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Science and Service

THE course of events during the past year has tended to bring into clearer relief the challenge issued at the York meeting of the British Association last year in the addresses of Sir Alfred Ewing and Prof. Miles Walker. Even those who have been at the most pains to deny the claims of the man of science to participate in the control of events cannot fail to recognise the urgency of relating action to knowledge in national and international policy, the inadequacy of mere partisan or even national policies, the fundamental necessity for a deliberate and impartial survey of the facts of a situation before the nation is committed to action. The most reluctant are being compelled to admit the essential place of considered planning in industrial revival and in national and international recovery, the irreparable damage which selfish and sectional interests may work if uncontrolled. There is growing impatience with leaders in politics or business who allow themselves to be caught in difficult situations through failure to provide for the long-range research essential for a wise decision. Many citizens will be disposed to ask that organised knowledge, and methods of acquiring knowledge represented by science, must be given place in an era of social and economic planning, and that scientific workers themselves might show how knowledge may be related to wise and beneficial action.

On these grounds alone special interest is attached to the recent meeting of the British Association at Leicester. There were, indeed, no pronouncements like those on the position of the scientific worker in the modern State which aroused so much discussion at York last year. None the less, public interest in the British Association is unlikely to be satisfied even with the ablest exposition of the latest advances in particular branches of science. It will inevitably insist on learning of their bearing on the welfare of the community, their relation to those difficult problems of our age which have repercussions in every home.

It is unquestionably true that the time is past when such a representative gathering as the British Association can concern itself at its annual meeting merely with the announcement or interpretation of recent advances in science, or even with the discussion of such results between specialists in the several fields. More and more it

is called upon to demonstrate the way in which science can serve the general interests of the community. This is a responsibility which has fallen on it from the very success of its development in the last century; and at a time when science is frequently and widely blamed for evils for which its indirect responsibility is often very small, and in consequence its share in the promotion of the common weal is often unfairly discredited, such a duty is not lightly to be evaded.

This responsibility of science for service was frankly recognised in Sir Frederick Gowland Hopkins's presidential address, and the complexity of his general theme did not prevent him from giving a most admirable exposition of the extreme importance of biology to social progress. The bearing of biology on human welfare is more and more evident and Sir Frederick recalled a number of important recent pronouncements regarding the necessity of bringing into our statesmanship the guidance of biological truth if we are to obtain an adequate knowledge and control of life. What biology may do towards making man more worthy of his inheritance has yet to be fully recognised, but Sir Frederick boldly met the challenge of leisure and reminded us of the difference in use which can be made of real and ample leisure compared with that possible for very brief leisure associated with fatigue. He believes that even the gifts of the engineer to humanity at large are immense enough to outweigh the assistance he may have given to the forces of destruction.

The courageous facing in this address of the paradox of poverty amidst plenty, and of the replacement of human labour by machinery, reminds us that science cannot be held responsible for the evils which have flowed from the advent of power-production into a world in which our economic and distributive system remains on the basis of a pre-scientific era. Serious and impartial examination of the questions involved establishes the unassailable conclusion that, while technical and scientific factors may be only some of the factors in a situation, there can be no survival for a society which refuses to take adequate cognisance of such factors and to base its action and policy on definitely ascertained factors. Moreover, in the growing importance of the human and social aspects of even our industrial problems, the need for the closer and wider application of scientific factors in such fields becomes the more apparent. There are far too many problems in which action is still based on guesswork or on prejudice because no steps have been taken to ascertain the facts of the situation.

Simultaneously with this imperative need for enlarging the sphere within which science has served the needs of humanity—the application of scientific methods in the fields of sociology, economics, distribution and finance—the influence which the scientific worker exerts on industrial and public policy is perceptibly growing. Even in public administration in Great Britain the claim of the scientific expert to a place on a level with that of the financial and administrative expert, and to have his due say in the formulation of policy, has received public recognition in the report of the Bridgeman Committee.

In industry the increasing extent to which professional workers are filling the higher administrative posts presages the coming of a new age of scientific management, in which knowledge rather than influence or financial qualifications will be the essential condition for participation in the control of a company or industry. In many industries the capacity of the scientific member of the staff to participate in administrative work has already been abundantly demonstrated, while in the international sphere, the invaluable part of the expert committee has received striking demonstrations the success of which is emphasised by the futility of purely political efforts in the same fields.

These developments intensify the necessity for clear thinking and for careful exposition on these important themes. Society has every right to expect from scientific workers both a clear and convincing statement of the industrial and social problems, and also an unequivocal lead as to the terms upon which that contribution could be rendered.

In view of recent events, it is necessary to place some stress upon the conditions under which alone scientific workers could be expected to devote their energies to such tasks. There are principles which a follower of science cannot surrender without seriously prejudicing his power to render service to mankind.

The great benefits which science has conferred on humanity have in the main been commensurate with the loyalty and devotion of the scientific worker to the service of truth. The more indomitable his devotion to that quest, the more consistent his refusal to turn aside, the greater the discoveries he has made, the more important the truths which have been revealed to him. The history of science reveals her as a mistress who

permits no divided allegiance. It is this unswerving loyalty to truth that links science to art and religion as among the supreme human values.

In the new age the man of science is called upon to devote his energy to the bringing of fresh fields under the control of mankind, to apply his methods to the reduction to order of the chaotic conditions at present existing in economics, the financial and distributive side of industry and trade, in sociology and in politics. If his investigations in these fields are to enable society to sort out the issues, to frame its decisions and organisations on the basis of carefully ascertained facts and not merely on prejudices or irrelevancies, no lesser loyalty to truth, no slackening in the sincerity and impartiality of the scientific worker can be permitted.

That there are forces tending to weaken such loyalty and impartiality is obvious to all. The recent expulsions from academic life in Germany under the Hitler regime of some of her most eminent intellectuals, whose talents in arts and sciences and elsewhere have given her a leading place in international intellectual life to-day, place Germany with at least two other great nations in which assent to a particular national and political creed is a condition of freedom to pursue intellectual activities. No such limitations can be placed on the human spirit without impoverishing the race. The scientific worker's first claim must be loyalty to his vocation, and it is only when he concerns himself with the application of his results and discoveries that the State is entitled to see that his activities shall not be directed to ends likely to subvert the common weal. To demand allegiance to one narrow creed or outlook as a condition of disinterested inquiry is to impose shackles on the human intellect from which its noblest spirits instinctively revolt.

There is indeed in the present situation a strange resemblance to the conditions which such pioneers as Galileo encountered. The shackles which in past centuries the Church sought to place on the expansion of thought are now being imposed by the national authorities of such States as Italy, the U.S.S.R., Germany and Japan. It may even be that scientific workers will be called upon to win anew such a victory for human thought as it once before won over ecclesiastical forces.

Nor is this the only danger which threatens. One of the most significant aspects of the relation of modern industry to the technical sciences is very commonly overlooked. While the debt of industry to science is commonly acknowledged, it is less generally realised that with the development of these sciences there have grown up professional organisations, the spirit of which from the start has been alien to the spirit of business, at least in the years following the Industrial Revolution. The professional spirit has consistently refused to be governed by the motives of private gain and has on the contrary developed a sense of service to an ideal in which money-making has no necessary part. Such defects as have characterised the professions have in the main been due to lack of flexibility in adapting themselves to changing conditions and varying demands for the same quality of disinterested public service.

The entry of the administrative ranks in modern government and in industry by the scientific worker makes this a factor of outstanding importance. As Prof. H. J. Laski has pointed out, his membership of a profession relates him to purposes beyond himself and he ceases, from the strength afforded him by the tradition in which he shares, to be commanded *à la outrance* by men who would deny that tradition. Under modern conditions the direction of industry is passing to a greater extent into the hands of those who are members of a profession or under the influence of professional tradition. It would be perilous in the extreme, therefore, at a time when an industry is inceasingly liable to be judged less by the profits earned than by the services rendered to the community, if any check were given to the spirit of service characterising the professions or their corporate power to secure unwavering loyalty to the highest traditions on the part of their members wherever their vocation is pursued.

It is not too much to say that under modern conditions the future of society as a whole, and of industry in particular, depend alike upon the vigour of unimpeded individual and fundamental thought, and upon loyalty to an ideal of service. Scientific workers have a great part to play in establishing a new world order, in assisting mankind to regain control over the main forces threatening the disruption of society. That part cannot be played, however, if their freedom of thought, of speech and of teaching is restricted, or their loyalty to unselfish ideals of disinterested service seduced, by national or any other sectional claims. The world is entitled to look to scientific workers for help, but that help cannot be given on terms which deny their allegiance to the supreme claims of truth for unrelenting, wholehearted and unselfish service.

Veterinary Science in South Africa

Animal Diseases in South Africa. By Prof. M. W. Henning. (South African Agricultural Series, Vols. 11 and 12.) Vol. 1: *Bacterial and Protozoal Diseases.* Pp. xi+406. Vol. 2: *Virus and Deficiency Diseases, Plant Poisons.* Pp. x+407–878. (Johannesburg: Central News Agency, Ltd.; London: Gordon and Gotch, Ltd., 1932.) 50*s*.

DURING the past thirty years, the progress of agriculture in South Africa has been rapid, and probably the most striking advance has occurred in connexion with stock-farming. This rapid progress has been rendered possible by the control that has been gained over the numerous and serious animal plagues that formerly afflicted a large proportion of the country. South Africa owes much to the devoted work of some pioneer veterinarians, and especially the late D. Hutcheon, who, faced with a disease situation of great complexity and obscurity, carefully sorted out and dealt with the more familiar components of the mixture and studied the many unfamiliar forms, collecting all the facts and experiences known to the pioneer farmers and recording their own patient observations.

The greatest advance came with the development of research, however, and particularly from the work of Theiler. Sir Arnold Theiler's personal researches began in the days of the Transvaal Republic, and they were encouraged by the Milner Government of the Crown Colony period. During the years 1907–20, with the support and encouragement of Generals Botha and Smuts, he built up a veterinary research organisation of a character and size not to be found elsewhere in the Empire. The research staff, magnificently housed at Onderstepoort, included representatives of various ancillary sciences, as well as veterinary pathologists and bacteriologists, and the work was conducted on a scale previously unknown in any British veterinary institution.

The results of such generous support of research and inspired leadership are to be seen to-day in the effective control of animal disease in South Africa, and in the introduction of highly-bred animals, of considerable and increasing value, into areas where previously a few 'scrub' or 'kaffir' animals of low value led a precarious existence.

Progress in research and scientific administration was followed by educational development, and the University of Pretoria has now an active veterinary faculty, the Onderstepoort staff combining teaching with research. These later developments have naturally created a demand for technical literature adapted to the special requirements of the South African veterinary student. A great mass of information on animal diseases in South Africa has accumulated, but it is widely scattered, and much of it is to be found only in official reports that are not always readily accessible. Moreover, the information is in many instances far too detailed for the beginner, and it was essential that a competent worker should face the task of collecting and collating the material, and selecting the more important facts for the student's guidance.

This is the task that Prof. Henning has set himself, and we think he has achieved a large measure of success. The diseases selected for treatment are naturally those that are, or have been, of the greatest importance in South Africa, and his choice of subjects may be commended. Some of the selected diseases, such as anthrax, tuberculosis and foot-and-mouth disease, are of equal importance to the European student, but so far as possible they are treated from the South African point of view. The historical side, in relation to South Africa, is fully dealt with, and any features that are peculiar to, or particularly characteristic of, these diseases as they occur in South Africa, are as a rule brought out clearly.

A feature of these volumes that might perhaps surprise the European reader is the prominence given to plant poisoning, but it should be remembered that the herbivorous animal in South Africa usually grazes on a mixed pasture that has been comparatively little modified by man. Illness and death resulting from the consumption of poisonous plants have occurred, and are still occurring, on a very considerable scale, and in some instances they take unexpected forms which would not generally be associated with suspicions of poisoning. In this field Prof. Henning has been able to draw upon a very interesting and extensive mass of information provided by the researches of Sir Arnold Theiler and a number of his disciples, including the author himself.

Where a single author has so wide a field to cover, one would not expect to find all sections of equal merit, and we think that the best parts are those dealing with poisonous plants and protozoan diseases. It is also not surprising that in the first edition of a work of this character one should find some facts not very clearly expressed and a few

actual errors. These we hope to see corrected in a future edition.

Prof. Henning has earned the gratitude of the South African veterinary student for whom his work is primarily intended, and the volumes may be recommended to any veterinarian who is going to a tropical or sub-tropical country, and particularly to any part of Africa. W. H. A.

Agriculture through the Empire

(1) *The Farm and the Nation.* By Sir E. John Russell. Pp. 240. (London : George Allen and Unwin, Ltd., 1932.) 7*s.* 6*d.* net.

(2) *West African Agriculture.* By O. T. Faulkner and J. R. Mackie. Pp. viii + 168. (Cambridge : At the University Press, 1933.) 8*s.* 6*d.* net.

(3) *An Introduction to Tropical Soils.* By Dr. P. Vageler. Translated by Dr. H. Greene. Pp. xvi + 240 + 12 plates. (London : Macmillan and Co., Ltd., 1933.) 15*s.* net.

(4) *A Note-Book of Tropical Agriculture.* Compiled by Prof. R. Cecil Wood. Pp. iv + 149. (Trinidad : Imperial College of Tropical Agriculture, 1933.) n.p.

(1) IN "The Farm and the Nation" British agriculture is described and the possibility of its development discussed. The question is intimately associated with the alternative sources of supply of the nation's food ; for, if British farming is not to be fostered at the expense of the non-agricultural communities, food must be produced under competitive conditions. The question is further complicated by the fact that the land of Britain is not a *tabula rasa* ; through centuries, vast capital sums have been expended in a lay-out which cannot be discarded except at enormous expense. The present use to which the land is put as the result of that development is described in much detail, and this historical description is extended to cover the main countries of the Empire which, in the past, have absorbed so much of the British emigrant population.

On this foundation, backed by much statistical detail, the nature of the farmers' difficulties is portrayed and the reader is led to a discussion whether the land can be put to better use. There are three criteria of success ; the amount of food produced, the rate of wages and the profits of those remaining on the land and the population carried, and they are independent measures.

The book is based on a series of broadcast talks and bears the obvious impress of that origin. It lays before the general listener the broad facts of the present problem ; but those who, led by the title, hope to find a constructive policy, will be disappointed. Of constructive suggestion there is little beyond reference to such official action as is covered by the National Marks scheme and the Small Holdings Acts.

(2) "West African Agriculture" forms a welcome addition to the growing number of books dealing with tropical agriculture. It is in no sense a text-book or a scientific treatise, and is addressed primarily to the candidates for Government service in the several West African colonies. In these circumstances it is only right that the economic aspect should be stressed. Underlying that aspect, however, are certain conditioning factors ; the primitive character of most of the agricultural communities, the policy of trusteeship and, arising from this, the prevalent system of peasant holdings.

Under these conditions the criterion of success is no longer, will this or that system of cropping yield the maximum wealth to the community, but will this or that crop be profitable to the farmer-peasant ? The limits thus imposed on the activities of the agricultural services and the various problems associated with the establishment of contact between the officers and the peasant are portrayed effectively. Particular interest is attached to the account of the efforts to build up a system of mixed farming from the customary shifting cultivation and nomadism.

The countries are so vast that wide divergencies both of climate and soil are encountered, associated with which is a range of crops from the perennial cacao and oil palm to annuals. Each has its problem, particularly those which form the basis of an export trade, and these various problems are discussed under the respective crops in Part 2, in which also is summarised briefly the live stock problem.

(3) Dr. P. Vageler's work is a stimulating book. It aims at supplying to the tropical planter the means of solving his own problems and to those seeking new areas the means of avoiding failure from faulty choice of land. But its scope is much wider. Tropical soils present many characteristics markedly different from those of temperate regions and the study of these differences is of so recent a date that the management of these soils is only now passing beyond the range of blind experiment.

Fundamentally, it is a question of the rate of

chemical action under tropical conditions, and the mineral part of the soil, consequently, assumes an added importance in the tropics. This conclusion leads to an account of the more important minerals which enter into the composition of these soils. The colloidal fraction of the soil is approached through a discussion of the humus in its relation to forms of vegetation and rock weathering which, in its turn, leads to a description of the more common types of tropical soils.

It may be doubted if the average planter is sufficiently equipped to follow this more general section, but the practical aspect is dealt with later and, in this, a very readable account is given of the value to be derived, both in the selection and treatment of land, from determinations of profile and the main chemical and physical characteristics which modern investigation has shown to be of importance.

(4) Prof. R. Cecil Wood's "Note-Book" is a compendium of information on many aspects of tropical agriculture which will find a wide range of utility among planters and agricultural workers generally. In it are brought together a body of facts and figures most of which have, hitherto, been hard to trace and not a few, it may be suspected, are the product of original determination.

Leipzig Lectures on Physical Chemistry

The Dipole Moment and Chemical Structure. Edited by Prof. P. Debye. Authorised translation by Winifred M. Deans. Pp. x+134. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1931.) 10*s*. net.

Molekülstruktur. (Leipziger Vorträge 1931.) Herausgegeben von Prof. Dr. P. Debye. Pp. viii+197+5 plates. (Leipzig: S. Hirzel, 1931.) 10 gold marks.

The Structure of Molecules. Edited by Prof. P. Debye. Authorised translation by Winifred M. Deans. Pp. xii+190+5 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1932.) 15*s*. net.

THE conferences organised annually by Prof. Debye at the Physical Institute of the University of Leipzig are beginning to occupy in German scientific life a similar position to that which the general discussions of the Faraday Society have taken up during the quarter century which has passed since the series was initiated by a discussion on "Osmotic Pressure" in 1907. Unlike the annual meetings of the Bunsengesellschaft, where attention is directed away from the main topic of discussion by a large mass of independent papers, a single subject is selected and this is discussed by a number of reporters chosen on an international basis.

The reports of the two annual conferences now under notice both deal with the general problem of molecular structure from the physical point of view; but whereas the earlier volume is concerned mainly with determinations of symmetry by the study of the behaviour of dipolar molecules in an electric field, the later volume is concerned mainly with optical methods of investigation. Thus Prof. Errera of Brussels contributes three papers to the former volume, whilst Profs. Mecke of Heidelberg and Victor Henri (now of Liège) contribute papers to the latter. Contributions to both volumes are made by Prof. K. L. Wolf of Kiel (and formerly of Karlsruhe), who is particularly interested in the problem of 'free rotation'. The later volume, which includes also two papers on Raman spectra, closes with a more general paper on "Valency and the Electronic Structure of Molecules" by Prof. Herzberg of Darmstadt.

The importance of these conferences is indicated by the fact that it has been found worth while to issue translations in English of two successive volumes. These translations are to be welcomed on account of the greater ease with which the subject-matter can be assimilated by English-speaking readers both in Great Britain and the United States; and it is a fair comment, in comparing the translations with the original text, to remark that the English publishers have produced more attractive volumes at approximately the same price.

Quantum Mechanics

The Elements of the New Quantum Mechanics. By Otto Halpern and Hans Thirring. Translated from the German by Dr. Henry L. Brose. Pp. xi+215. (London: Methuen and Co., Ltd., 1932.) 12*s*. 6*d*. net.

FOUR or five years ago, following what may be termed the 'Quantum Renaissance' of 1924 onwards, numerous textbooks ranging from the outline to the comprehensive survey began to appear. Many were little more than compilations from the original papers of those responsible for the new developments. In spite of the apparent remoteness, at the present time, of any finality in

the results achieved, it is now possible to obtain some critical digests of the real essentials of what has been done. In this category falls the volume under review, consisting of two reports covering, respectively, the period before and after 1926. The authors state that they have tried to bring into clear relief all the physically important ideas that have played a part in the development of the new quantum mechanics, and to interfuse the theoretical with the physical principles. The account is intended to meet the need felt by numerous physicists to grasp the fundamental ideas of the new and not easily understood developments, and therefore aims at a wide and intelligible treatment rather than an exact and complete presentation.

In the respects specified, the book must be regarded as eminently successful; a large amount has been judiciously compressed into a relatively limited space. The early chapters deal with the inadequacy of classical electrodynamics and proceed with the work of De Broglie, Heisenberg and Schrödinger, each section ending with a valuable critical discussion. The second part opens with a survey of relativity and electron spin, and it is here that the work of Dirac, in his contribution in 1928 to this particular problem, first comes under notice; his previous work on quantum algebra is omitted, and one must feel that in a book largely devoted to the development of the new ideas some space might have been given to summarise his earlier papers.

