it comes into contact". The species is the momentary realisation of such a line.

The great advantage of this view is that all demands for *constancy* are omitted from the species definition,

where they are, in reality, absolutely antagonistic to the theory of evolution. By regarding the species as an expression of the line of evolution, and only in that way, can we keep our species concept in conformity with the demands of the theory of evolution.

The curve of variation according to which the values of characters group themselves may change, but so long as it remains *one curve*, we really have the same species, as it is the realisation of the same line of evolution, even if the characters have changed. But if two (or more) different populations of a species change in different ways, so that the curves of variation are no longer congruent, two (or more) species arise from the old one. The line of evolution has divided into new ones, which manifest themselves as different species, none of which is identical with the old one, even if one of them might show to a certain extent the same exterior qualities. For the further consequences of my view I may refer to the original paper; I may add that the problem has recently been touched upon by Hiitonen[3].

KNUT FÆGRI.

c/o Bergens Museum,
Bergen, Norway.

[1] NATURE, **136**, 574, Oct. 12, 1935.
[2] Bergens Museums Årbok 1931. Natv. r. Nr. 4.
[3] *Mem. Soc. Faun. and Flor. Fenn.* (1933–34), 59; 1935.

"The University of London Council for Psychical Investigation"

IN September last the "University of London Council for Psychical Investigation" issued an invitation to an exhibition of fire-walking. Much attention was given to the subject in the daily Press, and an account of the demonstration was contributed by Mr. C. R. Darling to NATURE of September 28, p. 521. From the reports it is not clear what 'psychical investigation' had to do with the heat-resisting properties of the soles (? souls) of the feet; but what was more important was the interest apparently taken by the University of London in an unusual method of studying thermal conductivity. On inquiring, indeed, of the Principal, I was told that the 'University of London Council for Psychical Investigation' had no connexion with the University of London: if it had none with psychical investigation either, that might explain the matter. Since then, however, the "Honorary Secretary of the University of London for Psychical Research" has given an exclusive film interview, which was advertised recently in the programme of the Gaumont-British Movietone News Theatre. "Psychical Research", in spite of the Principal, has clearly come into its own.

It is to be hoped that other learned bodies will follow suit: for example, The Royal (Spook) Society of London; The Marine Biological Association (for the Study of Sea Serpents); The Institution of Fire (-walking) Engineers; The (Psychical) Research Defence Society. My only personal fear is that the Anti-Vivisectionists may seize their opportunity and announce themselves as A.V. Societies.

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Nov. 26.

Kelvin's 'As if' in Physics

IN a letter appearing in the issue of NATURE for November 9, headed "Kelvin and the Age of the Sun", attention is very needfully directed to an instance of a complete misrepresentation of Kelvin's attitude towards a special problem.

A still more lamentable instance was given in a comparatively recent statement, by a leading worker, in which scorn was poured on Kelvin for his support of the so-called elastic-solid theory of the ether. One can scarcely avoid the conclusion that the worker had never read the "Baltimore Lectures", which deals with investigations as great and mind-satisfying as any of the truly great investigations of the present day. For, on p. 9 of the "Lectures", Kelvin says: "The luminiferous ether we must imagine to be a substance which *so far as luminiferous vibrations are concerned* moves *as if* it were an elastic solid. I do *not* say it *is* an elastic solid". (I have added the italics.) And, on p. 17, he says: "There is no way in which that can be explained by the rigidity of an elastic solid".

It is greatly to be desired that the "as if" of Kelvin were freely interspersed throughout many of the unqualified statements made regarding the conclusions to be drawn from the theory of relativity. An apt illustration of the need for this occurs in the letter, by Dr. Lanchester, which appears in the same issue of NATURE.

It cannot be said that we are without indications, for example, in connexion with Miller's work on ether drift, that it may yet be found necessary to return to, and develop, Kelvin's methods. The necessary "as if" is as safe in them as it is in an unillustrated equation. Co-ordinates ignored in an equation may actually be the most fundamentally active.

The idea that relativity first told us that, possibly, physical "things are not as they seem to be" is inconsistent with the history of natural philosophy.

W. PEDDIE.

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Dundee.
Nov. 11.

A New Technique in Cookery

THE authorities on cooking understand the effects of time and temperature[1] better than one might be led to suppose from Mr. Dufton's comments in his letter[2] under the above title.

The new technique is interesting, and has some obvious advantages over normal roasting, which demands experience, personal attention and a knowledge of cuts, but the meat is really *stewed* in its own juices for a very long time. It would be a tough joint indeed that resisted fifteen hours cooking at 212° F., if evaporation was prevented. Stews can be delicious, and are generally made from inexpensive meats.

In *roasting*, the centre of the joint never reaches 212° F.; for 'well done' meat the maximum recommended is 180° F. to 185° F. Hence only cuts which do not require prolonged hydrolysis can be roasted successfully. Tough meat has to be stewed or boiled for some hours because more drastic hydrolysis of the tissues is needed to secure a tender result. To do this in the ordinary oven, water must be added on account of evaporation; but the smaller the excess, the more flavoursome the meat: a large excess yields tasteless meat, but good broth.

Although fully appreciating Mr. (and Mrs.) Dufton's contribution to the economics and technique of stewing, we would point out that :

(1) high temperature ovens are required for other dishes ;

(2) the cooking of meat and, incidentally, of other foods, has been studied scientifically, though not exhaustively ;

(3) many people consider the appearance and flavour of outside cuts to be worth the trouble and expense of roasting.

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L. HALL.

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[1] Vide "The Boston Cooking-School Cook Book", revised edition, 1933, p. 239 *et seq.*
[2] NATURE, **136**, 796, November 16, 1935.

Food and the Nation

I WAS disappointed not to find in the article under this heading in NATURE of November 18 any reference to the change that has taken place during the last half century in the manufacture of white bread.

In my young days, flour was produced by grinding wheat between millstones, whereby the skin of the grain (not the husk) was preserved in the flour. A notion having got abroad that the excellence of bread is in proportion to its whiteness, steel rollers were made to replace the millstones, whereby the grain was stripped of its dusky skin, with its valuable vitamin contents, and the baker was enabled to produce a whiter loaf.

Simultaneously with this change has grown the manufacture of margarine, coloured and flavoured to resemble butter, but with little, if any, of its nutritive quality. It is distressing to see children in our large cities fed chiefly on white bread and margarine.

In India, rice—the staple food of millions—is now milled in the same drastic way as wheat is in Europe, resulting in widespread mortality from beriberi.

Stone-ground flour is still produced in Great Britain. My own household is supplied with it from a mill in Horsham, and the bread baked from it is more agreeable in taste than the baker's ultra-white.

HERBERT MAXWELL.

Monreith,
Whauphill,
Wigtownshire.