More than a hundred pages are occupied with the achievements of the theory under the general headings of one-body problems, many-body problems, and "interpretations". These pages include such topics as the hydrogen and helium atom, dispersion, Compton effect, band spectra and nuclear spin, the Bose–Einstein and Fermi–Dirac statistics, magnetism, and the Heisenberg uncertainty principle. A detailed bibliography is appended. The book will be appreciated as giving a comprehensive, and at the same time a critical, digest in a clear and accessible form. N. M. B.

Short Reviews

(1) *Gmelins Handbuch der anorganischen Chemie.* Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 59: *Eisen.* Teil A, Lieferung 4. Pp. 587–846. 41 gold marks.

(2) *Eisen- und Stahllegierungen: Patentsammlung.* Von A. Grützner. Zugleich Anhang zur Metallurgie des Eisens in "Gmelins Handbuch der anorganischen Chemie", achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Pp. vi+308. 32 gold marks.

(Berlin: Verlag Chemie, G.m.b.H., 1932.)

(1) THE publication of this instalment of Gmelin's work is to be followed shortly by another which will bring Section A on iron, which deals with metallurgy, to a conclusion. The present issue contains a full account of the production of wrought-iron by indirect methods, that is, from crude iron rather than directly from the ores. It is a highly technical volume and is well-illustrated with phase-rule diagrams and drawings of manufacturing plant. Section B on compounds of iron has already been completed.

(2) The index of patent specifications relating to steel forms a useful supplement to Section A. The patent literature of Germany, Great Britain, France, Austria, Switzerland and the United States has been thoroughly searched between the years 1880 and 1932 and the multitudinous patent specifications on steel manufacture have been classified and tabulated. It was not considered necessary to take other countries into consideration, experience having shown that their patents are mostly to be found again in the specifications of the countries chosen.

The percentages of the component elements, other than iron, are arranged in columns, the first column being assigned to carbon, which is common to all the alloys, whilst the other elements follow in alphabetical order according to their chemical symbols. A somewhat complex system is followed, as nearly all the elements are involved and a complex steel may be listed several times, but there is not much difficulty in tracing a particular alloy if its components are known. Manganese and silicon have been ignored when the percentage falls below 0·5 and also traces of less than 0·05 per cent of phosphorus and sulphur.

This supplement should be of immense value to those who are engaged upon the problems of producing special steels, particularly as no similar compilation appears to have been published previously.

Foundations of the Theory of Algebraic Numbers. By Prof. Harris Hancock. Vol. 2: *The General Theory.* (Published with the Aid of the Charles Phelps Taft Memorial Fund, University of Cincinnati.) Pp. xxvi+654. (New York: The Macmillan Co., 1932.) 8 dollars.

THE general outlines and the methods employed by the author will be familiar to readers who have seen the first volume. He has made a study of standard works and papers by Bachmann, Hensel, Hilbert, Hurwitz, Minkowski, Weber and others, and presented an encyclopædic account of their

subject matter, the production of which must have entailed considerable effort. The present volume deals with the general theory of algebraic numbers and includes many topics, for example, the Dedekind theory of ideals, the Kronecker theory of forms, the theory of units, of the number of ideal classes, Minkowski's geometry of numbers, relative fields, the Galois theory and Hensel's p'adic numbers. It will make a useful compendium and will prove convenient for readers who wish to consult it upon different topics.

The volumes, as a whole, produce a distinct feeling that they would have been far more useful if written twenty-five years ago, when they would have reflected more accurately the state of knowledge at the time of publication. But since then, discoveries not inferior in importance to any of the past have been made, and the subject has been given an impetus in many other directions. The modern theory would also enable a reader to dispense with the study of some of the older theories which now are chiefly of historical interest. It would have suggested a rearrangement of the subject matter and a different outlook. These would have been more useful to the student anxious to come into contact with more recent work and unwilling to be delayed by so great a study of the older work as is now given here.

L. J. MORDELL.

Ergebnisse der Enzymforschung. Herausgegeben von F. F. Nord und R. Weidenhagen. Band 2. Pp. xii+358. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.) 30 gold marks.

THIS is a series of short chapters, each written by an active worker in the particular section, dealing with selected subjects in the larger field of enzyme chemistry, a subject which is once again very much to the fore. A previous and similar volume has already been noticed in these columns. The British contributors are Moelwyn-Hughes on the kinetics of enzyme reaction, Keilin on cytochrome, and Horning on mitochondria. From the United States, Northrop and Kunitz write on crystalline trypsin and Hand on peroxidase and the iron-porphyrin catalysts. Myrbäch of Stockholm discusses co-zymase, Lundsgaard of Copenhagen deals with glycolysis, and there are several German contributors, so that the volume, like the science, is essentially international. The German contributions comprise cryolysis by Nord, esterases by Rona, emulsin by Helferich, invertase by Weidenhagen, and several others.

All are highly specialised subjects, of which our knowledge is in a state of flux, but always expanding. Such summaries help workers to crystallise the momentary position and to correlate it with the advance in other fields; they spare reference to the original literature, though this reference should never be omitted by the actual experimenters. In a decade, much that is here will be discarded, corrected, or out of date, but it is only by such means that a contact with progress can be maintained.

The Intelligent Man's Guide Through World Chaos. By G. D. H. Cole. Pp. 680. (London: Victor Gollancz, Ltd., 1932.) 5*s*. net.

THE keynote to Mr. Cole's book may be found in its title, for this able exposition of current world economic affairs is essentially a plea for more intelligence in the whole interlocked world of industry, politics, economics and society in general. In this, as in his appeal to open-mindedness, Mr. Cole has large claims on the interest of the scientific worker, who will be quick to note how fairly and clearly, without concealing his own opinions, Mr. Cole contrives to express the differing views or theories of economics, finance and taxation, prices and price level, industrial organisation, economic planning and the like.

Mr. Cole discerns clearly enough the share of science, or rather of mechanical science, in our present difficulties. He sees, for example, that the trouble has been not the failure of the technicians to devise improved methods of production, but the slowness of farmers and employers in adopting the new technique, and above all the failure of the market for goods to expand fast enough to make it worth while to employ the new resources of production to the full. He writes pertinently about industrial organisation and scientific management and the position of the scientific worker in industry, and his observations should be noted by those who are concerned with the scientific administration of industry or the State.

The German Jew: his Share in Modern Culture. By Prof. Abraham Myerson and Isaac Goldberg. Pp. xiii+161+ix. (London: Martin Hopkinson, Ltd., 1933.) 3*s*. 6*d*. net.

THIS little book is a counter to Nazi anti-Semitism; but it is written temperately, and the facts, on the whole, are left to speak for themselves. Three brief introductory chapters survey the development of the present attitude towards the Jew in Germany, and contrast that attitude with the value placed on Jewish achievement by the rest of the world.

As an index to the latter, it is pointed out that in the award of the Nobel prize, ten per cent of the recipients have been Jews or persons of Jewish descent. The authors then take each of certain representative fields of intellectual activity, such as medicine, physics, chemistry, philosophy, music, literature, the drama and so forth, and single out for mention the more eminent of the German Jews whose merits in these fields have been universally recognised.

It is to be noted that the achievements of those mentioned are specifically contributions to German culture: contributions to German-Jewish culture are not taken into account. Although not exhaustive, the record shows that the Jews who have attained intellectual eminence in Germany have been far in excess of their proportion to the rest of the German population.

Must Science Ruin Economic Progress?*

By SIR JOSIAH STAMP, G.B.E.

ECONOMIC progress is the orderly assimilation of innovation into the general standard of life. It usually connotes a widespread sharing of new benefits, but is by no means inconsistent with some degree of uneven distribution of wealth or income, for in a non-socialistic community some disparity generally raises the standard of life of the mass to a point higher than it would be under a forced equality of distribution of wealth, the envies caused by disparity notwithstanding. The purely material standard in Great Britain was raised fourfold during the nineteenth century, and probably rather more in the United States. If we take into account also length of life and proportion of leisure, the increase is much greater. The improvement arises only to a very small extent in changes in the average innate capacity of man, not co-operant with, or parasitic upon, his environment. It is almost all due to innovation in social activity (including social education and the reactions of economic betterment upon physical and mental ability). The greater part of the innovation is scientific innovation—in physics, engineering and public health—but a not inconsiderable part falls outside these categories, and belongs to the non-physical section—better ideas about money, more social confidence in banking and credit, improved political and social security and legal frameworks for the better production and diffusion of wealth. The elaboration of these factors depends partly on intellectual prevision and invention, but mainly upon average moral standards, and calibre of character, since many political schemes, including international co-operation, are impracticable only because of failings in the present standards of human nature.

It is being commonly stated that scientific changes are coming so thick and fast, or are so radical in their nature and implications, that the other factors of social life, the intangibles of credit, the improvements in political and international organisations and ideas, are unequal to the task of absorbing and accommodating them, or else they present new problems which have no counterpart. If changes in social forms and human nature or behaviour cannot possibly be made rapidly enough for the task, then in that sense science may 'ruin' economic progress, and the world might be better served in the end if scientific innovation were retarded to the maximum rate of social and economic change.

Civilisation went through a long period when the limiting factor to progress was the scientific, but is now passing through a stage when the limiting factors are non-scientific. The lack of identity in the *tempo* of change creates new problems, tending to offset scientific advantages, of three types. First, for example, the utilisation for essential or competitive purposes of rare minerals, the need for which becomes general, but the distribution of which is particular and accidental, sets up great political strains, and we have invented no means of adjusting the international effects of accidental monopoly of essential elements. Second, the problem of scope, where the scale of production upon which, for example, a chemical innovation can be made to give its real economic advantages, is a scale inconsistent with the size of markets freely open in a nationalistic world. Here strains are set up in the international machine and the balance of trade, which may gravely jeopardise economic progress, and dry up the juices of commerce. Third, for example, where the innovation is absorbed most easily for offensive purposes in a military or naval sense, it may create rivalries and changes of balance of power inimical to economic security, and compel new economic sacrifices outweighing the direct economic advantages of peaceful uses. It is open to question whether the innovation of aircraft has yet become, on net balance, economic progress.

Inasmuch as all economic production creates real vested interest in a location or a skill devoted to it, and every scientific innovation alters the centre of gravity of collective demand, every such scientific change disturbs an economic equation. That equation for human life may often be richer ultimately, but the pain or waste of disturbance has to be debited to the gain, before the net balance is progress. For the time being, the balance may be net loss, the price paid for to-morrow. If to-morrow is continually postponed, because it, in its turn, is redisturbed, and the economic to-morrow never comes, it is 'jam yesterday, jam to-morrow, but never jam to-day'. Wastes of absorption will be at a minimum in certain conditions, which are related to the wearing life of existing assets and places, and to the rate of flow of new skill into new directions.

The orderly absorption of innovation into economic progress, apart from improvements in the non-economic factors of such progress, depends upon two kinds of balance. The first is the balance between two classes of scientific discovery, that which accelerates or makes easier the production of existing economic goods, and that which creates new kinds of economic satisfactions—the derivative and the direct. Let us suppose that in a static society a million people are employed making boots, and the gramophone has not been invented. Then let a labour-saving device be invented, such that the same quantity of boots can be made by half the workers, and boots are half the price. Assuming that the demand for boots is quite inelastic, and no more are wanted, there is potential unemployment for half a million people, and the whole population has now reserve unspent purchasing power, saved on cheaper boots. The

* Substance of an Evening Discourse delivered to members of the British Association at Leicester on September 8.

gramophone is introduced, employing the potentially unemployed, and absorbing the reserve or released purchasing power.

The progress of the past hundred years has been essentially of this order, and innovation has enabled purchasing power to be released for new spending, first upon far *more* of the same article at the reduced price; second upon more of other existing goods and, third, upon entirely new kinds of satisfaction, such as bicycles or radio sets. In this connexion it must be remembered that an old article may be so transformed in degree as to be equivalent to a change in kind—the silk stocking and feminine footwear are cases in point. Now even if these two classes of innovation, direct and derivative, are in balance, the process of absorbing them will give rise to economic 'growing pains' and temporary dislocations of capital and employment, but the gains will rapidly outweigh the disadvantages. But when they are not in balance, the process is more painful, and the debit to be set against progress very much greater.

The introduction of machinery has been for three hundred years accompanied by the same hostile arguments, for the immediate effects in unemployment are much more obvious and human than the countervailing employment given by the released purchasing power, which may occur in some other place or country. Illustrations may be found all the way from Queen Elizabeth's sentiments on stocking-knitting machinery, to the Luddite riots, and the eight looms per weaver, of to-day. But in the literature of the whole series, nothing can outdo, for detailed economic jeremiad and precise calculation of woe, a contemporary examination of the effect of the introduction of the stage coach in the middle of the seventeenth century upon the post horse industry and all that depended upon it ("In Grand Concern of England", 1673).

The argument so far, no doubt, begs the question of the meaning of progress, and assumes that silk stockings and fine shoes represent a 'higher' standard of life than black, homespun woollens and rough boots—a doctrine that is not acceptable to Mr. De Valera for example—but as we are not entering the field of morals or ethical aims, we are obliged to assume that those objects which are actually the subject of average human desire must be given their economic significance accordingly, and not attempt to solve the larger problem simultaneously. In this sense such a mechanical invention as the totalisator must take its place in 'progress' at this stage.

The problem of balance, in the direct and the derivative, is not, however, so simple in practice, for the sum total of the effect of derivative innovations (creating technological unemployment) ought to be balanced by the sum total of direct innovations or increased demand for other products (new and expanded employment). But many direct innovations are not additive; they are substitutional, and destroy the need for old commodities. If combs are made from celluloid, and dishes from papier mâché or pyrex, they will certainly not create a wholly additional demand or employment —there will be a displacement of the old types in metal or bone combs or china dishes. This substitution goes into rival classes of utility also, and a radio set may be a real substitute for a billiard table, and oil may be the enemy of hops, if cheap bus-riding supplants long sittings in public houses. These substitutions may be gradual enough to be absorbed as a normal feature of progress, but if they are very rapid and coincide with certain other economic disturbances they may be very distressing. By 'normal' I mean such as can be coped with by the direction of new labour entering industry or new capital spent on renewals, leaving the contractions to take place by natural age attrition without unemployment, or by premature obsolescence—for the moment this is the optimum point of change.

The lack of balance between derivative and direct innovation may be due, of course, to a terrific drive and rapidity in scientific recovery of the industrial type, but it is only fair to say that the excess of one may be due to causes on the economic side. If for purely monetary reasons, the gold standard, etc., the purchasing power of money is continually increasing through falling prices, and, with the current inability to change the money totals of wages and other costs, real wages are rising, it becomes increasingly possible to substitute innovations of machinery for hand labour, or complex for simple. A change that was not worth making on a balance of old wage costs against new capital costs in 1923, became well worth making by 1932, and indeed imperative, if any profits were to be preserved. Hence the almost artificial pressure which a rigid monetary system may bring to bear towards the over-rapid application of new methods and creation of unemployment.

The second kind of balance which is vital to economic progress and may be ruined by over-rapid innovation is that between obsolescence and depreciation. Nearly all scientific advance for economic progress has to be embodied in capital forms, to be effective, more and more elaborate, large and costly. The productivity of such apparatus and plant per man involved becomes greater, and even allowing for the men employed in making the machinery or process, the total satisfaction is continually produced with less and less human effort. Now it used to be said of British machinery that it was made good enough to last for ever and long after it became old-fashioned, whereas American machines were made to be worn out much earlier, and were thus cheaper, but could be immediately replaced by capital assets containing the latest devices. If the period of physical life and fashionable life can be made to correspond, there is greatest economy and security of capital. But if the expensive embodiment of the latest science can be outmoded and superseded long before it is worn out, there is waste of capital, loss of interest, and resultant insecurity of business and investment.

The factor of physical safety alone means that each embodiment must be really durable, even if roughly finished, and, therefore, it is impossible wholly to reduce physical life to probable 'obsolescent' life. In this way an over-rapid series of innovations may mean the scrapping or unprofitability of much excellent capital for very small marginal gains. A responsible socialist community would see each time that the gain was worth while, but competitive individuals have no collective responsibility. Suppose the giant Cunarder attracts a profitable contingent for two years only, when a lucky invention in a new and rival vessel attracts all her passengers at a slightly lower fare. Here is progress in one typical sense, but the small net advantage to be secured by individuals as free-lance *consumers* may be dearly purchased by large dislocations or loss of capital reacting even upon those same individuals as *producers*. Now, if the innovation were very striking, and were reflected in working costs, the margin of difference between the old working costs and new working costs may be large enough to pay interest on the new capital employed and also to amortise the cost of the unrealised life of the asset displaced. A locomotive may have many years of useful life left, but a new type *may* provide a margin by lower working costs not only sufficient to make one adopt it on normal renewal, but also to pay for the premature scrapping of the old type.

The majority of modern innovation is, however, of the type which does *not* pay the costs of obsolescence and proceed by orderly and natural physical renewal or substitution. A similar type of argument applies to the capital expenditure generally on a district, which can be amortised over the economic activity of that area, such as a colliery area, but which is wasted if a dislocation occurs by the adoption of some innovation stimulating rival activity in another place. Similar but more poignant considerations apply to obsolescence in human skill and training, more rapid than the ordinary attrition through age retirement can accommodate. Physical capital forms, human vocational training, and centring in geographical areas, are all essential features in the absorption of scientific innovation into economic progress. Each has its *natural* time span, and a narrower span of scientific change is bound to set up large economic debits to be set against the economic credits of the change. A man running a race might be stopped to be given a new magic cordial, which *after* allowing for the two minutes stoppage, would enable him to finish a minute earlier. But if he is stopped at frequent intervals for other magic cordials, each advantageous by itself, the total period of stoppages would at some point exceed the possible gains of speed during the short undisturbed running periods, and he would finish later at the post, instead of earlier. This is a parallel to the current effects of too rapid disturbance on progress.

Under an individualistic form of society, it is difficult to alter the social technique of change, and to make its credits really pay for the debits, and make all the people who gain by the profits on new capital pay also for the losses on prematurely displaced capital, or the gainers by cheapness and variety pay the human costs of unemployment and the skill no longer wanted. The *basic* economic reason for social unemployment relief is not the humanitarian argument of social obligation against distress, *or* the argument against revolution, but the plain argument that the gainers by innovation should bear the losses of innovation.

At the same time, much can be done to shorten the hitherto natural time span and make society ready to absorb the quickened tempo of science. No prices ought to be charged except on the basis of costs fully loaded with short-period obsolescence —this would prevent over-rapid substitution, economic only to a narrow range of people. We have no adequate technique of change; we treat life as mainly static, with occasional and exceptional periods of change, whereas we must learn to look upon it as continuously changing, with occasional and abnormal periods of rest, and we have to secure all the changes of social outlook implied by that reversal of view.

The next field in which scientific advance alters the economic problem faster than we can solve it, is in the duration of human life. We have to provide a social dividend adequate to maintain a much larger proportion beyond the age to contribute to it. Combined with the altered birth-rate, a profound change is taking place in age densities, and the turnover from an increasing to a stationary and then a declining population, in sight in Great Britain, Belgium, Germany and even the United States, is bound to affect the *tempo* of economic life. A larger and more immediate problem of adjustment is, of course, the absorption of the results of science not in increased masses of new kinds of commodities made by the released labour of labour-saving devices on old kinds, but in generalised leisure. The transition from a state of affairs in which we have an uneconomically high commodity wage paid to a part of the population, and the rest with a mere pittance and enforced idleness, to a state where a part of the reward is taken *all round* in larger leisure, and where economic satisfaction from leisure is deliberately equated to that from commodities in the standard of life, may need a surgical operation, or a catalyst, such as the United States experiment can show.

In the past, the absorption of innovation has been achieved, according to contemporary explanation, by four agencies: (1) great elasticity of demand for the old commodities at reduced prices, food and staple household necessities, (2) rapid introduction of new things, (3) the rise in population *created* by the increase in produce, (4) overseas outlets in more backward industrial countries. In the first the elasticity completely alters as the standard rises, and generally there is not now the scope for lower price in food or clothing increasing the demand *pro tanto*: for the third, a rising

standard no longer stimulates population but tends the opposite way; for the fourth, the external outlets are now largely self-producers. As regards the rapid introduction of new things—these mostly now demand increased leisure for their proper absorption and use, so that the two are co-related and mutually dependent.

It can be conceived that a socialistic organisation of society could obviate such of the maladjustments as depend upon gains and risks of absorption not being in the same hands, and a theoretical technique can be worked out for the most profitable rate of absorption of scientific invention, having regard to invested capital, and skill and local interests. It is sufficient to say that it needs a *tour de force* of assumptions to make it function without hopelessly impairing that central feature of economic progress, namely individual choice of the consumer in the direction of his demands, and an equally exalted view of the perfectibility of social organisation and political wisdom. But in the field of international relations and foreign trade, which alone can give full effect to scientific discovery, it demands qualities far beyond anything yet attainable.