WHAT Sir Herbert Maxwell says with regard to the loss of nutritional value through the widespread use of white bread and margarine is no doubt true enough ; but omission of reference to this point does not affect the economic relationship between food-production and consumption, with which the article was particularly concerned.

Editor, NATURE.

Points from Foregoing Letters

Helium produced from boron by neutron bombardment has been purified, observed spectroscopically, and measured by Prof. F. A. Paneth and H. Loleit. This seems to be the first case where an artificially produced element has been detected spectroscopically and measured by other than radioactive methods.

Dr. L. Szilard states that slow neutrons filtered by thick sheets of a strongly absorbing element like cadmium are strongly absorbed by thin sheets of indium and some other elements, though cadmium itself is transparent for such residual neutrons from cadmium. This is in contradiction to the conclusions usually drawn from current theory. The residual neutrons from cadmium show strong selective absorption effects, and are in some elements more absorbable than the unfiltered beam.

Dr. Hans von Halban, Jr., and Dr. Peter Preiswerk have determined the degree of activation produced in a silver plate by neutrons (from a radon-beryllium source) slowed down by passing through various thicknesses of water, alcohol, benzene and liquid paraffin. The difference in the effects observed suggests that the molecular structure of those compounds may affect the amount by which the velocity of the neutrons is reduced. The authors believe that the neutrons part with some of their energy in order to excite rotation and oscillation of the hydrogen atoms in those compounds.

A modification of Born's theory of the electromagnetic field has been suggested by M. H. L. Pryce to explain the existence of two different kinds of charged particles, electrons and protons, both with the spin $\frac{1}{2}$. Dr. Max Born calculates the mass of the proton by means of formulæ derived from that theory ; he arrives at the value 2,400, which is of the right order of magnitude. He points out that the theory allows for the transformation of a proton into a positron, with emission of radiation quanta of one thousand million electron volts, such as are found in cosmic rays.

T. L. Eckersley maintains that, notwithstanding the criticisms of Farmer and Ratcliffe and of Prof. Appleton, his previously suggested formula for the calculation of the frequency of collision of electrons in the upper atmosphere gives sufficiently accurate results.

Dr. R. D. Desai and Prof. R. F. Hunter state that they have carried out further experiments with methyl*cyclo*hexanones in order to test the Sasche-Mohr hypothesis, according to which four isomeric forms of certain derivatives of these compounds should exist ; but so far, they have been unable to obtain more than two isomeric cyanoarylamino derivatives.

C. W. Parsons reports that a pair of South American lung-fishes, living in a wooden tank containing mud and partly filled with water, maintained at 20° C., have bred after a period of some months during which they have been disturbed as little as possible. Twenty-two young fish (just post-larval) have appeared at the surface, representing the brood. This seems to be the first record of this fish breeding in captivity.

Knut Fægri states that, in dealing with biological classification, it is preferable to speak of "lines of evolution" rather than species. A line of evolution is a sequence of generations, the individuals of each generation grouping themselves according to the law of probability with regard to all essential features. Only by regarding the species as a momentary expression of the line of evolution, Mr. Fægri states, can the species concept be kept in conformity with the theory of evolution.

Research Items

Venezuelan Archæology

THREE new archæological sites in the State of Falcón, Coro, El Mámon and La Maravilla, in the important but little explored coastal area of northern Venezuela, have been described by Gladys Ayer Nomland (*Ibero-Americana*, **11**). They are situated in the midst of shifting sand dunes in the flat coastal strip at the edge of the plain, which lies between the inland range of mountains and the present coast line, and was left by the retreat of the sea with which it was covered in Pleistocene times to a distance of twelve kilometres inland. This flat strip must have served as a cultural highway between central and eastern South America. The location of the sites, excepting the hill-top site of El Mámon, was determined by the seasonal presence of dammed water in the gullies. The inhabitants lived by hunting and fishing. The absence of any signs of European contacts is strong presumptive evidence of a pre-Columbian dating. Notwithstanding the fragmentary condition of both pottery and skeletal remains, it is evident that the inhabitants practised urn burial, presumably as a secondary interment, judging from the size of the mortuary vessels, which could not have held a corpse entire. The artefacts from the sites consisted of pottery, implements of black and green stone, and ornaments of shell, pottery and stone. The pottery comprises a grey-brown ware, painted ware and a red ware. The ornament is geometric. In the Venezuelan fictile art, which is of a high degree of excellence, the plain red and grey-brown ware appear to form the basic substrata from which the more complex painted ware was developed. Certain groups can be differentiated, but phylogenetic relations are to be traced. The site of Coro, however, stands apart, the red ware diverging from the orderly progression into the highly complex incised group and not in the direction of the painted ware as elsewhere. This may be due to chronological difference, Coro probably being the earliest and La Maravilla, with its rich development of painted wares, the latest; but this is mere conjecture. The groups cannot be affiliated with any other datable groups.

Courtship of Manakins

THE manakins (not to be confounded with the fashionable variety!) are small passerine birds (family Pipridæ) inhabiting the tropical and sub-tropical regions of America, exclusive of the Antilles. They show courtship behaviour which in some species is complex, co-operative and well organised, and the existence of fundamentally similar habits among widely distributed and strongly differentiated members of the same family suggests that these are rooted in the origin of the family itself and are as much part of its evolution as is form. Frank M. Chapman has made a particular study of the courtship of Gould's manakin (*Manacus vitellinus vitellinus*) on Barro Colorado Island (*Bull. Amer. Mus. Nat. Hist.*, 68, 471, Sept. 1935). About a fortnight before courtship activities begin, the males commence to gather at an established *lek* or courting ground in the forest. The arrival of the breeding season is marked by the making of a 'court' from which the male removes all loose material, and into which the chief object of its existence is now to induce a female to enter. The courting ground generally contains from five to seven courts, thirty to forty feet from each other. Since the males have limited vocal powers, they announce their presence by making snapping and whirring sounds with their wing-feathers. When a female has once entered a court, there is no further competition for her favours by other males. The courting site has no immediate connexion with the nesting site, for the nest is built in a forked branch a short distance off the ground (twenty inches to five feet) usually a hundred yards or more from the nearest court.

Evolution of the Human Foot

HERBERT ELFTMAN and John Manter (*J. Anat.*, 70, Part 1, Oct. 1935) state that the fundamental similarity in architecture of the foot of the chimpanzee and that of man leaves no doubt as to the evolution of the human foot from that of an ape. Superimposed upon this structural similarity are important differences, considered in some detail, which the foot has undergone in evolution. The authors state that although the gorilla resembles man more closely than does the chimpanzee in the relative shortness of the lateral digits of the foot, it shows no indication of the more fundamental changes which are essential for the development of the human condition. "The fact that the human foot, adapted as it is for walking on the ground, bears a closer resemblance to the ape foot as used in arboreal than in terrestrial locomotion, may be regarded as another evidence of man's arboreal ancestry. It would also suggest that the essential features of man's foot were acquired at an early stage of his terrestrial existence, rather than after long apprenticeship on the ground."