Economic life must pay a heavy price, in this generation, for the ultimate gains of science, unless all classes become economically and socially minded, and there are large infusions of social direction and internationalism, carefully introduced. This does not mean government by scientific technique, technocracy, or any other *transferred* technique, appropriate as these may be to the physical task of production; for human wills in the aggregate are behind distribution and consumption, and they can never be regulated by the principles which are so potent in mathematics, chemistry, physics, or even biology. Scientific workers may contribute much by sharing the problems of social science along its own lines, by giving a greater proportion of brilliant minds to this field and by planning research.

Atomic Transmutation

TWENTY-SIX years have passed since the British Association last met at Leicester in 1907, and the apparently stable world of a quarter of a century ago has altered almost out of recognition. These changes in political, moral and spiritual values are reflected in the world of physical science, which differs almost *toto cælo* from the structure raised by the labours of the nineteenth century and its predecessors. But even then rumblings were apparent, and it is a remarkable fact that the discussion on atomic transmutation, opened in Section A (Mathematics and Physics) by Lord Rutherford on September 11, had its antitype in a sectional discussion on the constitution of the atom opened by Prof. Ernest Rutherford, as he then was, at the 1907 meeting, to which contributions were made by Lord Kelvin, Sir Oliver Lodge and Sir William Ramsay.

Lord Rutherford, whose contribution to the present discussion was a masterly review of a quarter of a century's work on atomic transmutation, remarked that, at the discussion which he opened in 1907, he indicated the importance of the transformations of radioactive bodies, and emphasised the difficulty of explaining the part played by positive electricity—we had then no inkling of a knowledge of the positive electron. He reminded the audience that Sir Oliver Lodge, who nevertheless proclaimed his belief in the electrical structure of the atom, had remarked that the opener was an adept in the art of skating on thin ice. Kelvin, who in 1904 was prepared to accept the notion of the transmutation of the radium atom, in 1907 did not find the evidence for transmutation satisfactory. It was about this period that Lodge, in a letter to the *Times*, suggested that if Kelvin would read the evidence he would change his opinion; Kelvin's reply was that he *had* read Rutherford's "Radioactivity" and remained unconvinced!

The work of the eighteenth and nineteenth century chemists had given to the world some eighty-odd elements, and it was quite clear that the atoms of the elements were very stable structures. But though the old ideas of transmutation were exploded, the problem still existed, and indeed had been clearly formulated by Faraday. The discovery of radioactivity showed that elements such as uranium and thorium were undergoing spontaneous transformation, and a large number of new elements were brought to light. Moreover, the property was shown to exist in a very slight degree in elements such as potassium and rubidium, the remainder of the normal elements being stable under ordinary conditions over periods to be reckoned in millions of years.

It was in 1911 that the nuclear structure of the atom was clearly evidenced, and a little later that Bohr's masterly interpretation of the movements of electrons gave an explanation of spectral regularities. It soon became evident that outer electrons played no major part in transmutations, that the changes produced by stripping off electrons were only temporary in character, and that the structure of the nucleus must be changed if we wished to institute any permanent atomic transmutation. Moreover, evidence had accumulated to show that the nucleus was a very small entity.

If an α-particle were fired at a nucleus, the enormous forces developed in a head-on collision might be expected to disturb the structure of the nucleus, and it was in 1919 that decisive experiments were made. When α-particles were fired in oxygen, no effect was produced, but when they were fired in nitrogen, a new type of particle appeared—the *proton*.

If we assume that the proton originated from a transformation of the nitrogen nucleus, the question of the rationale of the transmutation becomes urgent. Photographic evidence showed the *capture* by the nucleus of an α-particle accompanied by the *emission* of a proton. If then a nitrogen nucleus of mass 14 and charge 7, assimilates an α-particle of mass 4 and charge 2, with the *emission* of a proton of mass 1 and charge 1, we are left with a nuclear structure of mass 17 and charge 8—an isotope of oxygen, in fact. In a similar manner, other transmutations may be checked, remembering that all such changes must obey what may be termed *general* energy conditions, that is, we must take into account not only kinetic energy, but also the masses involved, remembering that, in some sense, mass and energy are convertible terms. It will be seen that in the instance considered, the new element has a mass three units higher and a charge one unit higher than that of the element which has suffered transmutation.

Beryllium, of mass 9 and charge 4, when bombarded, captures an α-particle of mass 4 and charge 2, giving rise to a structure of mass 12 and charge 6 and emitting a *neutron* of mass 1 and charge zero.

It is not difficult to picture the changes which ensue when neutrons are fired into oxygen or nitrogen with the consequent emission of an α-particle, and indeed it is certain that future experiments will show that the neutron is a very powerful weapon of research. Five years ago it became evident that the methods of attack developed must be supplemented by the use of other types of fast particle if more information were to be forthcoming, and it was found possible to obtain from an electric discharge large supplies of particles the speeds of which might be raised by travel through an electric field. This demand has resulted in the development of laboratory methods for the production of high potentials. Lately, assistance has been given by developments of wave mechanics which have shown that particles which could not surmount a potential barrier might yet get through, so that there is a possibility of successful attack by using intense streams of particles at low voltages. One timely word of warning was issued to those who look for sources of power in atomic transmutations—such expectations are the merest moonshine.

It was fortunate that Sir Oliver Lodge was able to be present at the discussion. His charming and reminiscent speech in moving a vote of thanks to Lord Rutherford was a fitting tribute to a remarkable survey.

Space will not permit of the detailed consideration of the symposium which followed the opening address. As has been remarked, the nuclear theory developed by Gamow indicates the possibility of disintegrating the nuclei of the lighter elements by protons having energies corresponding to a few hundred thousand volts. Dr. J. D. Cockcroft and Dr. E. T. S. Walton described an apparatus capable of producing protons having energies of 700 kilovolts. With these protons they have disintegrated lithium, boron and fluorine, the disintegration in every instance being accompanied by the ejection of an α-particle. Lithium splits up into two α-particles and boron into three. Dr. M. L. Oliphant described experiments in which elements in a very pure state have been bombarded with protons and ions of 'heavy' hydrogen—the isotope of hydrogen of mass 2. The heavy elements are not disintegrated appreciably by bombardment at energies below 220 kilovolts. The disintegration of lithium by protons and 'deutons' was described, the last-named particle being remarkably efficient as a disintegrating agent. Mr. P. I. Dee showed some remarkably interesting photographic tracks obtained with the expansion chamber, and Prof. P. M. S. Blackett developed the story of the discovery and possible genesis of the positive electron, thus closing a symposium as striking as any of those that have been associated in the past with the work of Section A of the British Association.

A. F.

Obituary

The Right Hon. Viscount Grey of Fallodon, K.G., F.R.S.

ALTHOUGH the first Viscount Grey of Fallodon, Northumberland, devoted nearly the whole of his life to political work, his death, on September 7, at the age of seventy-one years, has removed from ornithological circles, and bird protection bodies in particular, a keen and devoted student.

Lord Grey's wild birds' sanctuary at Fallodon has become widely known and many are the naturalists who have benefited from his courtesy, and visited it. Waterfowl were Lord Grey's especial interest and the fact that for twelve years none of the foreign species bred at Fallodon were pinioned, but left to find their own nest-sites, hatch their own eggs and bring their broods on to the ponds unaided, living a perfectly wild existence excepting for wheat-feeding in morning and evening, the addition of a fox-proof fence and the destruction of stoats and rats, and in the case of the wood-ducks, the supplying of small barrels on the boughs to allow for the insufficiency of natural nesting holes in the trees, adds considerably to the scientific value of the observations.

In a paper read before the Berwickshire Naturalists' Club in 1921, Lord Grey described the breeding of ten species of British duck, mallard, wigeon, pintail, shoveller, garganey, teal, tufted duck, common pochard, red-crested and

white-eyed pochard, and of thirteen species of foreign duck, spotted-bill, Carolina or North American wood-duck, mandarin, chiloe wigeon, Chilian pintail, Bahama pintail, Chilian teal, rosy-billed duck, jalcated duck, Brazilian teal, blue-winged teal, Japanese teal and the versicolor teal on the ponds at Fallodon. The breeding of the versicolor duck, when eight young were reared, was stated to be the first occurrence in Great Britain.

When pinioning was carried out, hybrids occurred between the wood-duck and Brazilian teal, and the wood-duck and the ring-necked teal, in both instances the mother being a wood-duck (Grey, "Habits and Breeding of Mandarin and North American Wood-Ducks", *Nat. Hist. Mag.*, No. 16, Vol. 11, Oct., 1930), but in 1929 a male wood-duck paired with a female mandarin, both birds being unpinioned. This duck, like many of the mandarins, had the habit of flying on to Lord Grey's head at feeding time. A large number of the mandarins have been reported many miles from Fallodon, where they have nested near woods and the little burns, but the wood-duck does not seem to have wandered away. Lord Grey concluded that young mandarins are more clever, more hardy, and grow faster than young wood-duck. It was possible at Fallodon to see twelve or so mandarin drakes all courting together in the middle of one of the ponds. The longest-lived bird at the sanctuary was a male chiloe wigeon, bought fully grown in October 1888, which died of every sign of old age in October 1908 ("Fallodon Papers", 1926). A valuable record was a fourteen-year old tufted duck, marked with a ring from Alnwick, which died at Fallodon in 1929.

Of wild birds at Fallodon, Lord Grey has noted ("The Charm of Birds", 1927) the green sandpiper on regular passage in August, a flock of waxwings, the great grey shrike, the jack snipe and brambling regularly in winter, and wild specimens of pintail, shoveller and teal. The walk of Lord Grey and President Theodore Roosevelt through the New Forest in 1910 has become historic because of the birds they noted, and last May Lord Grey chose the spot for the bird group, drawn by Mr. G. E. Lodge, which is to memorialise the occasion.

Lord Grey had been Chancellor of the University of Oxford since 1928, was president of Armstrong College, Newcastle, in 1918, and was also a trustee of the British Museum. He was born on April 25, 1862. He took an active interest in the bird protection movement, becoming a life associate of the Royal Society for the Protection of Birds in 1893, and being elected, with the first Lady Grey, a vice-president in 1895. Speaking at the annual meeting of the Society at the Middlesex Guildhall, Westminster, last year, Lord Grey made a strong plea for the more careful protection of the rare British birds and opposed the habit of egg-collecting, stating the present law is far too weak for combating it. As a member of Parliament, and of the Cabinet, Lord Grey gave valuable assistance to bills relating to wild birds. It is stated that President Theodore Roosevelt said of him: "He knows the songs and ways of English birds as few do know them." E. H.

Sir Philip Magnus, Bt.

The death of Sir Philip Magnus on August 29 at the age of ninety years removes the last survivor of the pioneers of technical education in Great Britain. In 1880, an advertisement appeared in Nature for an "Organising Director and Secretary" of the City and Guilds of London Institute for the Advancement of Technical Education, a voluntary undertaking on the part of the City Guilds, which were anxious to recognise their hereditary obligation towards technical instruction. Magnus was given the appointment and soon embarked on an ambitious programme of work. This included the building and equipment of a central institution originally intended for the training of technical teachers, now the City and Guilds Engineering College at South Kensington. He was concerned also with the foundation of the Finsbury Technical College (since closed) of which for a time he acted as principal.

Some of the impetus of the technical education movement came from foreign commercial rivalry. Curiously, as Magnus points out in his chapter on the Movement, included in his "Educational Aims and Efforts 1880–1910", the attitude of the Government towards the movement was inspired by the philosophy of the old economists and by the principles of free trade. State assistance was deprecated as discouraging individual initiative, and any interference with trade was taboo.

Under this influence the ideals of the Science and Art Department, though established originally to assist trade, became cultural rather than technical; but the Government was induced to appoint in 1881 a Royal Commission to inquire into the instruction of the industrial classes of certain foreign countries, Bernhard Samuelson being the chairman and Magnus and Roscoe being included among the members. Their work gave Magnus the opportunity to study the technical education systems of the Continent and he was greatly impressed, especially by the German system of education. Magnus showed missionary zeal in the cause, and many of our large cities were privileged to hear his addresses on the subject. These, as he modestly said, "helped, no doubt, to fulfil their purpose". History, he observed, will award no small measure of praise to the patriotic efforts of the City of London and the ancient Livery Companies of London for their contribution towards the promotion of technical education. With equal justice, Magnus's pioneer work in the cause should receive grateful recognition.

The movement having been successfully started, the Institute established a Department of Technology with training classes throughout the country

and a scheme for the examination and certification of technical teachers. From 1890, Magnus's work for the Institute was almost exclusively devoted to this department, which assisted in the formation of trade and technical classes under the Technical Instruction Act of 1889. The magnitude of the work may be judged from the increase in the number of registered classes in ten years (from 1890 until 1900) from 483 to 2,182 and in the number of students from 12,022 to 34,189.

Another important activity of Magnus's long and useful life was his work in relation to the University of London, of which he was a graduate in both arts and science. A student of University College, he acknowledged his great obligation to the professors of the College, especially de Morgan, Masson and Morris. As a member of Convocation, then a more influential body than under later constitutions, Magnus was soon drawn into the controversies relating to the constitution of the University. In 1867 Convocation took the initiative in reform by suggesting the formation of boards of studies to give teachers an official voice in framing curricula, but the Senate took no action to give effect to the recommendation. In 1884, Magnus was largely responsible for defeating a scheme of re-constitution proposed by a committee of Convocation over which Sir Edward Fry presided; and he became chairman of another committee appointed to prepare a revised and simpler scheme of reform. This was accepted by Convocation in 1886; but the whole question was remitted to the Royal Commission known as the Selborne Commission appointed in 1888.

In 1890, Magnus was elected by Convocation a member of the Senate of the University and at his death was the senior of the four surviving fellows of the pre-1900 constitution. As a member of the Senate he was instrumental in securing the inclusion of a Faculty of Engineering in the University as re-constituted under the Statutes of 1900—against strong opposition, for the proposal was only approved by the Senate with the help of the casting vote of the Vice-Chancellor, Roscoe. Magnus served as a member of the Departmental Committee of the Board of Education on the Royal College of Science appointed in 1904 and in that capacity was associated with the establishment of the Imperial College of Science and Technology of which the Royal College forms an integral part. Of the wisdom of incorporating colleges in the University he appeared to be unconvinced, but thought that the principle, having been applied to University College and to King's College, should be extended to other institutions providing education of university standard. But he was not friendly to the appointment of the Haldane Commission in 1907, consistently maintaining that the University should have been allowed "to work out its own salvation". Election in 1906 as the representative of the University in Parliament was a deserved reward for loyal service. He retained the seat until 1922, contributing usefully to debates on education, university representation, medicine and public health, and arboriculture.

Magnus published many books and pamphlets, including "Educational Aims and Efforts 1880–1910" to which reference has been made. His well-known elementary textbook on mechanics proved his natural instincts as a teacher. In his later years—few survive who knew him as a young man—his character was benign and generous. If he was more effective in carrying the argument to its logical conclusion than in fighting false premises with demoniacal force, his influence on education and politics was sane and informed; and his achievement, especially in the promotion of technical education, was worthy of his name.

T. Ll. H.

News and Views

British Association

THOUGH for the most part science proceeds upon her even way, her head raised above the changes of the times and her feet firmly planted in regions unswept by surface movements, nevertheless her response to the needs of time and place was well marked in the proceedings of the British Association at Leicester this year. The surrounding country was the focus of many contributions on regional planning, land utilisation, education for the local industries, its system of grazing, its early colonisation, its water supply, and so on. This attention to its needs and recognition of its efforts cannot but be appreciated by the citizens of Leicester. Finally, education in relation to the agricultural need of the region occupied time, and stress was also laid upon the need of science and especially of the biological sciences. The cultural educational value, as opposed to its industrial value, of science in relation to adolescence and adult life was emphasised in several contributions, while the stringency of the time was prominent as shown by the many contributions on vocational training, for example, of university men for a department store, Post Office men for the counter staff, and, in general, the needs of business in administration. The rapid colonial extension in Africa—particularly East Africa—in recent years was reflected in a number of papers and demonstrates the new centre of interest. It adumbrates and lays the foundation for administration based on knowledge of place and people. Modern physics was, of course, well represented; an account of the discussion on atomic transmutation appears elsewhere in this issue (p. 432).

THE British Association meets next year at Aberdeen on September 5–12 under the presidency of Sir William Hardy. At a meeting of the general committee at Leicester on September 12, an important

resolution was adopted in the following terms: "to request the council to consider by what means the Association, within the framework of its constitution, may assist towards a better adjustment between the advance of science and social progress, with a view to further discussion at the Aberdeen meeting". The new members of council are Prof. F. Aveling, Prof. R. N. Rudmose Brown, Prof. F. Balfour-Browne, Prof. G. W. Howe and Dr. J. A. Venn. The report of the council announces that the Seismology Committee of the Association is a prospective beneficiary in the sum of £1,000 under the will of Dr. J. E. Crombie, and that the late Mr. Bernard Hobson bequeathed £1,000 to be invested and the proceeds to be devoted annually to the "promoting of definite geological research". The Pilgrim Trust has promised the Association £150 a year for five years towards the maintenance of Down House. Invitations have been accepted to hold meetings of the Association at Norwich (1935), Blackpool (1936) and Nottingham (1937).

A Ten-Year Plan for Industrial Research

If planning ahead in industry is necessary for national and international well-being—and Democratic America, Fascist Italy, and Soviet Russia hold that it is—it is equally desirable for industrial research. The financing of scientific and industrial research in Great Britain has been marked by alternating gusts of national generosity and national parsimony, thus precluding the possibility of progressing on an even keel by laying down settled plans of research for more than a year ahead. During the decade 1930–40, the main avowed objective of the Forestry Commission was the planting of 353,000 acres of forest, for which a continuous supply of nursery stock had to be arranged in advance. In 1931 the programme was curtailed shortly after recovering from its birth pangs. This curtailment has resulted in an absolute loss—and waste—of £50,000 which had been invested in young trees which could not be planted out or sold; and this in the sacred name of 'economy'!

On March 1, 1932, Great Britain was transformed by a stroke of the pen from a free trade to a protected community. That is to say, its industries became protected, but without any effective provision that the consuming public should also be protected by ensuring that the industrialists conducted their concerns in the most efficient and economic manner. Had a compulsory levy been made on our protected industries for the purpose of financing industrial research so as to render them better able to compete with other countries—and to produce for the home market at a reduced cost—or had a percentage of the resultant tariff revenue been earmarked for this purpose—say for a term of ten years—our statesmen would have shown greater vision. It is not too late, even now, for the Government to legislate on these lines; and a joint committee is being constituted by the British Science Guild and the Association of Scientific Workers to explore the subject and to formulate a scheme for presentation to the Government.

Recent West Indian Hurricanes

Reports of widespread damage and loss of life in Cuba and neighbouring islands, and in Mexico, Texas and Florida, during the first few days of September, due to West Indian hurricanes, suggest very exceptional storm activity even for the month which on an average provides the greatest number of hurricanes in those regions. The reported number of deaths on September 1 in Cuba alone had reached 150 by September 5, with more than 1,000 people more or less seriously injured. The storm that did the damage in Cuba appears to have been moving due west at that time, and to have passed on to reach Texas on September 4 without having lost much of its intensity. Another storm followed quickly along a more northerly path and was most destructive in the northernmost islands of the Bahamas and on the east coast of Florida. Its path appears to have been almost exactly the mean path for September hurricanes. Florida was reached on September 4. If the statement appearing in the *Times* of September 6 is correct that destructive winds affecting the east coast of Mexico on the same date were due to two further tropical cyclones, then no fewer than four storm centres were reaching the Gulf Coast and Florida on the same date, which is remarkable seeing that the average number for the whole month is only a little more than one, even when hurricanes of less violence than the two most northerly of those just described are counted. A noteworthy feature of the Cuban storm was that at Cardenas, to the east of Havana, the wind—reported to have blown with a speed of 120 miles an hour—drove the sea inland no less than eight miles according to a detailed account that appeared some days after the disaster.

Memorial to Jouffroy d'Abbans

On August 28 a memorial plaque was unveiled in the fortress of Sainte-Marguerite, Ile les Lerins, near Cannes, to Claude François Dorothée, Marquis de Jouffroy d'Abbans, the French infantry officer who, one hundred and fifty years ago, made a successful experiment with a steam-boat on the River Saône, near Lyons. The ceremony was attended by a naval guard of honour, and the Comte de Jouffroy d'Abbans, a descendant of the inventor, was present. Jouffroy was born in 1751 at Roche-sur-Rognon, Haute Marne, and at the age of twenty-one years joined the army. A visit to Paris stimulated his interest in the steam-engine and in 1776 he endeavoured to drive a boat by steam on the River Doubs. Of the construction of this, or of his boat of 1783, few details are known, and no development resulted from either of his experiments. Like all the earliest pioneers of the steam-boat, he found the problem of steam propulsion a very complicated one. That he did not continue his experiments was probably due to the outbreak of the Revolution, which caused him to emigrate, and he was absent from France for ten years. He still, however, retained his interest in the matter and in 1816 was connected with a company which placed the steam-boat *Charles*

Philippe on the Seine. Jouffroy died in the Invalides on August 7, 1832. His statue was erected at Besançon in 1884.