Crustacea of Jehol

IN the report of the first scientific expedition to Manchoukuo under the leadership of Shigeyasu Tokunaga, June–October 1933 (Sect. 5, Div. 1, Part 2) various crustacea are described by Masuzô Uéno (Phyllopoda), Tune Sakai (Decapoda-Brachyura) and Hajime Uchida (terrestrial Isopoda and freshwater Amphipoda). Most of the text is in Japanese, but there are descriptions of species and bibliography in English, and all the papers are beautifully illustrated, some in colour. *Apus numidicus* was found in a swamp of alkaline water in the northern part of Jehol. It is a form typically inhabiting water of warm and arid regions of Africa and the south-western parts of Asia. The extension of its distribution into Manchoukuo from these western regions is probably due to the similarity of ecological conditions in both countries. Only one crab was collected by the expedition, *Eriocheir sinensis*, the mitten crab, which has now become notorious from its having been accidentally imported from China into Germany and settling there. It is now difficult to eradicate. Of terrestrial Isopoda, only one species was found, a new one, *Porcellio jehoensis*; and one new species of Amphipod, *Gammarus nekkensis*, inhabiting a cold spring, 1,000 metres above sea-level.

Plankton Production in the Southern Hemisphere

THE yearly cycle of events in the production of marine plankton has been followed for many years and in many places in the northern hemisphere. Similar observations are, however, to a large extent lacking from coastal waters in the southern hemisphere. It is therefore worthy of note that the yearly sequence has been followed in Australian waters off Sydney (Dakin, W. J., and Colefax, A., "The Marine Plankton of the Coastal Waters of New South Wales (1)", *Proc. Linn. Soc. N. S. Wales*, **58**, Parts 3–4, 186–222; 1935). Collections made at fortnightly intervals throughout the year showed that in its main essentials the seasonal cycle is similar to that known for northern waters. The phytoplankton production shows two peaks, one in early spring and a smaller one in late summer. The spring outburst is not so markedly great as in northern seas; but it is of interest to find that the similarity extends also partially to the sequence of species, in that *Rhizosolenia* species follow those of *Chætoceros*. The zooplankton appears also to show two maxima, occurring respectively just after the two phytoplankton maxima. Tables are given for all the plankton catches, the organisms being identified to species so far as possible. This work forms a valuable foundation for further research on the plankton of Australian waters.

Primitive Colour-Pattern of Insect Wings

MR. HEMMING LEMCHE, of the Zoological Laboratory of the Royal Veterinary and Agricultural College, Copenhagen, discusses this subject in a recent paper (*Vidensk. Medd. fra Dansk naturh. Foren.*, **99**, 45–64; 1935). His chief contention is that there exists in insect wings a primary colour-pattern, which can be traced back to an archaic pattern common to all insect groups. This archaic pattern comprises a number of cross-bands (most probably seven) separated by hyaline interspaces. He further points out that these archaic cross-bands traverse the wing in such a way that the bifurcations of the veins lie at the inner edge of the bands. It follows from this contention that the primary vein-forks cannot have been scattered irregularly over the wing, but have been located in cross-lines represented by the inner edges of the bands. The theory, it is claimed, is supported by evidence afforded by the most primitive fossil insects. Traces of the primitive banding are also retained among generalised Lepidoptera, in Mecoptera and in Acridiidæ among living forms. The present paper, it is stated, will be followed by more detailed studies which will form the subject of a later contribution.

Leaf and Scale Types in *Pinus*

WITHIN this single genus, indeed upon a single tree, are found four distinct types of branch system, long shoot, dwarf shoot, staminate cone axis and ovulate cone axis, and the generally accepted theories of this last cone would add yet another, the axis of the seed scales. Upon these varying branch systems are found no less than eleven types of foliar structures which include some leaf types, many scale types and the sporophylls. A most instructive analysis of these different foliar and branch types, of their development and structure and of their homologies, has been prepared by Dr. C. C. Doak (*Illinois Biol. Mon.*, **13**, No. 3, August 1935). Evidence for reduction of leaf number both in the fascicles of the short shoots and in the number of simple leaves or cotyledons in the seedlings thus emerges very convincingly, whilst the influence of the closely knit surrounding bud scales upon the shape and growth of the meristematic basal regions of the needles growing within is very clearly brought out. Alike in its extensive and clearly recorded observations upon some thirty-five species of pines and in its extensive and critical survey of the relevant literature, this monograph will have permanent value as a contribution to some of the most intriguing problems of shoot morphology.

Asparagus Cultivation

A SHORT note by Mr. A. N. Rawes (*J. Roy. Hort. Soc.*, Oct. 1935) gives some very useful information about the cropping of *Asparagus*. Several series of beds containing all male plants were compared with beds planted with female crowns. The result showed that in every case the male plants yielded about 60 per cent more saleable stems than the females. The series covered a variety of planting methods and differing cultivation, but the superiority of the males was obvious in every case. Very little difference in the relative grades of produce was, however, demonstrable between the two sexes. The paper reports a continuation of previous experiments made at the Wisley gardens, with confirmation of the earlier results, and also discusses the merits of close and wide planting.

Antarctic Moraines

IN his presidential address to the Australian and New Zealand Association for the Advancement of Science, 1935, now reprinted in pamphlet form, Sir Douglas Mawson gave a lengthy review of the unveiling of Antarctica, and discussed several of the problems which that continent presents. He stressed the evidence of the former much more extensive glaciation and noted particularly the recent recognition of terminal moraines on the sea floor often fifty to one hundred miles beyond the real coast line. These moraines are frequently hundreds of feet in height. Off Adelie Land the height of the chief off-shore moraine is about three thousand feet. It is the occurrence of these submarine banks that has much to do with the ice-obstruction that prevents access to certain coasts of Antarctica. Huge icebergs become grounded in 600–1,000 ft. of water and hold up floating pack, and thus coastal waters are blockaded. It is noticeable that where the sea floor is down-faulted, as on the west of the Ross Sea or the east of the Weddell Sea, deep water prevents these moraines acting as barriers to moving ice. Such shores are relatively accessible. It is only the action of periodic super-tides as described by O. Pettersen that moves the more securely anchored ice obstructions.

Earthquakes and Rainfall

MR. J. F. BRENNAN, Government meteorologist in Jamaica, has recently made an interesting comparison between the mean monthly frequency of earthquakes and the mean monthly rainfall in Jamaica (*Earth. Notes, East. Sect. Seis. Soc. America*, **7**, 25–26; 1935). During the years 1908–34, 480 earthquakes were recorded. The curve representing the mean monthly frequency shows two maxima, in February (60 earthquakes) and July (46), both months of minimum rainfall, and two minima in May (25) and

October (31), months of maximum rainfall. The author suggests that the greater frequency of earthquakes during the dry seasons may be due to the withdrawal of water from underground water-courses, which may thus facilitate the fall of large masses of rock.