Bronze Age Implements

A RESEARCH committee of the British Association, first appointed twenty years ago at the Birmingham meeting, to report on the distribution of bronze age implements, reported at the Leicester meeting that its labours, so far as England and Wales are concerned, are now completed. With a few insignificant exceptions, all the specimens in museums and private collections in England and Wales, in the Isle of Man and in the Channel Islands, a majority of the specimens in Scotland, a considerable number of those in Ireland, and early specimens from the Museum in Copenhagen have been drawn, measured and described in an illustrated card catalogue, which is deposited, and is available for consultation, in the rooms of the Society of Antiquaries, London. The most important exceptions in the list of specimens are those of foreign origin in the British Museum, the Ashmolean and the museum at York. The original intention of the committee when it was first appointed was, by international co-operation, to extend the catalogue to cover the whole of Europe and the adjacent lands. The question was raised at the meeting of the Association Française in July 1914, but came to nothing owing to the War; while a further attempt to secure international action made at the Prehistoric Congress in 1932, has, as yet, produced no result.

Wild Bird Sanctuaries

A COMMITTEE has been formed in Manchester, with the Earl of Stamford as chairman, to perpetuate the name of the late T. A. Coward, an honorary keeper of the vertebrate collection at Manchester Museum and an eminent ornithologist, by purchasing two wild birds' sanctuaries in Cheshire. It has also been decided by the Lancashire and Cheshire Fauna Committee to dedicate Part 2 of its "Check List of the Fauna of Lancashire and Cheshire" to the late Mr. Coward; the first part, published in 1930, was dedicated to the memory of Mr. Linnaeus Greening. Of the two memorial sanctuaries, Cotterill's Clough, a hanging wood on the River Bolling within sight of Coward's home at Bowdon, has yet to be purchased, though most of the second, the reed beds and woodland at Marbury Mere, have been acquired. At the former, Coward recorded the grasshopper-warbler in 1898, and thirty-two nesting species were recently listed, while at Marbury the bittern is a frequent winter visitor, the night heron has been recorded, and A. W. Boyd recorded 23 black terns on August 18, 1930 (*British Birds*, 25, 276, 297). The usefulness of certain wild bird sanctuaries for ornithological records and observations is amply demonstrated by those of the Norfolk Naturalists' Trust, and the reports of the Committee on Bird Sanctuaries in the Royal Parks, which have recorded some sixty nesting species in Richmond Park. Facilities for observation on nesting waterfowl at the late Lord Grey's private bird sanctuary have produced valuable information (*Natural History Magazine*, Oct. 1930) and the recently acquired sanctuary at Dungeness will, it is hoped, preserve one of the few remaining nesting sites of the Kentish plover (*Ægialitis cantiana*). The sanctuary at Liverpool Cathedral has proved valuable in observations on movements of city birds (NATURE, Aug. 5, p. 199).

Right- and Left-Handed Spirals in Gastropods

A CORRESPONDENT has raised the question as to whether there is any explanation for the fact that spiral shells of present-day marine gastropods wind in the opposite direction to similar shells found in the Crag formation of East Anglia. The first point is that only certain species of fossil shells wind in this manner, and although it is usual for present-day gastropods to be dextral, that is to say, they wind in the ordinary clock-wise spiral, there are certain genera which always wind in the opposite direction and are sinistral; also in species which are usually dextral, there are frequently sinistral varieties. The well-known fossil shell *Fusus contrarius* from the Red Crag is so common that it has given rise to the idea that all fossil shells of this kind are sinistral, but there are a large number of fossil gastropods which are normally dextral and, to take but one example, the common 'Buckie', *Buccinum undatum*, closely related to *Fusus*, sometimes is sinistral although normally dextral. Other common recent gastropods which are known to have sinistral varieties are the edible snail, *Helix pomatia*, and the common fresh-water snail, *Limnæa peregra*. A good deal of work has been done, and is still going on, on the breeding of the last-named mollusc in order to find out the reason for these sinistral varieties (Diver, Boycott and others), the conclusion being that the general organisation of the germ cell determines whether the animal is to be dextral or sinistral, the factors for right-handedness or left-handedness being in the chromosomes and inherited in special ways. A sinistral individual may have an entirely sinistral brood or it may have an entirely dextral brood or a mixture, the broods from these varying to a large degree. Besides truly sinistral shells which also have a sinistral animal, there are species with a sinistral shell and dextral animal. It is practically certain, however, that the fossil *Fusus* must have been wholly sinistral both in shell and animal.

A Triple Rainbow

MR. R. C. T. EVANS, of 10 Eddington Lane, Herne Bay, has forwarded a description of an unusual rainbow seen by him at Herne Bay that differs from any of those described in recent numbers of NATURE, in that it made a considerable angle with the ordinary primary and secondary bows, implying that the sun was not at the centre of curvature of the unusual bow. The phenomenon was seen at 18h. 20m. G.M.T., presumably on a date in the third week of August; it was visible for about five minutes, the secondary bow for only about three minutes, while the primary bow lasted much longer. The tide was low at the

time and the sun was clearly reflected on a distant wet mud flat, no doubt forming an extension of the northward sloping beach, so as to give an image below the level of the observer's eye and to the left of the sun, that is to say, lying in a direction somewhat farther round towards the south. Mr. Evans attributes the third bow to this additional source of light. It appeared as a short arc with colours arranged in the same order as those in the primary bow, with an apparent centre of curvature above the horizon and north of the centre of curvature of the two ordinary bows. He estimated that about two-thirds of a complete circle would have been above the horizon had the arc continued far enough, while the two normal bows would have shown to only half that extent above the horizon. The explanation offered seems to accord well with the observed effect.

Distributive Enterprises in the United States

In the United States decennial census of population for 1930, there was included, for the first time in any country, a special census of distributive enterprises and activities. In order to bring this important innovation to the attention of business men, traders and others, a report has been prepared for the International Distribution Commission by the International Management Institute (2, Boulevard du Théatre, Geneva, pp. 72; 2 Swiss francs). This report points out that the American experiment in the statistical study of a hitherto neglected aspect of economic activity is likely to prove extremely valuable to other countries. The distribution census provides a complete guide to the position in the United States in 1930 with regard to distributive enterprises throughout the country, including particulars of their size, turnover, expenditure, number of employees, type of organisation and similar facts. The census of distribution is complementary to a census of production since it is an attempt to establish the exact statistical facts as to the various enterprises engaged in distributive as opposed to productive activities. The material provided should be of particular value to small retailers since they will obtain facts and information which larger concerns have in the past gathered for themselves at considerable expense. The census provides a unique contribution towards the study of an important aspect of economic organisation. Greater distributive efficiency would increase the power of the market to absorb goods and services, whereas at present, production is limited to the capacity of ill-organised markets.

Aiming at 1,000 kilovolts for the Transmission of Power

An account by Mr. T. Rich of a recent High Tension Congress at Paris is given in the *Electrician* beginning on July 28. The problems of the use of direct current for power transmission and the many uses of thermionic converters were discussed in several papers. M. Sitnikov, of Leningrad, described a system of thermionic converters with cold electrodes and magnetic control which possesses many advantages for the transmission of power by direct current. Experiments prove that, for a discharge in gas, the limit of the current which can be passed by the tube is determined by the limiting value of the power which can be given out by the two cold electrodes at a sufficiently low temperature so that their surfaces suffer no deterioration. The gaseous column will carry practically any current, provided the energy can be taken from the electrodes. A tube tested up to 70 kilovolts operated quite satisfactorily up to 30 kilovolts. A plan is under consideration in Russia for the transport of a million kilowatts at a pressure of the order of 600 kilovolts. The necessary researches in connexion with the converter tubes are being carried out in Leningrad. Mr. E. S. Henriksen, of the Norwegian Nitrogen Co., described the development of valves with grid control for very high tensions. He stated that if 400 kilovolts is the highest voltage practical with three phase current, then with direct current 725 kilovolts is possible with overhead transmission and 1,000 kilovolts with underground cables. Various schemes were discussed relating to a project for transporting power from Norway to the north of France. It will be remembered that the voltage of the English 'grid' is 132 kilovolts.

An Industrial Jubilee in Sweden

In the *Asea Journal* (Allmanna Svenska Elektriska) for April there is an interesting account of the jubilee of the Asea Electric Co., which was founded fifty years ago. In 1883, it employed seven workmen and the total horse power of all the machines manufactured was 62. For the ten years before the War, the development of hydro-electric supply systems in Sweden created a great demand for electric machinery. During the War, thanks to the neutrality of Sweden, the business rapidly increased. The scarcity of petrol also gave a great impulse to the use of electrical energy and networks of wires were erected over various parts of the country. For the last ten years new forms of rationalisation have been introduced into the various branches of the business, and last year it employed 10,000 workmen and the horse power of the machines manufactured reached a total of one and a half million. The celebrations were initiated by a special performance at the Royal Opera House in Stockholm to which all its employees were invited. In Sweden it is the custom for the Royal Patriotic Society to present long-service medals to persons industrially employed as a token of recognition for faithful and loyal service. Two hundred and forty-four of the company's workmen and engineers were presented with the 30 years' medal. At the conclusion of the ceremonies the directors gave donations amounting to £40,000.

Eighteenth Century Map of Hampshire

We have received from the Hampshire Field Club and Archæological Society a copy of the reproduction, on a slightly reduced scale, of the map of Hampshire by Isaac Taylor, 1759, which has recently been published by the Society (Winchester: price to non-members 6*s*. net). The scale of the original map is one inch to the mile, the reproduction being three-quarters of an inch to the mile. The map is a beautiful

production in characteristic eighteenth century style, with engravings of buildings such as Porchester Castle and "Carresbrook Castle" as well as a plan of Silchester, lists of "Gentlemen's Names", etc. It is interesting to note that exaggerated emphasis is given to relief. Very little appears to be known of Isaac Taylor. He was a native of Ross in Herefordshire. His first-known map is a Plan of Oxfordshire, issued in 1750 and his last a map of the county of Gloucester, which appeared in 1777. He was both an engraver and a surveyor, and on the map of Hampshire there is a note "Estates are surveyed and mapped". His more important maps, in addition to those named, are Wolverhampton, 1750, County of Hereford, 1754, Hereford City, 1757, Dorset, 1765, County of Worcester, 1772.

Revision of Ordnance Plans

A LEAFLET on the revision of areas of twenty-five inch plans, issued by the Ordnance Survey, notes that revision is far behind the standard formerly achieved. The hiatus due to the War meant a gap that would not have been easy to bridge even if other difficulties had not supervened. Road and housing development have led to abnormally quick changes within the last twelve years. But most serious of all has been the effect of the call for public economy. Since 1928, revision has, perforce, been limited to those areas in which development and changes have reached a certain standard. This standard is defined as the addition of 200 houses or equivalent area of factory, road or other development in a six-inch quarter sheet. This principle means the abandonment of the revision of any county as a unit, which in former days was done every twenty years. It has much reduced the areas scheduled annually for revision.

Bibliography of Sir James Frazer's Work

IN January next Sir James Frazer will celebrate his eightieth birthday. In the same year will fall the fiftieth anniversary of the publication of his first work. To meet the desire of his many friends and admirers, who feel that there should be some appropriate mark of the occasion, which would convey to Sir James the esteem in which he is widely held, it has been decided that a number of learned societies, with which Sir James has been connected, should join under the auspices of the Folk-lore Society in the compilation and publication of a complete bibliography of his writings. It is probable that no form of commemoration could be more appropriate than this. It will serve as a perpetual reminder of the wide range of learning that Sir James has covered in his long life of activity in the service of humane letters and science. The editorship of the volume has been entrusted to Mr. Theodore Besterman, 47 Great Ormond Street, London, W.C.1, to whom subscriptions (10*s*. 6*d*.) should be sent.

Distribution of British Animals

THE significance of the distribution of a species or group of species is often best appreciated by map-plotting. To simplify and encourage this method, an octavo map has been prepared showing the counties and vice-counties of Great Britain as delimited for the Watsonian botanical scheme. The areas are numbered so clearly that no confusion can arise, and the key to the numbers is printed alongside the map. Two series have been prepared; one is printed in black, in the other the county outlines, numbers, and list are printed in blue, so that although perfectly legible in ordinary use, they will disappear when photographed for reproduction. The maps may be obtained from Messrs. Oliver and Boyd, Tweedale Court, Edinburgh, at a cost which runs from £1 3*s*. a hundred to £2 2*s*. a thousand for the all black, and £1 11*s*. 6*d*. a hundred to £3 a thousand for the black and blue.

Libraries and Gardening

A CATALOGUE of books on gardening, poultry and bees has recently been issued by the Leicester Municipal Libraries. Its contents are illuminating, and show that the gardening public is beginning to take an interest in the scientific aspects of their hobby, craft or vocation. Such volumes as Dr. Keen's "Physical Properties of the Soil", Bourcart's "Insecticides, Fungicides and Weed-Killers", Dr. Kenneth Smith's "Text Book of Agricultural Entomology" and many others of proved scientific worth show that the modern gardener is alive to the need of moving with the times. More than fifty volumes are included in the section on garden planning, and the kitchen gardener and floriculturist are amply supplied with books. The sections on poultry-keeping and bee-keeping are good, but do not give evidence of such scientific and artistic progress as characterises the volumes on gardening.

North American Birds of Prey

CONTINUING its series of reproductions of paintings of birds in North America, the *National Geographic Magazine* for July illustrates and describes the eagles, hawks and vultures. The descriptive text is by Alexander Wetmore, assistant secretary of the Smithsonian Institution; and the coloured pictures, 28 in number, by Major Allan Brooks, if inclined to be a little hard in texture and colour, are the best American drawings we have seen since the death of Louis Agassiz Fuertes. The present article is the fifth of a series very useful and attractive to bird lovers; the first, including humming birds, swifts and goat-suckers, appeared in July, 1932, the second, with ibises, herons and flamingoes in October, 1932, the third, with crows, magpies and jays in January, 1933, the fourth with woodpeckers in April, 1933, and the sixth will be published at an early date.

Copper-Steel Welding

THE issue of the *Scientific American* for September contains a short illustrated description of a large Detroit welding plant capable of effecting 2,000 welds of steel parts an hour. The parts are either screwed or tightly fitted together and the joint has a thin copper wire or a paste of copper applied to it. A trolley full of articles is sent through a long tube

6–8 ft. in diameter the centre portion of which is heated to 2,100° F. electrically. The copper melts and is by capillary attraction drawn into the joints. Oxidation is prevented by the tube being filled with a gas prepared by the action of steam at high temperature and pressure on illuminating gas. Beyond the welding zone the tube is cooled so that the articles emerge at room temperature. The copper alloys with the steel at the joint and the alloy appears to be stronger than the steel.

Lectures on the Rothamsted Experiments

DURING the forthcoming winter, Mr. H. V. Garner, guide demonstrator at the Rothamsted Experimental Station, and other members of the staff are prepared to give a few lectures to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted experiments. The subjects offered include manures, soil micro-organisms (bacteria, protozoa, etc.), agricultural botany, agricultural chemistry, soil physics, entomology, and plant pathology. No fee will be charged for the lecturers' services but travelling and other expenses must be defrayed. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

Gift to the University of Sheffield

SIR ROBERT HADFIELD, as head of the firm of Hadfields, Ltd., and by his generosity to the University of Sheffield, for which some years ago he built and equipped a metallurgical research laboratory for the Department of Applied Science, is well known to the citizens of Sheffield. He has now placed them still further in his debt by a gift of £5,000 to the University, expressing the hope that it may form a nucleus for the establishment of a course in founding in the Faculty of Metallurgy. Sir Robert was president of the Iron and Steel Institute when it visited Sheffield in 1905, and now, after an interval of twenty-eight years, the Institute has again held its annual meeting at Sheffield, the president being a friend of Sir Robert's, Mr. W. R. Lysaght, who was unfortunately prevented by ill-health from attending. It is to mark these two visits that Sir Robert has made this generous gift to the University. The steel industry of to-day, still centred at Sheffield, owes much to metallurgical research in which the universities have played their part, and Sir Robert's benefactions to the University of Sheffield are a fitting recognition of this debt and at the same time a gesture for the encouragement of so-called academic research.

Institute of Metals

THE Institute of Metals will hold its silver jubilee autumn meeting in Birmingham on September 18–21, under the presidency of Sir Henry Fowler. The Institute was founded in Birmingham twenty-five years ago and it is appropriate, therefore, that the forthcoming meeting should be held in that city. An inaugural lecture on "Twenty-Five Years' Progress in Metallurgical Plant" will be given by Mr. W. R. Barclay, vice-president, and a series of fourteen papers dealing with various phases of metallurgical work are to be delivered. A specially interesting feature of the meeting will be the reproduction of the first office of the Institute of Metals. This was housed in the Metallurgical Department of the University of Birmingham, and was set up by the Institute's first and only secretary, Mr. G. Shaw Scott, who, with the president and the chairman of the executive committee, will receive the remaining original members of the Institute in the reconstituted office. Here visitors will have an opportunity of inspecting the earliest records of the Institute—including the original membership applications and photographs taken during the inaugural meeting in 1908. During Mr. Shaw Scott's period of office as secretary and editor the membership of the Institute has increased from 200 to 2,200. Whereas originally the membership was confined almost entirely to Great Britain, it now covers the whole world. The Institute removed in 1909 to London, where it now has offices at 36 Victoria Street, Westminster, S.W.1.

Announcements

THE following appointments have recently been made in the Colonial Agricultural Service: Mr. A. C. Barnes, to be director of agriculture and Island chemist, Jamaica; Mr. D. L. Blunt, to be director of agriculture, Cyprus; Mr. H. B. Stent, to be agricultural chemist, Coffee Experimental Station, Tanganyika.

WITH reference to the paragraph in NATURE of August 19, p. 285, on the cluster variable numbered 65 by Bailey (who discovered its variability, but not its period) it was stated that the period was first found by Mr. Kooremann. This is incorrect. The period was actually determined by Prof. E. Hertzsprung.

A BIBLIOGRAPHY of the scientific papers of Sir James Dewar and his colleagues from 1867 until 1923 has recently been published in a limited edition of two hundred copies, price 5*s*. Copies may be obtained from Mr. H. Young, 16, Causton Road, London, N.6.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A principal teacher of mathematics and physics at the Technical College, Coatbridge—The Director of Education, Lanarkshire House, 191, Ingram Street, Glasgow (Sept. 23). An assistant inspector of scientific supplies—The Director-General, India Store Department, Belvedere Road, Lambeth, London, S.E.1 (Sept. 25). A drainage engineer for the Government of Bihar and Orissa—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Sept. 26). A principal of Dudden Hill Technical Institute, Denzil Road, Willesden, London, N.W.10—H. M. Walton (H.), 10, Great George Street, Westminster, London, S.W.1 (Oct. 7). An agricultural bacteriologist in the Punjab Agricultural Service, Class 1—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Oct. 7). A lecturer in agriculture at the Cheshire School of Agriculture, Reaseheath, Nantwich—The Principal (Oct. 7).

Letters to the Editor

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

Sponges without Collared Cells

My friend Mr. Maurice Burton has given his reasons for believing that there are many siliceous sponges which have no oscula, pores, or flagellate chambers, and nourish themselves through the general surface[1]. His evidence does not seem to prove the existence of such structure other than, as previously recognised, where degeneration of tissue has followed the onset of unfavourable conditions; and there we have no knowledge that subsequent nourishment takes place. It is difficult to understand how a solid finger, 1 cm. wide, of amœboid animal cells in jelly, can be nourished and grow by soakage of solubles from sea water; if it can be done, it is not clear why sponges or metazoa came into existence. Loisel (1898[2], p. 220) considered his experiments proved that a *Spongilla* was nourished by adding to its water the filtered juice of another *Spongilla*; but this does not show that Mr. Burton's hypothesis is tenable, for there is little organic matter dissolved in ordinary sea water. Further, the spongilla which was nourished possessed collar-cells and currents, and exposed to the water an internal surface of ingesting protoplasm twenty or a hundred times the area of its horny external skin.