Irrigation Research

THE Punjab Irrigation Research Institute has issued two further reports of its work. In "Protection below Khanki Weir" (2, No. 8, Nov. 1934), Mr. J. P. Gunn gives an account of the experiments made, by means of models, to determine an effective and simple method of preventing scour at the reconstructed portions of the Khanki Weir, which is built on a sand foundation. The arrangement adopted and incorporated in the new works consisted of three rows of 'arrows' pointing upstream, followed by several rows of control blocks, as it had been found that this gave a low velocity of flow at the bottom without local turbulence and had the effect also of raising the level at which maximum velocity occurred sufficiently near the surface of the water to stabilise the scour. The results in practice are so far reported as satisfactory, but a complete investigation could not be made until the fall of the river. In the second of these reports, entitled "Influence of an Upstream Sheet Pile on the Uplift Pressure on a Floor" (2, No. 9, Jan. 1935), Dr. N. K. Bose, mathematical officer, and H. L. Uppal, assistant research officer, present the results of one of a series of experiments directed towards ascertaining the influence of different arrangements of sheet piling on the distribution of floor pressure. The work has involved extensive observation and mathematical analysis of the data obtained, and from it two general conclusions are drawn: namely, that, length for length, a long sheet pile is less effective than a short one, and that the longer the sheet pile the less effective is the floor. As the investigation proceeds, it is hoped to be able to determine data for safe and economical dimensions under varying working heads.

Solar Radiation and Weather Studies

IN "Solar Radiation and Weather Studies" by C. G. Abbot (*Smithsonian Miscellaneous Collections*, 94, No. 10) an account is given of an investigation begun by Dr. S. P. Langley, formerly secretary of the Smithsonian Institution, into the dependence of weather on variations in the radiation emitted by the sun. While few physicists or meteorologists are likely to dispute the probability of a connexion between the two, some may doubt whether the problem of measuring the solar radiation, which involves various assumptions about the relation between its intensity outside the earth's atmosphere and at the point where measurement is made, has been solved, and may regard any apparent variations of the intensity, after due allowance has been made for the varying distance between the earth and the sun, as mere errors of measurement and computation. Such doubts may perhaps be dispelled by the generally close resemblance found between graphs representing the day to day values of the solar 'constant' obtained by measurements made at places so far apart as Montezuma (Chile), Table Mountain (California) and Mount Brukkaros (South West Africa) illustrated in this work. The solar variations on which the comparisons in this discussion are mainly dependent are those revealed by ten-day means of the solar 'constant' for the period 1920–34. A number of periodicities ranging from 7 months to 68 months were revealed by a variant of the periodogram method of analysis, and these suggested the existence of a well-marked 23-year period. For tracing the connexion between these and weather, use has been made of long meteorological records collected together in an earlier Smithsonian Publication—"World Weather Records". Considerable success is claimed in this, and practical application of the results was made in long-period forecasts for 1934, 1935 and 1936; it is stated that these were fairly well verified for temperature and precipitation in 1934.

Vibration of an Incomplete Circular Ring

FINDING that Lamb's method of treatment is applicable only to relatively small arcs of rings, Mr. T. Ikebe has investigated, by means of a mathematical analysis, the frequency and form of vibration of a ring having a very small air gap ("On the Vibration of an Incomplete Circular Ring", *Sci. Pap. Inst. Phys. and Chem. Res., Tokyo*, 27, No. 589). His investigation is based on equations given by Prescott in "Applied Elasticity", and proceeds by the application of Ritz's method and of an integral equation to determine values of the frequency of a ring of negligible cross-sectional dimensions. Comparison of these results with those obtained experimentally reveals marked discrepancies, which are considered to be due to the effect of rotational energy in the test ring, the radial thickness of which cannot be regarded as negligible. A further investigation, giving effect to the influence of rotational energy, yields more comparable results; but as the experiments were carried out on a magnetised ring and in a magnetic field, some doubt is expressed as to the effective value of Young's modulus and as to the condition of free oscillation.

A Method of Improving the Radio Beacon

IN 1929, the Air Ministry erected an improved rotating beacon at Orfordness, Suffolk, for direct navigational use in the North Sea. Mr. H. A. Thomas has discussed the possible errors of this method when the navigator uses it to find the direction of the beacon from the ship (*J. Inst. Elec. Eng.*, 77, 285). An analysis of the records of bearings taken on this beacon by ships at sea shows that within a range of 100 miles, about 80 per cent of the bearings obtained were correct within 2°, whether taken by day or by night. At greater distances the day observations showed reasonable consistency up to 250 miles, but the night observations gave evidence of the well-known 'night effect' errors. These effects are known to be due to interference at the receiver on the ship between the ground ray and other rays which have travelled through the upper atmosphere. These produce false bearings owing to the lack of definiteness of the minimum points. With the operating frequency 288·5 kilocycles (1,040 metres) at present allocated to rotating beacons, it is necessary to use a large aerial system, and rotating this produces mechanical difficulties. In the system described by Mr. Thomas, there are two pairs of spaced aerials supplied by two power amplifiers. These amplifiers, automatically controlled, provide the necessary voltage variations. Experiments show that a controller of this type can advantageously fulfil the function of an excitation apparatus. It is concluded that the system would be suitable for incorporation in a full-sized rotating radio beacon for marine navigational purposes.

British Institute of Radiology: Annual Congress and Exhibition

THE ninth Annual Congress and Exhibition of the British Institute of Radiology was held in the Central Hall, Westminster, on December 4–6. As usual, one session was devoted to the reading of papers on the physical and technical aspects of X-rays as applied to medicine.

Dr. J. Read, of the Radium Institute, gave a lecture on "High Voltage X-ray Tubes in the U.S.A.", in which he traced the development of continuously evacuated tubes for voltages up to one million volts. The first tube of this type, constructed by Lauritzen at the Kellog Laboratory, Pasadena, in 1927, was successfully operated at 600 k.v. peak supplied by an alternating current generator comprising four transformers in series. The tube, which was self-rectifying, had a glass envelope some nine feet long and an earthed anode. A later tube of the same type has a central earthed discharge-chamber and a balanced arrangement of electrodes, one at 500 k.v. positive potential to earth and the other at 500 k.v. negative potential to earth, so that the peak potential difference between the electrodes is 1000 k.v. Whereas the earlier tube made use of the 'cold emission' of electrons, the later tube has a shielded hot filament. Special vacuum pumps, first of the mercury vapour type with liquid-air traps and later of the oil vapour type, were designed. The latest pump has a pumping speed of 2,000 litres per second.

A somewhat similar X-ray tube excited by alternating voltages up to 100 k.v. peak has been installed at the Soiland Institute. In this tube, the glass envelope is replaced by a porcelain one consisting of a large transformer bushing insulator, this permitting a considerably smaller over-all length. At Lincoln (Illinois) and at the Harper Hospital, Detroit, similar tubes are operated by constant voltage generators. Rather different types of tubes and generators are installed at Seattle and at Chicago. In these installations, the high-tension generators consist of two Villard generators connected in series, and the tubes are built in a cascade arrangement so that the electrons are subjected to successive accelerations. This design reduces the cold emission of electrons, but requires a considerably better vacuum than the Lauritzen design. A further difficulty in operating such tubes arises from the fact that, owing to the long electron path (some 10 feet) the electron beam is deflected by magnetic fields to a serious extent. The effect of the earth's field may be balanced out by suitably disposed magnets, but even so the focus is apt to wander.

Dr. Read also described an ingenious arrangement devised by Sloan at the San Francisco hospital. In this outfit, the high-tension generator consists of an oscillator generating high-frequency waves of 6 metres wave-length, coupled as in a Tesla transformer to a tuned secondary. The transformer is mounted in an evacuated tank, and the high-potential end of the secondary carries the target of the X-ray tube, the filament being mounted in the side of the tank. The high-tension transformer and X-ray tube are thus mounted in the same vessel, and the complete outfit is considerably smaller than those previously considered. Some difficulties are experienced owing to mechanical vibrations of the high-tension coil, and the efficiency of the generator is rather low, an input power of about 100 k.w. being required to give a reasonably powerful X-ray beam.

Dr. L. H. Gray, of the Mount Vernon Hospital, gave a paper on "The Ionisation Method of Gamma Ray Energy Measurement", in which he showed theoretically that the degree of ionisation produced in light elements can be related to the energy of the radiation, and measured by ionisation in air. The possibility of measuring gamma ray energies by ionisation depends on two factors: (1) The energy required to produce an ion pair in air must be independent of the velocity of the ionising electrons; and (2), the ratio of the stopping powers of air and other materials for electrons must be independent of the velocity of the electrons. Reviewing the experimental evidence, he is of opinion that both these conditions are fulfilled. In the case of heavy elements, the degree of ionisation is relatively higher, due to the fact that the absorption process is not wholly one of scattering, but is partly photo-electric. In aluminium the ionisation is some 10 per cent higher than in carbon, and in lead more than four times as great.

The eighteenth Silvanus Thompson Memorial Lecture was given by Dr. G. W. C. Kaye, of the National Physical Laboratory, on "Forty Years of Radiology (1895–1935): A Review and Some Reminiscences". Observing that, almost to the day, forty years have passed since Röntgen's discovery of the radiation that bears his name, Dr. Kaye reviewed in a fascinating manner the history of the subject, starting from the early gas X-ray tubes excited by induction coils, passing on to Coolidge's invention of the hot cathode tube (1913), Bouwer's development of the self-protected tube and the recent advances of various types of shock-proof equipment. High-tension generators, he said, beginning as induction coils and made by instrument makers, have become more and more powerful, and modern equipment follows closely the lines of other branches of electrical engineering. Apart from everyday apparatus in use in all hospitals, there is a tendency, particularly in the United States, to experiment with much higher voltages, and generators and tubes operating at one million volts have been described. In Great Britain, X-ray treatment with 400 kilovolt X-rays is being carried out in several hospitals in London, Leeds, Manchester and Birmingham.

Reviewing the question of dosage, Dr. Kaye stated that the ionisation unit of X-ray quantity, the röntgen, has practically replaced the older arbitrary standards such as the pastille dose. Recent research, he said, appears to show that the röntgen will also serve as a unit of gamma-ray dose. Touching briefly on radium therapy, Dr. Kaye remarked that since 1913 the National Physical Laboratory has measured about a quarter of a pound of radium, of value more than a million pounds, the bulk of this radium being the property of the National Radium Trust. Mention was also made of the industrial and physical applications of X-rays in the radiographic and fluoroscopic examination of objects and the study of the solid state of matter by crystal analysis.

Lightning Stroke Currents

RECENT laboratory researches on impulsive rushes of electricity produced by high-voltage discharges of condensers have proved of great value by leading to improvements in the methods used in protecting buildings and overhead wires from damage by lightning strokes. The discharge in the laboratory is very similar to the lightning stroke in Nature. The sound produced, although the arc is only a few feet long, is uncomfortable and often painful to the ear. Anyone taken unawares by a laboratory discharge occurring a few feet away might be seriously affected by the blinding light and the deafening noise produced.

In a paper read at the Pacific Coast Convention of the American Institute of Electrical Engineers, Seattle, Mr. P. L. Bellaschi gives definite and interesting information about lightning strokes. Statistics prove that most of them are single discharges. The number of multiple discharge strokes is about 20 per cent, and the number of oscillations is very seldom greater than four. Field observations show that multiple discharges sometimes strike the ground at appreciable distances apart. Hundreds of cases are known where bronze conductors, used in telephone circuits, which are about 2 square millimetres in cross-section have been fused by lightning. A case has been reported where lightning has vaporised a 3·34 sq. mm. copper conductor. Several thousands of wood poles used for telegraphs and protected by 21 sq. mm. steel wires connected to the earth have been kept under observation for several years. None of the wires was found fused and none of the poles was damaged, although previously to being protected they were often found shattered.

Assuming that an ordinary lightning stroke fuses a 2 sq. mm. bronze conductor, and that it consists of a single discharge, then on the basis of a duration of 40 microseconds, the maximum value of the current produced by the stroke would be of the order of 100,000 amperes. On the basis of a 100 millionths of a second duration, the current would be of the order of 65,000 amperes. The data available show that currents as high as 200,000 amperes would be very rare.

Photographs are shown of copper tubes that have been crushed inwards by lightning discharges. In one case a hollow copper rod 1·47 cm. inside diameter and 6·675 mm. thick was crushed by lightning. From the incipient fusion shown in several places, the rod was obviously raised to a high temperature. The crushing force was calculated to be 400 lb. per sq. inch of tube surface. An oscillatory discharge would considerably increase this crushing force.

Lightning strokes to guy wires have blasted the rock, cement, etc., in which the wires were embedded. The shattering of poles and trees is a familiar occurrence. Parts of shattered objects have been thrown distances of more than a hundred feet. Metal pipes have been cracked and broken open by lightning. Experiments are quoted which show that the diameter of the lightning stroke channel generally lies between one and two centimetres.