Lieberkühn (1856) pointed out that Dujardin (1838) found his flagellate cells in freshwater sponges only after spring had begun; in the winter, cells exhibiting amœboid movements were alone present. Lieberkühn states that in the winter not merely a part of the gelatinous mass but indeed the entire sponge consists of amœboid cells; Weltner (1907) and others have repeated his observation. It would be interesting to know whether Mr. Burton's *Tenacia*, collected by the Swedish Antarctic Expedition, was found in a locality where, as in European lakes, alternations of ice-cold and temperate water might produce Lieberkühn's metamorphosis.

Such metamorphosis may be induced by other agencies beside cold. I described (1895, p. 27) a *Grantia compressa* which, after a month in the aquarium circulation at Plymouth, had replaced three-quarters of its flagellate radial tubes by the greatly increased gelatinous parenchym; suggesting that the loss of flagellate cells in *Halisarca* described by Metschnikoff (1879) was similarly due to pathogenic environment. *Clathrina clathrus* at Naples is a network of flagellate tubes opening into a wide vent. It closes this with a sphincter when removed from its wave-washed habitat (at Capo Miseno) into a beaker of sea-water. Placed in the aquarium circulation it remains closed, the porocytes gradually cover the collar-cells and (because the distending pressure is thus reduced—G.P.B.) the tubes shrink in diameter so that the collar-cells are forced to become a many-layered stratum of ovoid cells under the porocytes (Minchin, 1892, α). Ultimately each quondam tube becomes a withered string connecting spherical gemmules filled with amœboid cells (Urban 1910.—I am very familiar with this metamorphosis).

Urban describes these degenerative changes in other Naples species of *Clathrina*, and Dendy (1913, α), in *Clathrina* (*Leucosolenia*) *gardineri* from 10 fathoms in the Chagos Archipelago, found no collar-cells, and compared the condition with that described for *Ephydatia* and *C. clathrus* by Weltner and Minchin: in this 10-fathom sponge the metamorphosis had apparently been caused by an invasion of unicellular algæ. Parker (1910) does not describe metamorphosis in the siliceous *Stylotella*, but found a rapid closure of the vent, as in *C. clathrus*, when the surrounding water becomes still; the closure can be stopped by continuing a local movement of water across that terminal external surface of the sponge which includes the lip of the osculum. (I have found[3] a similar "Parker's reaction" in the cloacal surface of *Leuconia* and *Leucilla*—wrongly called "Leucaltis"; when the sponge's own oscular current diminishes in volume the sphinctral region contracts, so that the velocity of the jet does not sink proportionally.)

Metamorphosis may, therefore, be induced by cold, aquarium conditions, invasion by parasites or prolonged closure of the osculum; and closure of the osculum may be a reaction to mere stagnation of the surrounding water. Parker's account provokes the suggestion that this reaction protects the canal system from being clogged by the suspended matter which falls on the sponge when the surrounding water is still: the recent Great Barrier Reef Expedition has shown us what a live danger this can be in marine life. I have stopped the currents of a very robust *Leuconia* by a thick suspension of particles in the water, and found the prosopyles choked[4]. Few sponges are found in waters heavily charged with sand, clay or chalk; possibly *Haliclona* can live in the water Mr. Burton describes because, like *Stylotella*, it closes oscula when stagnation threatens deposit.

Closure of oscula is well-known in littoral sponges, such as *Grantia compressa*, when they are exposed to the air; and sponges which have been brought from the collecting ground in a crowded bucket have often closed oscula. Evidence of lipostomy based on sponges from a collection is therefore very weak unless the collection has been made with unusual precautions. Such evidence is inadequate to force us to revive the doctrine of Dutrochet (1828) of absorption through the external surface. Where Mr. Burton has examined a complete series of sections from a well-preserved sponge and states that there are no flagellate chambers, we must conclude that some adverse condition has produced Lieberkühn's metamorphosis, but we have no evidence that nourishment has taken place since the change. (It may be remembered, however, that Van Trigt—1919, Leyden—found that in emergency symbiotic algæ are digested.) But in 1891 I described *Clathrina clathrus* as lipostomous, as my betters had done before me, and in 1892 Minchin dived into the sea and found that *in situ* it has wide oscula. *Haliclona* Mr. Burton can observe *in situ*, but as to antarctic sponges he will not get better evidence than there was for the lipostomy of *C. clathrus* from the personal collections of Oscar Schmidt, Hæckel and others, and from the living sponge, three hours from its native rock, lying in a dish of sea-water on my table at Naples.

Sponges, whether calcareous or siliceous, and whether at Plymouth or Naples, will not often give currents when they have withstood for three hours the chances of a collecting boat (Grant gathered his own sponges). We need not therefore readily accept the conclusion that "Tetraxonida" (*sensu* Dendy—including Monaxonellida) are animals "often without any circulatory

currents, and with a very low rate of metabolism." Parker says: "In the thousands of living individuals of *Stylotella* that I have examined . . . I have never found a living specimen of *Stylotella* in which currents could not be demonstrated." Grant found no difficulty in showing the currents of *Halichondria*, and Carter notes as remarkable that in the extreme heat of the summer in India the currents of *Spongilla* will stop (Parker found for *Stylotella* that this happens at 40° C.). Lieberkühn, Weltner and others found *Ephydatia* and *Spongilla* constantly working; the only *Ephydatia* I tried from the Cam showed jets 12 cm. long, and from the small vents of a *Halichondria* at Plymouth (freshly gathered from the intake cave below the M.B.A. laboratory) came jets 4 cm. and 5 cm. long. On one occasion at Plymouth, Prof. Garstang supplied fortunate evidence that the currents of about twelve specimens of *Suberites ficus* were all active just after he had dredged them. As to the more recondite genera, we may reverse Sollas's calculation as to flints (in "Age of the Earth" I think) and from the percentage of silex in sea-water calculate how much water must have poured through the body to enable the sponge to form the "dense skeletons of siliceous spicules" which Mr. Burton finds characteristic of the preserved sponges that show no vents or pores.

Parker finds that the flagella do not stop working because the vents are closed in *Stylotella*; I have watched through the wall of a flagellate tube of closed *Clathrina clathrus* carmine particles moving inside it; and found the flagella of *Grantia compressa* in activity after the vent had been closed in air 26 hours. "I have never seen a flagellum motionless in a cell which was not moribund. I believe the motion to be ceaseless, unconscious, and uncontrolled"[5]. I do not believe that "the flagellated chambers of siliceous sponges are frequently quiescent over long periods" except when injured by temperature or poison.

GEO. P. BIDDER.

Cambridge.
Aug. 12.

[1] NATURE, 132, 209, Aug. 5, 1933.
[2] References are to Vosmaer's "Bibliography of Sponges".
[3] *Quart. J. Micro. Soc.*, 67, 314; 1923.
[4] *Proc. Linn. Soc.*, 34, 308, fig. F., and 316.
[5] *Brit. Ass. Report, Leeds*, p. 64; 1927.

Effect of the Solar Eclipse on the Ionosphere

IT has been definitely established that the ionosphere responsible for carrying radio waves round the curved surface of the earth is divided into two clearly distinguishable regions[1,2]. The lower—the classical Kennelly-Heaviside or the *E* layer—is situated at a height of about 90 km., and the upper—the Appleton or the *F* layer—is situated at a height of about 200 km. The nature of the ionising agencies producing these two different layers is, however, not yet definitely known.

An interesting suggestion was made some time ago by Chapman that one of the layers derived its ionisation from the ultra-violet light and the other from corpuscles or neutral particles shot off from the sun[3]. Chapman also indicated how observations on the ion content of the upper atmosphere during a solar eclipse would afford means of determining the relative influences of these two kinds of radiation[4]. He showed that the eclipse of the corpuscles and the eclipse of the light would not occur at the same time but that the former would take place about two hours before the latter. Radio observations during the eclipse of August 31, 1932, which was visible in Europe, indicated, however, that the ultra-violet light from the sun was the chief cause of ionisation of the *E* and the *F* layers and that the corpuscles had little or no effect[5]. In view of the importance of the subject, the opportunity afforded by the annular eclipse visible in Calcutta on August 21 last, was taken to study the question by making measurements of the ion content on the day of the eclipse as well as on preceding and following days. The results of our measurements present certain interesting features which are described below.

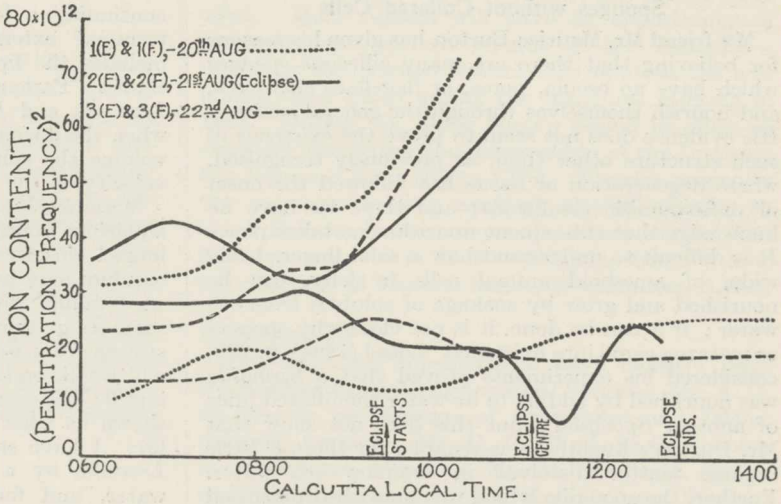

FIG. 1.

The measurements were carried out, after Appleton[6], by observing the critical frequencies of upwardly directed waves of varying wave-lengths at which they were just able to penetrate either the *E* or the *F* layer. The transmitting and the receiving stations were 7 km. apart. It was possible to take a complete set of observations of different wave-lengths to find out the critical frequency within 15–20 minutes. The maximum frequency available was $85{\cdot}7 \times 10^5$ cycles/sec. ($\lambda = 35$ m.); this was unfortunate, because that frequency was not high enough to penetrate the *F* layer generally after 11 a.m.

Curves in Fig. 1 depict the variation of the ion content of the *E* and *F* layers between 6 a.m. and 2 p.m. on August 20, 21 (eclipse) and 22. The following are interesting features of the curves:

1. The ionisation of the *F* layer increases fairly regularly on August 20 and on August 22 between 6 a.m. and 11 a.m., curves 1(*F*) and 3(*F*). On August 21 there is an outburst of variation about 8 a.m., curve 2(*F*). It will be noticed that there are slight irregularities in the *F* curves on August 20 and 22 at about the same time. A comparison of curves 1(*F*), 2(*F*) and 3(*F*) leads one to imagine that the variation on August 21 might have been caused by

the corpuscular eclipse which was due at about this time. But observations on the ion content on August 24 (not shown in the figure) showed a similar outburst of variation at the same time. The outburst of the variation on August 21 at the time of the corpuscular eclipse was therefore probably a mere coincidence.

2. The ionisation of the *E* layer increases with the progress of the day on August 20. On the day of the eclipse, curve 2(*E*), however, the ionisation starts decreasing from 8 a.m. and forms a well-defined trough of minimum value at 11.33 a.m. about twenty minutes after the optical maximum. On August 22, curve 3(*E*), the day after the eclipse, the gradual rise of ionisation with the progress of the day is entirely absent.

3. It can be concluded from these observations that the ultra-violet light is at least one of the agencies producing ionisation of the *E* layer, and that the corpuscular rays have little or no effect as an ion producing agency. The absence of regular rise of the *E* layer ionisation on the day after the eclipse can be accounted for by the fact that the eclipse occurred at an hour when the sun's action is greatest. The effect of the withdrawal of the ionising agency during this active period produced a quasi-permanent deficiency in the ion content which persisted until the next day. It will be noticed that on the day of the eclipse the ionisation had a tendency to fall after 12.30 p.m., curve 2(*E*). This also is due to the same reason, namely, the withdrawal of the ionising agency at the time of its most intense action.

More definite information about the nature of the ionising agencies other than ultra-violet light can only be obtained by a large number of stations participating in observations during a solar eclipse. It may then be possible to discriminate between fortuitous outbursts of variations in the ion content and variations caused by the eclipse.

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Aug. 28.

[1] Appleton, NATURE, 120, 330, Sept. 3, 1927.
[2] Mitra and Rakshit, *Phil. Mag.*, 15, 20; 1933.
[3] Chapman, *Proc. Roy. Soc.*, A, 132, 353; 1931.
[4] Chapman, *Mon. Not. Roy. Ast. Soc.*, 92, 413; 1932.
[5] *Wireless World*, 31, 273; 1932.
[6] Appleton, NATURE, 127, 197, Feb. 7, 1931.

Rainfall and Atmospheric Pollution

SEVERAL considerations which have been set out at some length in a paper to the Royal Meteorological Society[1] point to an increase of rainfall as a consequence of smoke in the atmosphere.

In a factory town Sunday is a day of reduced smoke pollution and concurrently Sunday is, in the long run, the day of least rainfall of any day of the week. There is in the Rochdale record of thirty years an exception to this rule in the years 1915–1918 inclusive—the years of the War. In that period of four years Sundays were not less but on the average more in rainfall than other days of the week. For example, in the long period of thirty years the ratio of rain on Sundays to all days of the week is 0·94, but in the War period 1·28. In another factory town—Halifax—the ratio of Sunday rainfall to that of all days on the average of 19 years is 0·98 but during the War period 1·12.

It seems, therefore, that the emission of smoke due to the running of munition and other factories on Sundays in War time has been sufficient to influence the rainfall. This unexpected result can scarcely be accepted without evidence in support of it in other directions.

At Llanfairfechan in North Wales there is a trustworthy record of thirty years or more, and an analysis of this record shows that Sunday is the day of least rainfall, the ratio of Sundays to all days being 0·93 for a period of twenty-eight years. Llanfairfechan lies under the shadow of Penmaenmawr Head on which up to a height of 1,500 feet drilling by steam power, blasting and quarrying go on vigorously on the working days of the week, but no work has been done either before or after or during the War on Sundays.

Now the ratio there of Sundays to all days is 0·95 for the War period, which differs but little from what it is at other times, Sunday being not more but less than weekdays. Here where there are no industrial activities on Sundays in War time, the Sunday rainfall is, as at other times, less than on weekdays.

Again sootfall in factory areas was certainly greater in the War period than usual. Observations are meagre, and there are not many suitable records which can be examined, but the available facts are briefly tabulated below, the figures being the average atmospheric deposit in tons per sq. mile per month.

Place	*War Time*	*Other Times*
Glasgow	38	33
Newcastle	50	41
Rochdale	77	67
Malvern	6	7

Malvern, which is not an industrial town, is inserted for comparison. The deposit there is nearly the same at all times, but with the industrial towns the War time deposit is considerably greater.

Unfortunately, there is no means of ascertaining whether the extra pollution took place on Sundays, but it is significant that the ratio of the War time deposit to that at other times is in each industrial area what might be expected if an extra day's work were put into the week.

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Aug. 9.

[1] *Quart. J. Roy. Met. Soc.*, 55, No. 232, Oct. 29.

The *N*- and *O*-Series and *N*-Absorption Edge of X-Spectra

IN a letter to NATURE[1] in 1922 I announced, from researches made in the laboratory of Prof. Siegbahn in Lund, the existence of a weaker group of lines in the *X*-region, 9–13 A., referred to the *N*-series of the elements uranium and thorium.

The X-rays region has meanwhile been enlarged for long wave-lengths by the use of a line grating from work done by Compton, Thibaud, Siegbahn and others. But most of the *N*-lines are so weak and

of such long wave-lengths, that it has hitherto been impossible with the known sources of X-rays from the elements on the anticathode to prove the existence of transitions from N-levels to higher levels, as previously found by me.

With the new ionic tube for low tension constructed and described by Dr. V. Kunzl and myself[2], an attempt has been made to obtain the long wave-length lines from the anticathode using heavy elements. The usefulness of our ionic tube in the region 5–10 A. is proved in the M-series, where many new lines have been obtained and partly published in collaboration with Dr. Filčáková.

For tungsten we have obtained, with a line grating, the two lines found by Thibaud (and recently by Prins and Takens) and classified as N–N transitions. Besides these we have obtained some new lines in the region 20–70 A. which correspond to the wave-lengths which can be calculated from the Bohr-Coster scheme for the N-lines for this element. In the region 240–295 A., where the lines of the O-series or O–O transitions for tungsten may be expected, we have also obtained two lines, which must probably be referred to the O-series of tungsten.

We have also found some absorption edges, of which three especially, in the region 90–140 A., are in the first order and very clear. In contrast to the lines observed and mentioned above, they have been observed more or less visibly in all elements investigated; hence they cannot be ascribed to the tungsten. Two of these edges coincide with the values calculated for the L_{I} and $L_{\mathrm{II,III}}$ absorption of silicon and can be ascribed to the discontinuity of absorption by the grating, analogous to the absorption by crystals as observed by Lindsay and van Dyke. This gives the same possibilities for obtaining absorption with a line grating.

One of these three edges is reversed, as the edges from silver and bromine in the K-series and L-series are reversed. This edge, when compared with the calculated values, corresponds to the N_{I} edge of silver. That this N-edge is clearer than other possible M-edges is probably due to the greater reflection power of the grating in the neighbourhood of the L-absorption of silicon.

I would further remark that under conditions for the discharge in the ionic tube as investigated by Messrs. Kunzl, Dráb and myself, the greatest degree of purity is necessary to obtain these lines of long wave-lengths. This is especially important for the above-mentioned edges, for if K-radiation of carbon should appear in the first order, the L_{I} absorption edge of silicon would be ascribed to the K-absorption of carbon in the second order. Only in a few cases, and not in connexion with L-absorption, has a weak white line—as found by Kunzl in the M-series with the ionic tube—been observed in this place.

When working with our ionic tube and using a tungsten anticathode, some M-absorption edges of silver (at. no. 47) and possibly of bromine (at. no. 35) were obtained. However, when using copper as anticathode, a wide, sharp absorption band appeared in the place of the K-absorption edge of C (at. no. 6) and no lines of wave-lengths longer than 90 A. have been observed, although the purest copper was used.

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[1] NATURE, **109**, 582, May 6, 1922.
[2] *Z. Phys.*, **74**, 565; 1932.

Series of Alkaline Atoms in an Electric Field

WE have investigated the absorption spectra of potassium and sodium vapours in an electric field with a method similar to the one used by C. J. Bakker in Prof. Zeeman's laboratory[1], and have reached a field of about 2,700 volt/cm. in the absorbing layer. The background was given by a hydrogen tube. Hilger's $E.1$ spectrograph was used. Absorption spectra, polarised parallel and perpendicular to the field, were photographed simultaneously and separated by means of a spar crystal.

With regard to potassium, we have confirmed Bakker's results and on account of the larger resolving power of our spectrograph and of the greater intensity of the electric field, we have been able to resolve the forbidden S–S and S–D lines; moreover, we noticed splitting beginning for the higher terms of the series.

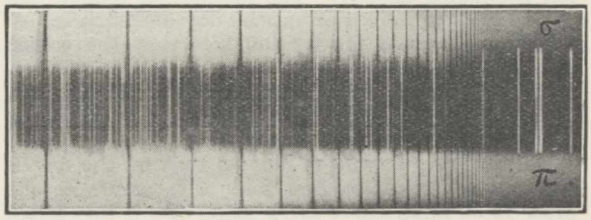

FIG. 1.

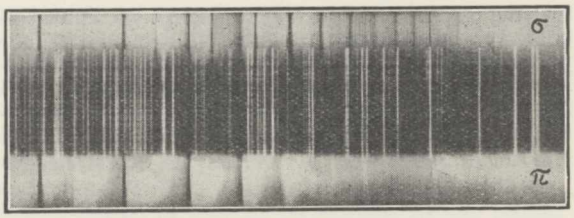

FIG. 2.

The degeneration of the terms S and D in the sodium spectrum produces a remarkable change of the aspect of the phenomenon; Figs. 1 and 2 show the absorption spectrum of sodium near the limit of the series $3S$–mP without field and with a field of about 2,700 volt/cm. The first line on the left is the $3S$–$11P$, $\lambda = 2475{\cdot}53$ A. In the region between the permitted lines of the series $3S$–mP, when the field was applied, appear, only in σ polarisation, some forbidden lines corresponding to the $3S$–mS transitions. On account of the splitting of the D term occurring in the electric field, lines $3S$–mD are resolved in a sort of band in both polarisations. In the first bands, the intensity increases on the side of the nearest P term. In the successive terms the electric perturbation increases to such a point that P and D terms become indistinguishable, and the splitting is an almost symmetrical one on both sides of the unperturbed P terms. Still more towards the series limit, the spectrum becomes a sort of band on which emerge (only in σ polarisation) the forbidden lines $3S$–mS. This band reaches the series limit in a way quite different from what happens for potassium; the explanation of this effect may be found by taking into account the S, D degeneration.

With these phenomena are connected a series of

electro-optical effects, namely, anomalous birefringence and dichroism near the lines which appear in both polarisations shifted or with different intensity. We have investigated these effects by putting the absorbing layer between crossed ultra-violet nicols placed with the axis at 45° to the electric field. With such an arrangement we observed an emission spectrum corresponding to the lines which are different in both polarisations. With this apparatus it is impossible to distinguish between dichroism and birefringence. This investigation will be carried on with a more appropriate method.

Further details, theoretical and experimental, will be published shortly.

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July 17.

[1] *Proc. Amst.*, **35**, 589; 1933.

Poisson Series and Biological Data

IT has been observed that the powder-post beetles *Lyctus linearis* and *L. brunneus* do not deposit a constant number of eggs in each vessel they attack, and observations have been made by one of us (E. A. P.) on the frequency with which given numbers of eggs are laid by these insects in the vessels of English oak.

As shown in Tables I and II, the observed frequencies agree closely with Poisson series having means 0·84 and 1·85 respectively.

GROUPING OF EGGS OF *LYCTUS* IN VESSELS OF ENGLISH OAK

TABLE I.

L. linearis.

No. of eggs per group (n).	Observed frequency.	$(n-1)\times$ frequency.	Calculated frequency.
1	121	0	120
2	98	98	100
3	45	90	42
4	14	42	12
5	1	4	2

Mean 0·84.

TABLE II.

L. brunneus.

No. of eggs per group (n).	Observed frequency.	$(n-1)\times$ frequency.	Calculated frequency.
1	29	0	28
2	42	42	52
3	60	120	48
4	28	84	29
5	13	52	14
6	5	25	5
7	0	0	2
8	1	7	0

Mean 1·85.

This difference of unity between the means indicates that *L. brunneus* on the average lays one more egg per vessel than *L. linearis*. Further information is desirable before formulating possible explanations of this, so no attempt is made to do so.

It is desired to direct attention not only to the difference between the two species but also to the method of obtaining the series. A Poisson series must have classes ranging from zero occurrences upwards. The data in question cannot, from their nature, have a class of zero eggs per group, so that the lowest class must be taken as the zero class. In other words, the frequency of occurrence of more than one egg per group is examined. Thus, in column 3 of the Tables, $n-1$ is used instead of n for calculation of the mean. Similarly, if in any set of observations for some reason the class of one per group could not exist, it would be justifiable to use $n-2$ to calculate the mean.

It must be emphasised, however, that there must be reasons, or suspected reasons, for the zero class not existing. It is not sufficient for it not to be observed, for it might, in the size of sample taken, have an expected frequency of zero.

The value of analysing the data in this way is first that the sampling technique is tested and secondly that differences in the means of different samples may be tested for significance.

A similar device was employed in studying the grouping of the vessels of Munyama (*Khaya anthotheca*). In this wood the vessels occur solitarily or in short radial groups. Here, again, a zero class does not exist, so that the frequency of occurrence of more than one vessel per group was examined.

Once a sufficient number of observations has proved the significance of differences between species, the mean may be used for identification of species, though in the case of the egg groups, the labour involved and the existence of other tests detract from its value for this purpose. There must be many other biological observations to which a similar method of analysing the data would apply.

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July 28.

Translation of 'Luftkörper'

THE expression 'air-mass' is, I believe, now universally employed in English as the equivalent of the German term 'Luftkörper', applied to extensive masses of air that, according to the conceptions developed by the Bergen school of meteorologists, are approximately homogeneous horizontally and tend to retain their distinctive characteristics in moving over the earth.

In Dr. Kassner's "Meteorologisches Wörterbuch", which forms a valuable feature of the recently published second volume of the "Meteorologisches Taschenbuch", edited by Dr. F. Linke, I find this expression rendered "atmospheric body" in the list of English equivalents. Although, as indicated in the "Taschenbuch", I collaborated with Dr. Kassner in preparing the English part of this glossary, the term 'Luftkörper' was not included in the list of German terms that he sent to me for translation, and I am therefore not responsible for the rendering above mentioned.

Dr. Kassner is entitled to the gratitude of all meteorologists for the publication of this tri-lingual glossary, which will doubtless be helpful in standardising meteorological terminology, and will serve as a valuable supplement to the list of equivalent terms in ten languages published in the "Meteorological Glossary" of the Meteorological Office (second edition).

C. F. TALMAN.

Library, Weather Bureau,
Washington, D.C.
Aug. 2.

A Tame Platypus

RECENTLY an observant and interested resident at Healesville, which is about forty miles from Melbourne, prepared an artificial rectangular trough filled with water and mud to which was attached a straw-lined tube above the water level. He then placed a platypus in this structure and fed him regularly on the only diet available in quantity, namely, earthworms. Mollusca and shrimps were not procurable, at all events in quantity. Within three months this excessively shy creature emerged when whistled for and took worms furnished by hand. The diet required was from twelve to fourteen ounces daily for an animal which weighs less than three pounds.

This platypus is quite indifferent to the presence of a large number of visitors, and after being satiated with food climbs upon a ledge and cleans its beautiful fur with the movable claws projecting from the webbed hind feet. The practical problem is the supply of food in sufficient quantity. An effort is being made to face this difficulty by the establishment of a worm-breeding area.

Those of us who know how shy the platypus is in the wild state were amazed at the result on June 9 of 110 days of semi-captivity. The animals have, of course, been kept before in captivity, but never, I fancy, has domestication been practised with so much method and trouble.

It may be that the relatively large amount of food taken is due to the possibility that the worms alone do not provide a balanced diet. Similar experiments when other food is available in quantity may throw light on that problem.

Much information is contained in Burrell's classical work on the platypus. This particular incident has, however, aroused much interest and is full of possible information with regard to an extraordinary animal which, I am thankful to say, is holding its own and is apparently, with the legal protection it receives, in no danger of extinction.

At the date of writing the platypus is still alive. It is now mid-winter and the animal shows a tendency to sleep for two or three days at a time. It has now been in captivity 153 days.

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July 22.

Nature and Science in Poetry

IT is not difficult to imagine how Herculean must have been the effort of the writer of the article in NATURE of August 26 under the above heading, to curb his pen. One realises the strength of mind required to put firmly on one side "La Semaine" of Guillaume de Saluste, Sieur du Bartas (1578); the "De Laudibus Dei" of Blossius Æmilius Dracontius (Fifth Century); and the many references in Dr. Charles Singer's works on oriental science.

There must have occurred to the minds of many readers of NATURE the quatrain of Omar Khayyám:

Those who have become Oceans of Excellence and Cultivation,
And from the Collection of their Perfections have become the Lights of their Fellows,
Have not made a Road out of this Dark Night,
They have told a Fable, and have gone to Sleep,

magnificently rendered by FitzGerald:

The Revelations of Devout and Learn'd
Who rose before us and as Prophets burn'd,
Are all but Stories, which, awoke from Sleep,
They told their Comrades, and to Sleep returned.

The couplet of Alfred Austin reminded me of an amazing poem by a too-little known author—Mr. John Litart—entitled "Death and Disease"—which opens with the lines:

Oh! happy, happy death, release from earthly cares,
Think of the thousands who suffer through years and years,
In such suffering and pain of a hundred kinds,
And the misery that is borne by all mankind,
Some which even the skill of the surgeon can't bind,
Disease of the body, and disease of the mind.

A single verse will give an idea of this masterpiece:

There is rheumatic *gout* and many will say
They are scarce free from suffering an hour a day.
Then there is *cancer* a most terrible disease,
The pain and tortures it gives will make one's blood freeze.
Great suffering, a living death, a gnawing pain,
The surgeon's art no good, aleviation (*sic*) vain.

There are fifty lines, all up to this standard!

This may, I think, be claimed as marking the nadir of scientific 'versification': to my mind the zenith was attained by the exquisite and delicate fantasy of the late Sir Arthur Shipley in his little poem:

When we were a soft Amœba
In ages past and gone,
Ere you were Queen of Sheba,
And I, King Solomon,
Alone and undivided
We lived a life of sloth,
Whatever you did, I did,
One dinner did for both.
At length came separation
By fission and divorce,
A lonely pseudopodium
I wandered on my course.

EDWARD HERON-ALLEN.

Influence of Certain Agents on the Lability of the 'Reducing Factor' (Vitamin C?) in Milk

IN a recent letter to NATURE[1] attention was directed to the marked fluctuations which were observed in the concentration of the substance or substances in milk responsible for the reduction of 2:6 dichlorophenol–indophenol when the test of Birch, Harris and Ray[2] for the chemical estimation of vitamin C was applied. It was pointed out that, even under the best conditions of production and distribution, the presence of a reasonable concentration of the reducing substances in milk cannot be guaranteed. Since that date, other experiments have been carried out to determine the reason for the fluctuations observed and two correlations which we believe to be significant have been found.

Identical samples of milk in sale glass bottles, one exposed to the light (none of the samples was at any time in direct sunlight since they were kept under a roof), another completely covered with

opaque paper, were stood in our dairy alongside the sale milk. We then observed that in all cases exposure to light had resulted in the rapid destruction of the labile factor while the loss in the samples protected from light was comparatively quite small.

On the other hand, we have found that common bacteria known to induce a low E_h in milk may play a part in the protection of the labile factor.

It seems obvious from our experiments that any work upon the stability of the labile factor to physical and chemical agents, such as heat or oxidation, must exclude the complicating factor of destruction by light.

Further work on these phenomena is in progress. Meanwhile it seems safe to say that our observations on the action of light emphasise the value of Nature's method of transference of milk from mother to offspring.

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in Dairying,
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Aug. 4.

[1] NATURE, 132, 64, July 8, 1933.
[2] *Chem. Ind.*, 52, 159; 1933; *Biochem. J.*, 27, 590; 1933.

Addition of Hydrogen Bromide to Olefines

IN some recent memoirs Kharasch[1] has observed that the dominant factor in the addition of hydrogen bromide to some olefinic substances is the presence or absence of oxygen. For example, the slow combination of hydrogen bromide and vinyl bromide forming ethylidene bromide gives place to a rapid formation of ethylene bromide if air is admitted.

The addition of hydrogen bromide to undecylenic acid is often carried out for the preparation of κ-bromoundecoic acid. That this reaction has given either the κ-bromo- or the ι-bromoacid in an apparently arbitrary manner is evident from the literature[2], and the cause is now seen to be the presence or absence of oxygen. Eight experiments in which hydrogen bromide was passed into a ten per cent solution of undecylenic acid in ligroin gave 70–80 per cent yields of almost pure κ-bromoundecoic acid; four experiments in which oxygen was removed either by passage of hydrogen or by addition of diphenylamine or by both methods gave a mixed product in which the ι-bromo-isomeride predominated.

Thus the very important observations of Kharasch are confirmed.

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Aug. 9.

[1] Kharasch and Mayo, *J. Amer. Chem. Soc.*, 55, 2468; 1933. Kharasch, McNab and Mayo, *ibid.*, 2521, 2531.
[2] Walker and Lumsden, *J.C.S.*, 79, 1191; 1901. Fairweather, *Proc. Roy. Soc. Edin.*, 46, 72; 1926. Cohen, *J.C.S.*, 594; 1932.

Photo-Chemical Activation of Adenine

EARLIER[1] it was found that adenine sulphate on irradiation by a mercury arc acquired growth-promoting properties. The material was tested on rats, receiving a synthetic basal diet deficient in vitamin B, supplemented by ox kidney extract as a source of vitamin B_2. Since those preliminary experiments a large number of tests have been carried out with rats and pigeons. In most experiments adenine sulphate in aqueous suspension (slightly acidified) was exposed to a Hanovia Home Sun (220 volts, consuming 2·1 amp.) at 15 cm. distance for ½–1 hour. The irradiated product has proved unable to cure 'polyneuritis' in pigeons even in 5 mgm. doses. But the same daily dose supported growth in 36 young rats which had ceased to grow on a diet composed of starch, caseinogen and McCollum's salt mixture supplemented by cod liver oil and an aqueous extract of ox kidney, which provided vitamin B_2 and a small quantity of vitamin B_1. Irradiated adenine gave no response in young rats (31 in number), receiving ox liver extract or autoclaved marmite as the source of vitamin B_2. Irradiated guanine chloride, cytosine chloride and uracil did not resemble the action of irradiated adenine in preliminary experiments (7 rats were used). Irradiated adenine could not replace vitamin B_2 in the diet.

The above results indicate the formation of a growth promoting substance on irradiation of adenine. The optimum conditions of activation have, however, not yet been obtained. The relation of this active factor to the different B-vitamins is being studied. Until further results are obtained, it is not profitable to discuss these results in relation to those published by Heyroth and Loofbourow[2], Heard *et al.*[3], and Bernal and Crowfoot[4].

The details are being published in the *Journal of the Indian Chemical Society*.

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Calcutta. Aug. 14.

[1] Guha and Chakravorty, NATURE, 130, 741, Nov. 12, 1932.
[2] Heyroth and Loofbourow, *ibid.*, 131, 92, Jan. 21, 1933.
[3] Heard *et al.*, *ibid.*, 131, 617, April 29, 1933.
[4] Bernal and Crowfoot, *ibid.*, 131, 911, June 24, 1933.

Seismic Sea Waves

IN a note on the sea waves of the Japanese earthquake of March 2, 1933, which appeared in NATURE of July 8, it is stated that "it was clear" that the waves would travel 3,950 miles—presumably sea ones—in about 8½ hours. It is understood that this calculation is based on the assumption that the waves must be 'long' ones, so that they would conform with the formula $v^2 = gd$, and progress with a speed independent of period or length, the mean depth of water being the sole relevant factor. The time of arrival of the waves indicates that this assumption is probably correct, but nevertheless it might be interesting if those in a position to anticipate the arrival of waves of this sort were to time their periods. So far as I know, but little has been published about the character of sea waves generated by earthquakes. If the periods were observed, especially when the seismograph only indicates a single severe shock, in which case the original disturbance should presumably consist of one solitary wave, comparison of the actual with the theoretical periods should give a good indication as to the accuracy with which hydrodynamical theory works out in practice.

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Research Items

Archæological Exploration in Derbyshire Caves. A Research Committee of the British Association appointed to explore caves in the Derbyshire district (Mr. M. C. Burkitt, chairman, and Dr. R. V. Favell, secretary) reported at the Leicester meeting of the Association on the work of the year 1932–33. The excavation of the Pin Hole Cave, Creswell Crags, has been continued by Mr. Leslie Armstrong. Breccia was removed from the whole area of the passage on the east side of the main chamber and in the trefoil-shaped terminal chamber, revealing four large cavities in the rock floor, one coinciding with the width of the passage and extending 7 ft. along it. These were entirely filled with cave earth of Mousterian age, 2 ft. 7 in. deep, and an underlying deposit of sterile red sand. The Mousterian deposits yielded the usual fauna, including the greater portion of the skull and jaw of a young mammoth with complete dentition, and two large fragments of the lower jaw of a giant deer. The large cavity showed evidence of human occupation in a small but well-preserved hearth and a stone pounder, animal bones, split and charred, and crude artefacts of quartzite and crystalline stalagmite. Similar tools were recovered from the smaller cavities at the rear of the chamber. Several worked bone tools included a bone knife and two awls. In the large inner cave of the chamber the deposits were excavated from the 12 ft. level to the base at a depth of 17 ft. An exceptionally thick layer of limestone slabs pointed to the probability that this part was unsuitable for occupation. The remains of Mousterian age recovered here are less numerous than elsewhere in the cave, but include a fine side-scraper of flint.

Sumerian Copper. The fifth report, presented at the Leicester meeting of the British Association, of the research committee appointed to report on the probable sources of the copper used by the Sumerians (Mr. H. Peake, chairman, and Prof. C. H. Desch, secretary), states that during the past year specimens have been received and examined from a number of sites, as well as a few ores. The presence of arsenic in relatively high proportions in several objects of early date has made it necessary to regard this, like nickel, as a key element, which should assist in the location of the source of the original copper. Unfortunately, works of reference, as well as geological monographs, seldom make mention of the presence of accessory elements, and native coppers received by the committee for examination have been derived from deep-seated deposits of pyrites, whereas ancient copper was undoubtedly derived mainly from oxidised outcrops. The known occurrences of arsenical copper ores, sometimes containing nickel, have been mapped and the region within which such mixed ores may occur appears to form a band extending through Anatolia, Armenia and Azerbaijan, though at present sources farther afield cannot be excluded. Several objects have been subjected to analysis or micrographic examination. Among these a thin piece of metal from Kish, 3200 B.C., gave 95·17 per cent copper, 0·08 per cent nickel and 0·15 per cent iron. Two objects of early date from Ur proved to be copper, hammered and slightly reheated after casting, while the bronze was in cast condition. The bronze contained 11·65 per cent tin and 0·20 per cent nickel; the copper spear, 0·56 tin and 1·36 nickel. A spear-head from Nineveh proved to be of pure copper without tin or nickel. A thin razor of the Egyptian Fourth Dynasty, received from Sir Robert Mond, in appearance of copper, proved to be of bronze, containing 8·5 tin. The edge had been hardened by severe hammering. In view of the high proportion of sulphur in objects from Mohenjo-daro, the possibility of its derivation from the soil was examined, but it would appear that the sulphur in the specimens is derived from the ores.

Snails from the Philippine Islands. Mr. Paul Bartsch has discussed some interesting land molluscs from the small islands and islets in the Mindoro Province ("The Land Shells of the Genus Obba from Mindoro Province, Philippine Islands". Contributions to the Biology of the Philippine Archipelago and Adjacent Regions. United States National Museum. Bull. 100, vol. 6, part 8, 1933). These islands are ideal collecting grounds, for each one apparently harbours a special form of *Obba*, regarded by the author as a race or sub-species. The genus, all the species of which have a flattened shell with a thickened aperture, is a large one and the shells differ widely in form, sculpture and colouring. *Obba listeri*, Gray was figured by Martin Lister in his "Synopsis Methodicæ Conchyliorum et Tabularum Anatomicum", published in 1770; Gray in 1825 listed it as *Caracolla*, and it was described by Broderip in 1841 as *Helix* (*Caracolla*) *listeri*, the habitat being Luzon, on trunks of trees. It occupies a very wide range in the Philippine Archipelago and, like most widely distributed species, it breaks up into a host of so-called races, each of which occupies a limited zoogeographical horizon. There are nine from the Mindoro province which the author designates as sub-species, but he believes that there are probably many more still to be found, as the small islands, and even Mindoro itself, have not been explored adequately. Six species of *Obba* are recorded and described here, each with a number of sub-species.

Recent Knowledge of the Slime Fungi. The presidential address by Miss G. Lister to the British Mycological Society is a valuable review of present-day knowledge of the Myxomycetes ("Field Notes on Mycetozoa", *Trans. Brit. Mycol. Soc.*, 18, pt. I, pp. 18–29, Aug. 1933). The work of Prof. Brandza of Roumania is described. 'Nurseries' of straw, pine needles, dried leaves and other substances were placed in various positions in the city of Bucharest, and all yielded interesting specimens. It seems possible that physiological species are to be found in the Myxomycetes, for *Fuligo septica* arises either from a yellow or a cream-coloured plasmodium. Differently coloured plasmodia will not fuse to form one æthalium, but plasmodia of a similar hue will readily do so. Work by M. Charles Meylan and M. J. Jarocki on the alpine slime fungi of Europe is mentioned, and the mycetozoan flora of a sea-beach has been studied by Hagelstein in New York State. Many other papers are reviewed, and the main thesis of the address is that slime fungi are active over a much wider range of climatic and edaphic conditions than was at one time supposed.

Preservation of Cattle Fodder. One of the most important problems of modern agriculture is to discover a process for preserving cattle fodder which will produce a wholesome and palatable food, retaining, as fully as possible, the original nutritive value and vitamin content of the fresh material. The chief difficulty in preserving fodder is to prevent breakdown of protein, and A. I. Virtanen (*Empire J. Exptl. Agric.*, 1, July 1933) has developed the A.I.V. method, which is based on the assumption that all detrimental breakdown processes would be eliminated by treating the fodder, at the time of ensiling, with such amounts of acid as would rapidly raise the acidity of the mass to a point below *p*H 4 (see NATURE, 130, 783, Nov. 19, 1932). Sulphuric and hydrochloric acids give the best results, the amount required depending upon the kind of fodder plant and the acidity, and the lime content of the soil on which it grows. Experiments have shown that the fodder has no harmful physiological effect on the animals consuming it and that the quality of the milk produced is at least up to the standard of that from cows fed on hay, resembling that of summer milk. Butter quality is improved, but care is needed in the use of A.I.V. feeding in the manufacture of certain grades of cheese. Details are given of the most economical method of preparing this type of fodder, together with tables showing the reduction in concentrated food that can be brought about by its use.