Aluminium in Food

STATEMENTS appear from time to time incriminating the use of aluminium cooking utensils as dangerous to health, the small amounts of the metal that are dissolved by the food being considered responsible for the occurrence of various human ailments. As often as such allegations have been made they have been denied, and the question is not yet settled. There is no doubt that the ingestion of relatively large amounts of aluminium produces toxic symptoms, but it is not so simple to prove the toxicity to human beings of the minute amounts which are non-toxic to animals. In any event, knowledge of the amounts of the metal likely to be met with in cooked foods and of the amounts producing symptoms in animals is a prerequisite to a discussion on the subject. Such information is provided in a recent review by Monier-Williams*.

Alum itself has in the past been used as the acid ingredient of commercial baking powder and is still so used in some countries: bread made with such a baking powder may contain as much as 0·05 per cent of aluminium, or 500 parts in a million. The amount found in foodstuffs is much less and a large part of that found in plants is probably adventitious in origin, due to contamination with soil and dust. Probably the amount consumed daily with food is of the order of 5–10 parts, or less, per million. In animal organs the quantities are of the order of 1–2 parts in a million.

The accurate determination of aluminium in food and biological material is a difficult matter. Monier-Williams describes a method in which 8-hydroxyquinoline is used as a precipitating agent for aluminium. It has the advantage that the compound with aluminium contains only 5·9 per cent aluminium, so that small amounts can be determined with great accuracy; the precipitate can be weighed or titrated with bromine.

The amount of aluminium taken up by food during cooking varies greatly with its nature, especially its acidity, and the conditions of cooking as well as with the particular utensils used: the purer the metal employed in the latter the more resistant is it to corrosion. Probably less than 10 parts in a million

* Ministry of Health. Reports on Public Health and Medical Subjects, No. 78: Aluminium in Food. By Dr. G. W. Monier-Williams. Pp. 34. (London: H.M. Stationery Office, 1935.) 9*d*. net.

is usually the amount occurring in food cooked in aluminium vessels. It appears that a considerable proportion of the metal taken into the stomach is soluble, but the actual amount dissolved varies greatly with the circumstances. Only minute amounts, however, appear to be absorbed into the body, from determinations of the quantity in the blood, tissues or urine. The presence of relatively large amounts of the metal in the digestive tract may interfere with the digestive processes, alum especially producing gastro-intestinal irritation and loss of appetite in both animals and man.

Neither these experiments nor those which show the harmlessness of the ingestion of small amounts of aluminium are necessarily conclusive, since it is possible that there may be individuals who are susceptible to even such small doses of the metal as may be derived from aluminium utensils. Monier-Williams concludes that there is no convincing evidence that these small amounts have a harmful effect upon the ordinary consumer, but that it is undesirable to admit the entry of aluminium into food in the relatively large amounts in which it may be employed as a constituent of baking powders or self-raising flour.

Phytoplankton and Herrings*

THE concentration of phytoplankton organisms at times in dense patches in various parts of the sea is a phenomenon, which was recognised by early observers (see also NATURE, Dec. 7, p. 897). These brownish or greenish patches in the North Sea, usually formed of the diatoms *Rhizosolenia* or the colonial flagellate *Phæocystis* and accompanied by a slime which clogs the nets are well known to the fishermen, who call such discoloured water 'stinking water', 'weedy water', 'Dutchman's baccy juice', etc., regarding it as a bad sign for the fishing. The present authors analyse the herring fishery of the southern North Sea together with the occurrence of these phytoplankton patches, the object of the work being "to give an account of our knowledge of the distribution and movement of any dense phytoplankton concentrations in the southern North Sea from 1921 to 1932 (excepting years 1928 and 1929) at such times as might affect the herring fishing, and by examining the official reports and statistics of the fisheries from year to year to see whether or not the existence of these patches, either on the fishing grounds themselves, or lying in the path of incoming shoals of fish, can be regarded as a probable cause of some of the fluctuations in the herring landings over this period."

It has been found again and again that where large zones of phytoplankton occur the herrings avoid them, sometimes making extensive detours rather than penetrate them, and that these patches form definite barriers to the oncoming shoals.

At the time of the great herring shoaling in the southern North Sea, *Rhizosolenia styliformis* and *Phæocystis* are the outstanding features of the plankton in this area, and when the fish have been plentiful and the fishing above the average, no instance is found of a concentration of plankton in such a position where it might be held to have an influence on the fishery, whereas on each occasion when the fishery has been below the average and the decrease cannot be attributed to weather or economic conditions, phytoplanktonic concentrations occurred. Four factors are cited as possibly influencing the fishery—the effect of the moon, year classes, gales and economic conditions; to these are now added the very probable and now almost certain factor of influence of phytoplankton.

The authors note further that since the present paper was being prepared for press another autumn season has come round, 1933, and this brings with it such striking evidence in favour of the phytoplankton hypothesis that they feel justified in regarding this as not only possible but even highly probable.

* Ministry of Agriculture and Fisheries. Fishery Investigations, series 2, vol. 14, No. 2, 1934: Phytoplankton and the Herring. Part 1: 1921 to 1932. By R. E. Savage and Prof. A. C. Hardy. Pp. 73. (London: H.M. Stationery Office, 1935.) 3*s*. 6*d*. net.

Educational Topics and Events

CAMBRIDGE.—N. G. Hentley, of St. John's College, has been appointed to the Benn W. Levy research studentship in biochemistry.

At Queens' College, Sir C. J. H. Thomas, Permanent Secretary of the Ministry of Agriculture and Fisheries, has been elected into an honorary fellowship.

Mr. C. W. Gilbert, of Christ's College, has been elected into a research fellowship at Jesus College.

An election to the Pinsent-Darwin studentship in mental pathology will be made in January 1936. The studentship is of the annual value of not less than £225, and is tenable for three years. The student must engage in original research into any problem having a bearing on mental defects, diseases or disorders, but may carry on educational or other work concurrently. Applications should be sent before January 1, 1936, to the Secretary, Pinsent-Darwin Studentship, Psychological Laboratory, Cambridge.

ELECTIONS to three Beit fellowships for scientific research will take place on or about July 10, 1936. A fellowship is of the annual value of £240, and is tenable for two years at the Imperial College of Science and Technology, South Kensington, London, S.W.7. Candidates must be less than twenty-five years of age. Further information can be obtained from the Rector of the College.

THE thirty-sixth annual meeting of the Science Masters' Association will be held in the Chemistry Department of the Imperial College of Science and Technology, South Kensington, London, S.W.7, on January 1–4, under the presidency of Sir William Bragg. The following lectures will be delivered during the meeting: Sir William Bragg, "School Science after School" (presidential address); Prof. J. C. Philip, "Chemical Fogs"; Prof. J. W. Munro, "Recent Advances in Economic Entomology"; Dr. H. J. T. Ellingham, "Primary Cells: their Nature and Action"; Dr. John Taylor, "The Doctor as Detective". There will also be a lecture-demonstration of biological films by H. R. Hewer. Among the discussions to be held is one on "Geometrical Optics—especially Sign Conventions" and another on "School Certificate Biology Syllabus". Further particulars can be obtained from the Annual Meeting Secretary, The Square, Repton, Derby.