Lower Limit of Earthquake Perception. Several seismologists have tried to evaluate the maximum acceleration of vibrations that are just perceptible to human beings. Measured in mm. per sec. per sec., Omori placed the limit at 17, Cancani at 25, McAdie at 10 and Suyehiro at 9–17. Messrs. M. Ishimoto and M. Ootuka have recently made some interesting experiments on the subject (*Earthq. Res. Inst. Bull.*, vol. 11, 113–120; 1933). The observer is seated on a chair placed on a wooden platform that is suspended by four cords. An electric motor gives a periodic motion to the platform, which is measured by a seismograph placed on it. The experiments were made with five observers, the results in each case being similar. When the period of the oscillations amounts to about half a second, it was found that the limit of perception is lowest. With a period less than this, the limit is inversely proportional to the period. When the period becomes about one second or more, the limit of perception is practically constant, and, for different observers, lies between about 7 mm. and 10 mm. per sec. per sec.

Recent Work on Cosmic Rays. Several papers have recently appeared on the directional distribution of cosmic ray particles. An asymmetry may be produced by the deflection of charged particles in the earth's magnetic field, but previous work has failed to reveal an asymmetry at stations lying at sea-level and at geo-magnetic latitudes greater than 44°. Johnson and Stevenson (*Phys. Rev.*, July 15) find the east intensity to be 3 per cent greater than the west at Swarthmore (geomagnetic latitude 51° N.). This confirms the asymmetry previously found by these workers in Mexico. Viljoen and Schonland (*Phil. Mag.*, Aug.), working in Cape Town (geomagnetic lat. 31° S.), find no significant difference between east and west intensities. They also examined north and south directions, since they thought that thunderstorms over the African continent might lead to an asymmetrical bombardment with particles of terrestrial origin. This result was also negative. There was a defect from both east and west as compared with north and south which was on the limit of significance. This may possibly correspond with a cosmic bombardment of both signs. In any event, a large part of the radiation was probably of secondary origin. Swann (*Phys. Rev.*, July 15) points out that if interstellar space does not contain particles of both signs, the space charge corresponding with the intensity of cosmic rays would lead to inadmissibly high potential differences in comparatively small portions of space.

Isotopes of Cobalt. By means of the magneto-optical method of Alison (*J. Amer. Chem. Soc.*, 52, 3796; 1930), Ball and Cooper (*ibid.*, August 1933) find evidence for the existence of two new isotopes of cobalt lighter than the single mass 59 found by Aston. The masses are probably 57 and 58, the order of abundance being 59, 57, 58. The 57 isotope had been predicted on theoretical grounds by Bartlett (NATURE, 130, 165, July 30, 1932). The value of the magneto-optical method is favourably reported on by H. D. Jones and R. Goslin in another connexion (*J. Amer. Chem. Soc.*, August).

Temperatures of the Nuclei of Planetary Nebulæ. A new application of Zanstra's theory, by R. H. Stoy, appears in the June issue of the *Monthly Notices of the Royal Astronomical Society*. It will be recalled that the main feature of Zanstra's theory is the assumption, which at first sight appears extremely singular, that every quantum emitted by the nucleus of a planetary nebula the frequency of which is above a certain limit (the limit is that frequency for which the quantum is able to ionise a hydrogen atom in its normal state), one quantum, and one only, of one of the frequencies in the Balmer series will escape from the nebula into space. One traces the progress of one ultra-violet quantum from the nucleus out through the nebula. This is considered to contain an immense quantity of hydrogen, mostly ionised into protons and electrons, but when these are combined to form hydrogen, it is nearly all in the ground state. Under these conditions, one quantum of the Balmer series must appear at the outside of the nebula. It follows that the total light emitted in the Balmer series gives the total light emitted by the planetary nucleus in the far ultra-violet, and we are on the track of the nuclear temperature. As Zanstra left the theory, it was in a form in which line intensity was compared with the intensity of the continuous light from the nucleus to give the nuclear temperature, but Stoy gives an improved form in which line intensities only are to be measured. This is a great advantage in those cases where the nucleus is a feeble object. Stoy points out that the application to He lines is false: the ingenious theorem cannot be applied, as there is no excess of He as there is of H. It is unfortunate that the observers on whose work the actual temperatures that Stoy gives are based did not use red sensitive plates, so that H_α is missing from the observations. Stoy has to use H_β, H_γ, etc., and the intensity of H_α, the strongest line, has to be estimated by extrapolation. Mr. Stoy himself has gone to the Lick Observatory and will no doubt collect improved data to which to apply this arresting theory. The temperatures that he quotes at present range from 20,000° to 50,000° for the seven nebulæ for which data are available.

Shipping, Engineering and Machinery Exhibition

ON September 7 the Earl of Athlone opened the Shipping, Engineering and Machinery Exhibition at Olympia, London. Speaking optimistically of the trade outlook, he pointed to shipbuilding as an indication of the trend towards trade improvement. The Exhibition, in bringing together engineers from all parts of the world, will provide an impetus towards recovery. The improvement in the shipbuilding industry on the Clyde and the Tyne has been accompanied by a great increase in the tonnage of motor-vessels and a feature of importance is the development of high-speed cargo vessels. At a luncheon later on, Lord Stonehaven said the exhibition is a tribute to the technical skill, ingenuity, courage and perseverance of those engaged in industry, while Prof. H. S. Hele-Shaw directed attention to the research exhibits and the display of nautical instruments.

During the time the Exhibition is open it will be visited officially by some sixty engineering, technical and scientific societies, and whether the individual members are interested in the commercial production, designing, or operating side of shipping and engineering, there is much that will interest them. The exhibits cover a very wide range and though it is primarily a shipping exhibition and centres around the machinery and equipment of ships of all kinds, it is equally an exhibition of mechanical engineering. With boiler and engine plants, air-compressing and refrigerating plants, are shown welding apparatus, filters, machine tools, drawing materials, lubricants, lighting plants, motors, and a great wealth of scientific instruments. As examples of workmanship the exhibits as a whole are of a very high standard, while one noticeable feature is that in design, finish and general appearance they satisfy the eye in the same manner as works of art.

On no fewer than twenty-four stands are to be seen various types of internal combustion engines and it is said that such a display has not previously been gathered together anywhere in the world. The exhibits include many types of Diesel engines with compressed air injection and oil engines with airless injection in which the fuel is injected direct from the fuel pump. The engines have anything from 1 to 8 cylinders, their power ranging up to 800 brake horse power, the fuel consumption in some cases being about 0·38 lb. of oil per horse power per hour. Amongst the oldest makers of Diesel engines in Great Britain is the firm of Messrs. Mirrlees, Bickerton and Day, Ltd., which has a stand, while other oil engine exhibitors include Messrs. Davey, Paxman and Co., Messrs. Allen of Bedford, and Messrs. Belliss and Morcom of Birmingham. This last firm was the pioneer some forty years ago in the development of the modern system of forced lubrication for engines, one of the greatest boons ever conferred on engineers-in-charge.

Oil engines are extensively used aboard ship for driving auxiliaries, and for propulsion. They can be made reversible, or they can drive the propeller through reversing gear, or they can be used for oil-electric propulsion. On the stand of Messrs. Crossley Brothers, Ltd., is an 8-cylinder 600 b.h.p. engine similar to that used for operating the fast oil-electric ferry between Hong-Kong and Kowloon. Some of the firms exhibiting oil engines have examples also of steam turbines, turbo-generators and turbo-pumps, while turbine machinery development is illustrated by the exhibits of the companies founded by the late Sir Charles Parsons.

A notable steam exhibit is that of Messrs. Babcock and Wilcox, who show a section of an oil-fired water-tube boiler as supplied to H.M.S. *Guardian*. Attention must also be directed to the Diesel shunting locomotive of Messrs. Sir W. G. Armstrong, Whitworth and Co (Engineers) Ltd., which runs to and fro on a track to demonstrate the ease with which it can be manipulated.

Of the extended use of instruments such as meters, gauges, indicators, recorders and controllers for the temperature, pressure, volume and flow of liquids and gases, the visitor will find ample evidence on the stands of such firms as Messrs. Elliott Bros. (London), Ltd., Foster Instrument Company, Negretti and Zambra, George Kent, Ltd., and others. They cover an amazingly wide field and are fully representative of the instruments found in every ship, every factory, every engineering works and all power-houses. More intimately connected with shipping are the displays of radio apparatus by the International Marine Radio Co., Ltd., the Marine Electrical Equipment Co., Ltd., and the Marconi International Marine Communication Co., Ltd. Wireless is a necessity for all ships both large and small, and through the work of the Safety of Life at Sea Convention all passenger ships of 5,000 gross tons must now carry a wireless direction finder, while all compulsorily fitted ships which do not keep a watch throughout the twenty-four hours of the day have to be provided with an auto-alarm device by which the ship can receive a distress call from another ship at any time. The most recent installations of wireless telegraphy in passenger ships include a 2 kw. transmitter and are capable of communication on long, medium and short wave-lengths.

We have already briefly referred to the Industrial Research Exhibit arranged by the Department of Scientific and Industrial Research (see NATURE of September 9, p. 379). This is intended to show how research carried out by the Department itself and by various associated research bodies are assisting the shipping and engineering industries, and should enable visitors to obtain a closer knowledge of what is being done. An account of the exhibits is contained in a separate section of the catalogue, a copy of which should, if possible, be obtained beforehand. The price is 1*s*. Four research associations have collaborated with the Department of Scientific and Industrial Research. The exhibits range from ship model testing and research on pulverised fuel to the manufacture of iron and steel, the latest developments in the metallurgy of cast iron and the interesting work done by the British Non-Ferrous Metals Research Association.

The exhibition has been arranged with the active support of the British Engineers' Association, the Society of Motor Manufacturers and Traders, Ltd. and the British Marine Oil Engineer Manufacturers' Association, all of which are to be complimented on the varied, extensive and representative character of the collection of machinery and instruments which has been brought together.

Annual Exhibition of the Royal Photographic Society

THE seventy-eighth Annual Exhibition of the Royal Photographic Society is being held at the Society's rooms, 35, Russell Square, W.C.1, from September 9 until October 7. Lectures are given on Tuesday and Friday evenings during that period.

As in former years, there is much to be seen that is interesting from a scientific, as well as a photographic, point of view. The deciphering of documents by infra-red and ultra-violet radiation is illustrated, and there is one example in which success has been achieved by leaving a charred document in contact with a photographic plate for forty days. There is a remarkable set of photomicrographs of diffraction gratings, the spacings of the grooves being 300, 600 and 900 per mm.

Perhaps the most outstanding exhibits are the astronomical and spectrum prints from the Mount Wilson Observatory. Among these are five spectroheliograms of the eruptive solar prominence of August 6, 1931, taken at half-hour intervals. There is also a print showing four faint nebulæ at distances ranging from 23,000,000 to 105,000,000 light years, together with the spectrum of each. Another shows a display of stellar spectra with dispersion increasing from 835 A. per mm. to so much as 0·7 A. per mm. Of the series, the most notable is the spectrum of Jupiter, a comprehensive piece of work from the same source showing the presence of ammonia in the planet's atmosphere. For this the Society has awarded a medal. Included are spectra of the sun and of Mars taken while the planet was approaching and receding from the earth. These show displacement of the solar lines relative to the oxygen band and indicate that in the atmosphere of Mars there cannot be an amount of oxygen exceeding 1 per cent of that in our own atmosphere.

By means of an electric spark, photographs have been taken in 1/75,000 sec. at *F* 16 of an electric light bulb falling to pieces under the stroke of a hammer. In the same series is a print of a cup of coffee striking the floor and one of water apparently arrested in the act of flowing into a milk bottle.

An exhibit has been staged to show that the graininess of photographic material normally increases with its speed and that this is mainly due to the fact that fast emulsions contain large-sized crystals of silver bromide. The usual means at the disposal of the photographer for combating graininess are indicated and the real solution of the problem is shown to lie with the emulsion maker. That it is not an insuperable problem is demonstrated by comparison pictures showing the successful diminution of grain in new negative materials as compared with old without sacrifice of speed or quality.

Another feature of interest is a new method of optical intensification in which the image is converted to silver bromide and then sulphided in one of three types of bath each of which gives an image of distinctive qualities. Intensification takes place by exposure under solutions of sodium silver nitrite or sodium silver sulphite to a 100 watt or 200 watt lamp.

Classed under "Technical Applications" are pictures transmitted by telegraphy using the Siemens-Karolus-Telefunken system. These are from the Picture Telegraph Department of the G.P.O.

In the sphere of colour photography there are some excellent examples of results obtained with the Vivex process, in which the pigment image is obtained by chemical contact of a bromide print with carbon tissue. Another exhibit is arranged to show the possibility of eliminating, by photographic means, the need for fine etching in the reproduction of colour with printing inks.

In other sections the usual high standard is maintained. Among the accessories and apparatus on view are two cameras which played important parts in the recent Mount Everest Expeditions—the 'Williamson Eagle' which was used on the flight and the 'Leica' with which photographs were taken by the climbers at 28,000 ft.

Demonstrations are given of the results obtained with a new 16 mm. cine-camera with which it is possible for an amateur to produce most of the effects, like 'dissolves' and 'double exposures', which are usually looked upon as beyond his power. It is understood that a 16 mm. sound film is being incorporated in the exhibition. J. M.

Wireless Direction of Aircraft Landing in Fog

FOR many years past the application of wireless communication as an aid to air navigation has been studied intensively in various parts of the world. In the United States particular attention has been paid to the development of the course indicator system, by means of which an aeroplane can be navigated along prescribed air routes solely by the indications of wireless signals received from fixed transmitting beacons erected on the ground at appropriate points. By proceeding along a chain of such beacons, it is possible for the air navigator to fly from one aerodrome to another in a dense fog when visual observations become impossible. At a later stage, experiments were carried out in the United States on a means of enabling a pilot to land on the ground in a fog on arrival at the aerodrome.

A description of the mode of achieving this, with some details of experimental 'blind' landings made by aid of the invention, was published in 1930[1]. The method makes use of a concentrated beam of ultra-short waves into the line of which the aircraft is directed by the ordinary beacons. On picking up the signals from the beam, which is elevated slightly above the horizontal, the pilot adjusts his receiver until an output meter gives a deflection up to a prescribed mark. From then onwards, the pilot operates his machine in such a manner as to keep this deflection constant. In this way the aircraft 'slides' down the landing beam and reaches the earth tangentially, and the pilot is thus enabled to make a good landing without having seen the ground beneath him.

In the issue of the *Wireless World* for August 25, a New York correspondent gives a description of the recent installation of this landing beam system at Newark, the largest air port in the United States.

A demonstration of the working of the system was provided by the navigation of an aeroplane from Washington to Newark during a fog between the two cities of such density that all other aircraft were kept on the ground. In cases such as this, the ordinary radio beacons are used to navigate the aeroplane during the three-hour flight, until on approaching Newark at an altitude of 3,000 ft. the signals from the 'runway' beacon give the correct orientation, with respect to the landing path and the prevailing wind, for approaching the aerodrome. A second receiver on the aeroplane is now tuned to receive the signals on a wave-length of 3·3 metres emitted nearly horizontally by the beam transmitter indicating the landing path on the aerodrome. As the aeroplane passes a line 2,000 ft. from where the landing is to be made, a special signal is received from a vertical marker beacon. A second distinctive special signal is received as the aeroplane passes over the edge of the aerodrome, and the pilot now knows that he is not only in the runway, but actually over the field. He now prepares to land by so manœuvring his aeroplane that constant output is indicated on the ultra-short wave receiver picking up the landing beam signals. If the fog is thin enough to enable him to see the ground before he reaches it, he will land in the conventional manner. If it is still so thick that he cannot see the ground, he will throttle down his engine and prepare for a three point landing as soon as he crosses the wall of signals indicating the boundary of the aerodrome.

During periods of thick fog there is usually little wind, and it may be sufficient to instal the landing beam apparatus in such a position that the runway is in the direction of the generally prevailing wind for the airport. As an alternative, however, the runway beacon transmitter may be installed underground in the centre of the field and rotated to orient the runway as the wind conditions require. Since most commercial aircraft in the United States are now equipped to receive the signals from the course-indicating beacons, the only addition required to make use of this new service is an ultra-short-wave receiver together with a suitable aerial. The cost of the extra installation on the ground is not large, and it is likely that the system may be applied to other airports in the future.

[1] H. Diamond and F. W. Dunmore: "A Radio Beacon and Receiving System for Blind Landing of Aircraft." *Bur. Stand. J. Res.*, 5, 897–931; 1930.

Growth Substance (Auxin) in Plants*

By PROF. F. A. F. C. WENT

ADVANCES in the botanical study of growth substances have recently been made in several laboratories, but the present paper is more especially concerned with the work of the Utrecht Laboratory. Brief mention is made of Heyn's investigations in Paris and in Leeds on the influence of auxin on the extensibility of the cell walls of oat seedlings, where he could distinguish between the plastic and the elastic extension. This work affords an explanation of the differences of elastic extensibility, which occur as a result of changes of the rate of elongation. These experiments are carried out at Utrecht, more especially the X-ray investigations.

Van Overbeek, working with *Raphanus*, has been able to show, first, that auxin is produced in the cotyledons under the influence of light, and secondly, that light alters the sensibility of the cells for growth substance, more especially diminishing it; this gives an explanation of Blaauw's photo-growth reaction. On the other hand, lateral illumination causes a deviation of the auxin to the shaded side; the two phenomena together give an explanation of the phototropic curvatures of these seedlings, this being a synthesis of the theories put forward by Blaauw and by Went Jr. A somewhat similar explanation can be deduced from Du Buy's experiments with oat seedlings.

Dijkman has investigated seedlings of *Lupinus*, more especially their geotropic curvatures; he has been able to prove that here, just as in the case of *Avena* studied by Dolk, the flow of the growth substance is deflected from the longitudinal direction as soon as the hypocotyls are moved out of their vertical position. When they are placed horizontally, a greater quantity of auxin flows to the lower side, which afterwards shows more powerful growth so that a negative geotropic curvature arises. Just as in Van Overbeek's case, here also the amount of curvature produced was exactly equal to that deduced from the distribution of the growth substance.

Bottelier has made a study of protoplasmic streaming in the coleoptiles of *Avena*. In young plants the influence of temperature is rather small but in older plants the Q_{10} becomes 1·8, giving a ratio of the velocity of the streaming at 16·5° C. to that at 24° of 10 to 21·3, which is the same as the ratio found by Van der Wey for the velocity of transport of the auxin. The influence of light on the velocity of protoplasmic streaming is such that its curve can be very well compared with that obtained by Van Dillewijn for the influence of light on growth. The quantity of protoplasmic streaming is not always the same and it has become evident that this quantity is small when the sensitivity of oat seedlings to the growth substance is low, whereas it is high with a greater sensitivity.

An investigation into the factors which influence the sensitivity to growth substance in a room kept at constant temperature and constant humidity is in progress under the auspices of Kögl, and is being carried out by Haagen Smit and J. J. Went. They have been able to show that a standard sensitivity can be kept constant as soon as the plants are placed in boxes made of a good electric conductor. On passing a feeble electric current through the seedlings, the plants assume their standard sensitivity. When the tip is negative with respect to the base, the standard sensitivity is lowered; and in the opposite case it is increased. The supposition is made that changes of the electric conductivity of the air play a rôle in this variability of the standard sensitivity.

Already in several instances an influence of this electric conductivity on plant life has been suggested. Oat seedlings now will enable us to obtain exact measurements of it.

* Substance of a paper read before Section K (Botany) of the British Association at Leicester on September 12.

Calendar of Nature Topics

'Old Wives' Summer'

Towards the end of September in central Europe there is often a period of calm clear weather, with cold nights and misty mornings but fine warm days. This is the 'Old Wives' Summer'; it has been explained as the transition between summer and winter conditions. In summer, the pressure distribution over central Europe is dominated by the Azores anticyclone, from which a wedge of high pressure extends across southern France and south-west Germany. In winter the dominant feature is the great Siberian anticyclone, from which a long arm extends across Switzerland. There is, however, a short period of transition during which the Azores anticyclone has retreated to the Atlantic while the Siberian anticyclone has not yet developed. During this interregnum, which, on the average, occurs between September 18 and 22, an anticyclone develops over southern Germany north of the Alps, and this brings the fine weather of the 'Old Wives' Summer'. Later in the month, the anticyclone drifts away eastwards, and in Russia the 'Old Wives' Summer' occurs at the end of September or the beginning of October.