Science News a Century Ago

Meeting of the Royal Geographical Society

AN ordinary meeting of this Society was held on Monday, December 14, 1835, at its rooms in Regent Street. The president, Sir John Barrow, "announced that the Council had decided that His Majesty's annual premium should be awarded to Captain Back, on account of his recent discoveries, and particularly of a large river running beyond the Great Slave Lake a distance of 500 miles. He felt convinced that the south land seen by Captain Back was the coast of North America, and this convinced him of the possibility of a north-western passage. He was happy to state that the Council had decided in Captain Back's favour on no other authority than that of his simple and affecting narrative. So closely had he been within starvation that he had been compelled, on one occasion, to eat his own shoes; yet notwithstanding the great sufferings which he had undergone, he had come forward gratuitously to the assistance of his 600 fellow-countrymen who were now enclosed in the ice on the shores of Greenland with no other prospect before them than death. He was happy to announce that Captain James Ross had previously offered his aid to the Admiralty, which, he had every reason to believe, would be accepted." (*Courier*.)

Central Agricultural Society of Great Britain and Ireland

As the result of a largely attended meeting held on December 15, 1835, at the Freemasons' Tavern, Great Queen Street, a society called the Central Agricultural Society of Great Britain and Ireland came into existence. At the meeting, Mr. Ormsby Gore, M.P., was in the chair, while the Earl of Stanhope was the principal speaker. A few days later, on December 21, the Society published a notice in *The Times*, stating that at a meeting of the Committee held on December 16, at 448 West Strand, London, it was resolved that the objects of the Society "be exclusively national; directed to no theoretical purposes but formed solely with a view to procure the co-operation of the owners and occupiers of land in every practicable measure which can afford relief to the present distressed state of agriculture . . . and with a view to improvement in every branch of practical agriculture".

Manufacture of Machinery in Germany

ON December 18, 1835, *The Times* quoted the following extract from a Frankfort paper: "We have much cause to rejoice at the great advance which has been made in Prussia within these last few years in the manufacture of machinery. It is not very long ago, for almost every large machine, we required help from England, and had the greater part from that country. Now an entire change has taken place in this respect, and the great establishment of this kind in Berlin, furnishes the most complete and admirable machines at far lower prices than in England. These happy results we owe to the zeal of Privy Councillor Beuth, who, as President of the Mechanics' Institution and Director of the Department of the Interior, does everything to favour and improve the construction of machines". Beuth was born at Cleve in 1781 and died in Berlin in 1853. A statue of him was erected in 1861.

Monument to Laplace

ON December 19, 1835, the *Athenæum* stated: "A monument has been raised to this great man at Beaumont, and placed on the site of the house where he was born. It is a building erected for the purposes of a primary school, and a hall for the mayoralty. Two tablets of marble are inserted in the front of the building, on one it is recorded that the corporation of Beaumont had erected their edifice to the memory of Laplace, born at Beaumont, the 22nd of March 1749 and died at Paris the 5th March 1827. On the other is inscribed:

'Sous un modeste toit, ici naquit Laplace,
Lui qui sut de Newton agrandir le compas,
Et, s'ouvrant un sillon dans les champs de l'espace
Y fit encore un nouveau pas.'"

Societies and Academies

DUBLIN

Royal Dublin Society, November 26. G. F. MITCHELL: A recent bog-flow in Co. Clare. On October 29, 1934, a mountain bog burst above an escarpment which interrupted the gentle slope of the hillside. The bank of well-drained peat overlooking the escarpment gave way, allowing the bog above that level to flow away violently. It is suggested that the heavy rainfall (more than 2 in.) in the vicinity in the preceding week had increased the weight of the bog, and caused the supporting bank to give way. E. J. SHEEHY: The mechanical aspect of the nutrition of farm stock. Insufficient recognition of the mechanical effect of foods explains the absence of uniformity sometimes occurring in the results of different laboratories, and also the frequent conflict of opinion between the scientific worker and the practical feeder. Certain foods have, in particular circumstances, a nutritive value in excess of their net energy value. G. CRUESS-CALLAGHAN: The application of the catalase test to butter. An analysis of the large number of results published by Knudsen (probably for butter made from ripened cream) yields a value about $-0{\cdot}4$ for the coefficient of correlation between the catalase figure and the quality of the butter, and about the same value for the coefficient for the catalase figure and the keeping property. Reasons are suggested for the varying coefficients, ranging from $-0{\cdot}191$ to $+0{\cdot}96$, put forward by other workers.

PARIS

Academy of Sciences, November 12 (*C.R.*, 201, 861–916). AUGUSTE BÉHAL: Scientific bibliography. EDGAR BATICLE: The problem of distribution. GÉZA KUNETZ: The conservation of the Spearman common factor in a linear substitution. NIL GLAGOLEFF: Axioms of appurtenance of Euclidian geometry. MARCEL VASSEUR: Tangential invariants relating to the conjugated network common to two applicable surfaces. FRÉDÉRIC ROGER: The relation between the tangential and metric properties of Cartesian ensembles. N. ARONSZAJN: The metric characterisation of Hilbert space, of vectorial spaces and of certain metric groups. EDOUARD CALLANDREAU: The variation of the influence round a point. PIERRE CHEVENARD and XAVIER WACHÉ: The acceleration of a structural reaction in a steel by the effect of a mechanical constraint. Experiments on a chrome-

vanadium-molybdenum steel. Tests on the steel under load at temperatures between 450° and 600° C. show important changes. As neither the measurements of resistance, expansion or magnetisation showed any appreciable physiochemical modification, the softening observed must be due to a structural modification of the alloy. It is pointed out that these facts must be taken into account when designing machines required to work at a high temperature. MARIUS AUBERT, PIERRE CLERGET and ROGER DUCHÊNE: The influence the addition of various substances on the combustion of gas oil in injection motors. Study of the effect of adding ethyl nitrate to the gas oil in regulating the combustion and suppressing detonation. HENRI CAMICHEL: The constants of the movement of the *F*-type stars. LÉON DUBAR: The internal and superficial conductivity of cuprous oxide. Cuprous oxide possesses a very high superficial conductivity, which is reduced by the adsorption of water vapour. MLLE. SUZANNE VEIL: An electrometric control of displacement reactions. GEORGES BRUHAT and LOUIS WEIL: The rotatory power of quartz for rays perpendicular to the optic axis and its dispersion between 2537 A. and 5780 A. In the whole of the interval of the spectrum studied the rotatory dispersion of quartz is the same for rays perpendicular and parallel to the axis. JEAN LAVAL: The diffusion of X-rays varies in a discontinuous manner with the angle of diffusion. EDMOND ROTHÉ and MME. A. HÉE: The radiometric exploration of a rhyolite *coulée*. The rhyolite near Welschbruch is strongly radioactive, and it has been found possible to map out the volcanic *coulées* by radiometric measurements. OSIAS BINDER: The hydrolysis of solutions of copper sulphate. VICTOR HENRI and PIERRE ANGENOT: The relation between the ultra-violet absorption spectrum and the Raman spectrum of pyridine. The analysis of the ultra-violet absorption spectrum of pyridine vapour proves the existence in the lower level of the molecule of five fundamental frequencies. These correspond with the Raman spectra of pyridine and benzene. JEAN TABUTEAU: The application of the Raman effect to the study of the *cis-trans* isomerism of the methylcyclohexanols. It has been proved that the Raman spectra of the *cis* and *trans* isomers are different and the variations are greatest for frequencies between 300 cm.$^{-1}$ and 900 cm.$^{-1}$. PIERRE CARRÉ and HENRI PASSEDOUET: The influence of an element or a negative group on the relative mobilities of alkyl radicals in their chloroformates. GEORGES LÉVY: The nitration of α-ethylnaphthalene. GEORGES DARZENS and ANDRÉ LÉVY: The preparation of 1, naphthyl-β-propionic, 2, naphthyl-β-propionic and 2, tetrahydronaphthyl-β-propionic acids. The synthesis of dihydrophenalone and of 5, 6-tetrahydrobenzo-1-indanone. ANDRÉ GUILLEMONAT: The oxidation of 3-methyl-2-pentene and of 2-methyl-2-pentene by means of selenious anhydride. MOSHEH AVNIMELECH: The Vindobonian in Palestine. FERNAND JACQUET and THÉODORE MONOD: The fossiliferous Primary of the south of Mauritanian Adrar. RENÉ SOUÈGES: The embryogeny of the Resedaceæ. The development of the embryo in *Reseda Luteola*. JEAN RÉGNIER and ANDRÉ QUEVAUVILLER: The concomitant variations of chronaxy and of nervous excitability under a pharmacodynamic influence (action on the motor nerve of *Rana esculenta* of cocaine and its substitutes). MLLE. CATHERINE VEIL: The mechanism of the colour change in fishes.

Forthcoming Events

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

Saturday, December 14

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.—Prof. G. Hickling: "William Hutton's Observations on Coal, 1833".

BRITISH PSYCHOLOGICAL SOCIETY, at 3.—Annual General Meeting.

Prof. J. Drever: "The Status and Qualifications of Professional Psychologists" (Presidential Address).

Sunday, December 15

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. R. J. Edwards: "Pests".*

Monday, December 16

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Capt. Guy Dollman: "Pouched Mammals".*

Wednesday, December 18

INSTITUTION OF CIVIL ENGINEERS, at 6.30.—Prof. A. H. Gibson: "Tidal and River Models" (Vernon-Harcourt Lecture).

Official Publications Received

Great Britain and Ireland

International Tin Research and Development Council. Miscellaneous Publications. No. 4: Tin and its Uses. By D. J. Macnaughtan. Pp. 16. Free. No. 5: Tin and Civilisation. By D. J. Macnaughtan. Pp. 9. Free. Technical Publications. Series A, No. 22: Improvement in the Quality of Tinplate by Superimposed Electrodeposition of Tin. By A. W. Hothersall and W. N. Bradshaw. Pp. 16. Free. Series A, No. 24: The Atmospheric Corrosion and Tarnishing of Tin. By L. Kenworthy. Pp. 17. Free. Series A, No. 25: Electrodeposition of Tin Alloys from Alkaline Stannate Baths. By R. G. Monk and H. J. T. Ellingham. Pp. 12. Free. (London: International Tin Research and Development Council.) [2911

Other Countries

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 39, Part 1: The Isolation and some Cultural Characters of *Bacillus cellulosæ dissolvens*. By Jun Hanzawa and Sadahiko Yoshimura. Pp. 48+1 plate. (Tokyo: Maruzen Co., Ltd.) [2911

Territory of Papua. Anthropology, Report No. 16: The Blending of Cultures; an Essay on the Aims of Native Education. By F. E. Williams. Pp. iii+46. (Port Moresby: Government Printer.) 1*s*. [3011

Tide Tables for the Atlantic Coast of Canada for the Year 1936: including the River and Gulf of St. Lawrence, the Bay of Fundy, Northumberland and Cabot Straits, Hudson Bay, and Information on Currents; in addition Tide Tables for New York and Boston, U.S.A. (Fortieth year of Issue.) Pp. 96. Ottawa: Government Printer.) [3011

Report on the Administration of the Meteorological Department of the Government of India in 1934–35. Pp. ii+35+1 plate. (Delhi: Manager of Publications.) [212

Comisión de Estudio del Túnel submarino de Gibraltar. El Túnel submarino de Gibraltar: Estado actual de los trabajos. Pp. 118+5 plates. (Madrid: Comisión de Estudio del Túnel submarino de Gibraltar.) [212

Royal Agricultural Society. Summarised translation of Bulletin No. 20, Chemical Section: Preliminary Investigations on the Phosphoric Acid Supply in the Soils of the Bahtim Permanent Experiments. By Ahmed Mahmoud. Pp. 47. Summarised translation of Bulletin No. 21, Chemical Section: Phosphatic Fertilisers, Comparative Trials on Immediate and Residual Effects. By Ahmed Mahmoud. Pp. 30. (Cairo: Royal Agricultural Society.) [212

Indian Forest Records. New Series, Vol. 1, No. 5: Neue Attelabiden aus Indien (Curculionidæ, Col.) Von Eduard Voss. Pp. ii+95–104. (Delhi: Manager of Publications.) 5 annas; 6*d*. [212

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No. 7: A Siltometer for Studying Size Distribution of Silts and Sands. By Dr. Amar Nath Puri. Pp. 6+4 plates. 5 annas; 7*d*. Research Publication, Vol. 4, No. 7: Soil Deterioration in the Canal Irrigated Areas of the Punjab. Part 1: Equilibrium between Ca and Na ions in Base Exchange Reactions. By Dr. E. McKenzie Taylor, Dr. Amar Nath Puri and A. G. Ashgar. Pp. 15+4 plates. 8 annas; 9*d*. Research Publication, Vol. 4, No. 8: Soil Deterioration in the Canal Irrigated Areas of the Punjab. Part 2: Relation between Degree of Alkalisation and Dispersion Co-efficient in Deteriorated Soils. By A. G. Ashgar, Amar Nath Puri and E. McKenzie Taylor. Pp. 7+4 plates. 4 annas; 5*d*. (Lahore: Punjab Irrigation Research Institute.) [212

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 18: Paleoantropología Argentina. Edición Oficial ordenada por El Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 704+33 plates. (La Plata: Director de la Edición Oficial de Obras de Florentino Ameghino.) [312

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