Greatest Frequency of West Indian Hurricanes

The revolving storms or 'hurricanes' of the West Indies are among the most dreaded of all natural phenomena, and since the first colonisation of Central America they have caused enormous loss of life and property. In recent years, they have been studied intensively and an elaborate system of hurricane warnings has been organised. The majority of hurricanes originate over the open ocean between about lat. 10° N. and 20° N., travel westwards or north-westwards across the West Indies, and after re-curving towards the north-east, either strike the Gulf States and die out over the land, or continue over the ocean parallel with the Atlantic coast. The great majority occur in August, September and October, and in recent years a number of severe hurricanes have been experienced about the third week of September. New Orleans suffered great damage from a hurricane on September 20, 1909, and another storm which crossed the West Indies and the south-eastern States on September 22–30, 1916, gave a wind velocity of 140 m.p.h. at the mouth of the Mississippi. Florida was struck by a hurricane on September 19, 1926, and great damage was done in the West Indies about September 24, 1929.

A Great Hawk Migration in Ontario

On September 19, 1931, Manly Miner saw such a migration of hawks as has seldom or never been recorded, in spite of the incredible numbers which annually cross Essex County in Ontario every September and October. His own words give an extraordinarily vivid description of this outstanding movement: "The number of hawks present could scarcely be made believable to one who had not seen them. Some witnesses thought there were as many as fifty thousand present. Circling flocks could be seen with the naked eye for two miles in any direction and with glasses more were visible at a greater distance. By counting the number in a single flock I estimated that between ten and twenty thousand hawks were passing within sight.

"High in the air Broad-wing, Red-shouldered and Red-tailed Hawks circled, sailed four or five miles and circled again. To my surprise, lower down an occasional Osprey or Fish-Hawk passed, not circling like the others but flying much faster and not mixing with them. Near to the ground were many Sharp-shinned and Cooper's Hawks with occasional Sparrow and Pigeon Hawks.

"I have seen as many hawks in a whole day but never before such numbers in less than an hour as on this occasion. It was between eight and nine o'clock in the morning and I conclude that the birds probably congregated for the previous night in some near-by woods and were starting out together on their day's travel. They were progressing at varying speeds and by night would very likely be spread out for fifty or a hundred miles" (*Canadian Field Naturalist*, Nov. 1932, p. 191).

Breeding Ewes

The financial success of sheep farming depends very largely on the number of lambs reared for each ewe in the flock, and in ordinary farming the condition of the ewe is far more important in deciding the number of twin births than that of the ram. There is no doubt that the plane of nutrition of the ewe has a great deal to do with her fertility. Hence the practice of 'flushing' the ewes just before the mating season. After weaning, the ewes are kept in rather hard condition and then at about this season of the year they are admitted to better food rich in protein; a piece of fresh young aftermath, a fold of rape or mustard, or even an addition of some concentrated food to their ordinary rations. The ewes come to the ram in rising condition and a heavier fall of lambs is the result. Excessive fatness in breeding ewes is to be avoided as a well-known cause of shy breeding and sterility.

Societies and Academies

PARIS

Academy of Sciences, July 31 (*C.R.*, 177, 365–432). The president announced the death of Edouard Quénu, member for the Section of Medicine and Surgery. A. LACROIX: A stony meteorite which fell in Morocco on August 22, 1932. R. FOSSE, P. DE GRAEVE and P. E. THOMAS: The transformation of the intermediate term of the permanganate oxidation of uric acid into allantoic acid, in the presence of the soya ferments and of potassium cyanide. CHARLES NICOLLE and L. BALOZET: Man is insensible to inoculation of the aphthous virus of known types, even in the form of a latent infection. CHARLES NICOLLE, J. LAIGRET and P. GIROUD: The transmission of typhus by bites and by ingestion of infected fleas. The ape can be infected by flea bites, rats by ingestion of infected fleas. The infections produced were of the latent type, none of the animals showing febrile symptoms. B. CABRERA and H. FAHLENBRACH: Diamagnetism and temperature. PAUL PASCAL and BONNMEMAN: The reversible passage of the dimetaphosphates to the condensed salts of Graham. Study of the metaphosphates produced by the dehydration of silver acid pyrophosphate and by heating silver hypophosphate at varying temperatures. G. B. GOUREWITCH: The

canonical forms of a trivector in space of six dimensions. RENÉ DE POSSEL: The theory of measurement. The prolongation of an additive function of ensemble. TULLIO VIOLA: The points of convergence of general trigonometrical series. B. RIABOUCHINSKY: Total dissemination. P. DUMANOIS: Concerning the influence of the temperature on detonation in internal combustion motors. From the peroxide theory of detonation, the author concludes that if the temperature of the explosive mixture going into the motor cylinder be raised, the detonation should disappear. Experiments confirming this are described. J. LE ROUX: A new form of the Lorentz formulæ. J. SAVARD: The ionisation potential and formation of the molecule of hydrogen. ALEXIS GUERBILSKY: Piezo-electric crystal dynamometers in resonance vibration. J. SOLOMON: The effect of internal conversion. A discussion of the application of Dirac's theory of the electron to the explanation of the effect of internal conversion, that is, the absorption by an electron of a radioactive atom of the photon emitted by the nucleus. W. GENTNER: The absorption of very penetrating γ-rays. MARCEL LECOIN: The β-radiation of radium *E* and of the active deposit of actinium. AUGUSTE LE THOMAS: The anomalies of the tempering of cast irons: their relation with the oxidation in the liquid state. ED. CHAUVENET and MLLE. J. BOULANGER: The compounds of zirconyl bromide with the alkaline bromides. Application of the calorimetric method indicated the formation of definite compounds of zirconyl bromide with the bromides of sodium, potassium, rubidium, cæsium and ammonium, but not with lithium bromide. The compound with cæsium bromide was isolated in crystals. O. MILLER and L. PIAUX: The Raman spectra of the cis-trans isomeric orthodimethylcyclohexanes. VOLMAR and BETZ: The emetics derived from mandelic and malic acids. The preparation and properties of sodium antimoniomandelate and sodium antimoniomalate are described. E. VELLINGER and G. RADULESCO: The antioxidising or antioxygen constituents of petrol prepared by cracking. It is suggested that the petrol passing below 170° C. should be refined and then mixed with the crude unrefined fraction passing between 170° C. and 180° C. MME. GUAISNET-PILAUD: The crystallographic constants of the hydrates of the phenylmethylethyl betaines and of the phenylmethylpropylbetaines. J. GUBLER: The presence of the Trias at Cambogia. A. DUPÉRIER and G. COLLADO: The fluctuations of the terrestrial electric field. Experiments made at Paris and Madrid show that the continuous fluctuations of the electric field cannot be regarded as being due to local irregular disturbances. H. COLIN and J. AUGIER: Floridoside, trehalose and glycogen in red fresh-water Algæ (*Lemanea*, *Sacheria*). J. ANDRÉ THOMAS: The evolution of prolonged cultures of the wall of the umbilical vesicle, in the embryo of the chick. A. POLICARD: The study by micro-incineration of the distribution of fixed mineral matter in the spermatozoids of mammals. In the spermatozoids of both man and rat the method of micro-incineration shows at the level of the head the presence of a part poor in mineral matter and a posterior part containing much more. SWIGEL and THÉODORE POSTERNAK: The phosphorus containing nucleus of the ichtulin of the pike. MME. ANDRÉE ROCHE: The comparative study of the chemical constitution of normal animal muscle, dead through total starvation or through protein starvation.

MELBOURNE

Royal Society of Victoria, April 6. CEDRIC DEANE: Australian Hydrophilidæ (2). Nine new species of *Ochthebius*, namely *O. heiroglyphicus*, *O. costatus*, *O. subcostatus*, *O. lævis*, *O. lividus*, *O. flavocinctus*, *O. notalis*, *O. schizolabrus*, *O. labratus* and two new species of *Hydræna*, namely, *H. selecta* and *H. plenipennis*. These water beetles have received but scant attention by collectors until recently, owing possibly to their small size. NANCY ATKINSON: An investigation of the bacterial pollution of the waters of Port Phillip Bay with special reference to the effluents from the Melbourne and Metropolitan Sewage Farm, near Werribee. The *Bacillus coli* content of the water was taken as an index of its contamination. In every case the dilution factor was found sufficient to render the effluents innocuous.

ROME

Royal National Academy of the Lincei, April 23. FRANCESCO SEVERI: Theory of the equivalence series on an algebraic series: the topological and transcendent points of view (3). A. BEMPORAD: Stellar currents about R.A. 14^h, $+54°$ Decl. G. ARMELLINI and G. ANDRISSI: The radiation of the sun in 1931 and 1932. The results of pyrheliometric measurements at the Campidoglio Observatory show that, on the average, the atmospheric absorption is about double the value adopted by Müller for his Potsdam photometric tables. GIUSEPPINA BIGGIOGERO: Geometric observations on tensors. S. CINQUINI: Functional equations of the Volterra type. C. MIRANDA: Useful connexions between the methods of summation of series and problems of the linear differential equations to the partial derivatives of elliptic type. R. SARTORI: A theorem of functional operative calculus. M. HAIMOVICI: Curves of constant pressure. Curves on a surface such that a material point moving on one of them without friction under the action of a conservative field of forces exerts a constant pressure on the curve, are considered. R. SARMENTO DE BEIRES: The Euler-Savary formula. With the help of simple, plane perspective considerations, a ready method is demonstrated for establishing the Euler-Savary formula relating to rigid plane motions and for its extension to rigid spherical motions. M. TENANI: Constructive principles of magnetic compasses. G. WATAGHIN: The theory of the nucleus. Observations on Heisenberg's theory of nuclear structure, suggested by the discovery of positive electrons, are made. If the conception of intranuclear electrons, regarded as independent mechanical entities, has any significance, it is considered more plausible that they are positive, rather than negative, electrons. G. R. LEVI and M. TABET: X-ray examination of electrolytic chromium deposits. G. PICCARDI: Spectrum of molybdic anhydride. G. D'ERASMO: Remains of tertiary vertebrates collected in Libya by the expedition of the Royal Academy of Italy (1931). A. DEBENEDETTI: First results of the study of effusive rocks of south-western Sardinia. B. BORGHI: Trypanosomiasis and avitaminosis (2): Scurvy and *Trypanosoma Brucei*. When inoculated into guinea-pigs on a scorbutigenic diet, *Trypanosoma Brucei* is capable of living and multiplying as in the normal animals. If introduced when the animals have been on the scorbutigenic diet only a few days, the trypanosome produces an infection which differs markedly from that shown by animals on normal diet. G. BRUNELLI: The '*fossa circondaria*' and hydrobiological improvement.

SYDNEY

Linnean Society of New South Wales, April 26. J. ANDREWS and W. H. MAZE: (1) Some climatological aspects of aridity in their application to Australia. The present-day climatic factor is the most important of the immediate causes of aridity. The authors suggest, as a basis for discussion, the definition that regions of aridity are regions of markedly intermittent and strongly contrasted geomorphological and biological processes which are controlled in their occurrence by the length of the period of insufficient precipitation. (2) Seasonal incidence and concentration of rainfall in Australia. A series of maps of Australia is given showing the proportion of the annual rainfall occurring in each season, together with a map showing the degree of concentration of the rainfall in the wettest season. J. R. MALLOCH: Notes on Australian Diptera (33). A synopsis is presented of the species of *Amenia* belonging to the Ameniinæ and certain misconceptions regarding the species *leonina* and *imperialis* are cleared up. One genus and species of Tachinidæ belonging to the group Trichopodini is described as new, being the first record of this group in Australia. One species of *Amenia* is described as new, and a key is given for the identification of the species of the genus. A. J. TURNER: Revision of Australian Lepidoptera. Oecophoridæ. Part 2. Notes on eight genera and fifty species, of which five genera and forty-six species are described as new, are given. W. L. WATERHOUSE: On the production of fertile hybrids from crosses between *vulgare* and Khapli emmer wheats. More than 5,000 crosses have been made. An average of about 35 per cent grain-setting has resulted. Almost always sterility has been shown by the progeny, but in a few cases a low measure of fertility has been found. Some of these derivatives are now in the F_3 generation. A big advance comes from crosses made in 1931. Three *vulgare* wheats are found to cross readily with 'Khapli' and have given F_1 plants of normal development. Under conditions of open-pollination, these hybrid plants have set more than 17 per cent of grain. Crosses between these three *vulgare* wheats and other refractory members of other species of *Triticum* indicate an unusually high fertility in these cases also.

VIENNA

Academy of Sciences, May 18. GEORG KOLLER and GERHARD PFEIFFER: The enzymes of lichens and the constitution of umbilicaric acid. *Umbilicaria pustulata*, *U. deusta*, and *Evernia prunastri* contain an enzyme capable of splitting off carboxyl groups and also a depsidase which hydrolyses depsides of the lecanoric acid type. The formation of methyl iso-evernate on alcoholysis of umbilicaric acid with methyl alcohol excludes one of the two possible structural formulæ for this acid. WILHELM SCHMID: A cyclograph Z_4, derived from a quadratic Hirst complex. FRANZ HÖLZL, WALTER BRELL and GUIDO SCHINKO: Hexacyanocobaltic acid and *n*-propyl alcohol.

May 26. H. WENDELIN: Non-exchangeable operators. KARL BRUNNER: New derivatives of 3 : 3-dimethylindolinones (2). When treated with sulphuric acid on a water-bath, indolinones give monosulphonic acids in almost quantitative yields. JOSEF NORBERT DÖRR: Three slight earthquakes in Austria in 1932. HERBERT HABERLANDT and KARL PRZIBRAM: Fluorescence of fluorite. Like the red radio-photofluorescence, the well-known blue fluorescence of fluorite may be annulled by calcination and regenerated by irradiation with radium. It must, therefore, be regarded as radio-photofluorescence. R. WILLHEIM and ERWIN V. PAPHÁZY (with JULIUS FISCH and GERTRUDE NETTEL): A new carbohydrate occurring in the urine after administration of caramel or glucose. After caramelised products, particularly bread crust or glucosan, have been eaten, the urine is found to contain a non-fermentable, optically inactive sugar, which gives a phenylosazone of melting point 200° and of the molecular weight 350 in camphor solution. No means of isolating the sugar has yet been devised. FRIEDRICH LECHNER: Eigen vibrations of a valency-force system with five mass points. OTTO FÜRTH, HARALD MINNIBECK, and EMIL EDEL: The rôle of citric acid in the carbohydrate metabolism of the mammals and of man. WOLFGANG REICHARDT: Flora from the highest Auernig strata of the Schulterkofel (Carinthian Alps).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 19, 477–579, May 15). CLYDE E. KEELER: Akhissar spotting of the house mouse. The marking, a small white spot on the belly, seems to be due to the gene commonly producing recessive piebald in laboratory mice. CHESTER STOCK: A miacid from the Sespe Upper Eocene, California. DAVID I. MACHT: Effect of methylthionine chloride on the phytotoxic reaction of normal and pathological blood. Blood or serum in plant physiological saline has a toxic effect on lupin seedlings which is decreased by weak solutions of methylene blue. Such solutions also seem to detoxify carbon monoxide blood and sera from pernicious anæmia, leprosy and pemphigus, suggesting the guarded use of methylene blue in the treatment of these diseases. CECILIA H. PAYNE: A physical analysis of Wolf-Rayet spectra. These stars fall into two groups, those containing carbon and those without. Many of the bright-line spectra show lines arising from three or more successive stages of ionisation of the same atom, suggesting that Wolf-Rayet stars are compact planetary nebulæ. WILLIAM W. HOWELLS: Notes on blood-groups and race in the Pacific. Roughly, group *A* decreases and group *B* increases in going from east to west, while group 0 remains constant. It is concluded that the *A* factor is older than the *B* factor. ANGUS S. ROY and O. S. DUFFENDACK: The excitation potential of the λ 2883 and λ 2895 bands of carbon dioxide. These bands seen to be due to the carbon dioxide ion CO_2+, having an excitation potential about 18·7 volts. Their appearance in mixtures of carbon and oxygen is apparently due to collisions of the second kind with excited oxygen molecular ions. OSWALD VEBLEN: Geometry of four-component spinors. The first of a series of papers based on the use of the Pluecker-Klein correspondence between the lines of a projective 3-space and the points of a quadric in a 5-space in a manner inverse to that intended by Klein. E. H. KENNARD: Contribution to the theory of scattering by a force centre. SELIG HECHT and CORNELIS D. VERRIJP: The influence of intensity, colour and retinal location on the fusion frequency of intermittent illumination. In the rod-free region of the fovea, critical frequency and logarithm of intensity give a single narrow sigmoid curve. Measurements using a retinal area containing rods and cones show

a high intensity section corresponding with that obtained from the fovea (cones only) and a low intensity section (rods). Corresponding results are obtained at different wave-lengths. KENDALL W. FOSTER: Colour changes in *Fundulus* with special reference to the colour changes of the iridosomes. Iridosomes deep in the dermis are composed of guanin crystals and remain blue or green in colour regardless of background. Under illumination, however, they change colour progressively. The changes suggest that the laminæ of the crystals or the crystals thicken under the action of light and that the recovery is a reverse process. J. L. WALSH: The Cauchy-Goursat theorem for rectifiable Jordan curves. M. F. ROSSKOPF: An inequality for Legendre series coefficients. AARON FIALKOW: The geometry of degenerate heat families. E. K. HAVILAND: On statistical methods in the theory of almost-periodic functions. G. A. MILLER: Sylow subgroups and the number of operators whose orders are powers of the same prime. HERBERT DINGLE: Values of T^{ν}_{μ} and the Christoffel symbols for a line element of considerable generality. C. RAYMOND ADAMS: On non-factorable transformations of double sequences. A. KHINTCHINE: The method of spectral reduction in classical dynamics. EINAR HILLE and J. D. TAMARKIN: Questions of relative inclusion in the domain of Hausdorff means. E. T. BELL: Finite ova.

Forthcoming Events

INSTITUTE OF METALS, Sept. 18–21.—Twenty-fifth Autumn Meeting to be held at Birmingham.
Sept. 18.—W. R. Barclay: "Twenty-five Years' Progress in Metallurgical Plant" (Twelfth Autumn Lecture).

BRITISH MYCOLOGICAL SOCIETY, Sept. 18–23.—Annual Meeting at Newcastle-upon-Tyne.
Prof. W. Brown: "The Mechanism of Disease Resistance in Plants" (Presidential Address).

INTERNATIONAL CONGRESS OF GLASS AND CERAMICS, Sept. 18–26. To be held at Milan.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—Sept. 22–25. Tenth Annual Conference to be held in Wills' Hall, Stoke Bishop, Bristol. Sir Charles Sherrington: President.

Official Publications Received

GREAT BRITAIN AND IRELAND

East London College (University of London). Calendar, Session 1933–1934. Pp. 221. (London.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 73, No. 440, August. Pp. 97–212+xii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

The British Mycological Society. Transactions. Edited by J. Ramsbottom, B. F. Barnes and H. Wormald. Vol. 18, Part 1, August 16th. Pp. 92+6 plates. (London: Cambridge University Press.) 7*s*. 6*d*.

Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C. Syllabus of Classes, Session 1933–34. Pp. 116. (London.)

Journal of the Society of Glass Technology. Edited by Prof. W. E. S. Turner. Vol. 17, No. 66, June. Pp. xiii+35–238+133–300+xxiv. (Sheffield.) 10*s*. 6*d*.

Aeronautical Research Committee. Report for the Year 1932–33. Pp. iv+94+5 plates. (London: H.M. Stationery Office.) 2*s*. net.

Journal of the British Wood Preserving Association. Edited by A. H. Lloyd and R. C. B. Gardner. Vol. 3. Pp. viii+111+xxvi+8 plates. (London.) 7*s*. 6*d*.

University of London: King's College, Faculty of Engineering. Syllabus of Classes, 1933–1934. Pp. 39+xv. (London.)

The North of Scotland College of Agriculture. Calendar, Session 1933–1934. Pp. viii+120. Bulletin No. 38: The Use of Chlorates in Weed Control. By D. Clouston and A. Hill. Pp. 8. Bulletin No. 39: Worm Infestation of Lambs. By Dr. David Robertson. Pp. 8+2 plates. (Aberdeen.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1519 (T. 3091 and 'a'): Lateral Stability of an Aeroplane beyond the Stall. By L. W. Bryant, I. M. W. Jones and G. L. Pawsey. Pp. 18+20 plates. 1*s*. 3*d*. net. No. 1529 (T. 3326): Abstract—Flexural Centre and Centre of Twist of an Elastic Cylinder. By Dr. W. J. Duncan, D. L. Ellis and C. Scruton. Pp. 4. 2*d*. net. No. 1534 (T. 3361): Spinning of High and Low Wing Monoplanes. By H. B. Irving, A. S. Batson and A. G. Gadd. Pp. 5+6 plates. 6*d*. net. (London: H.M. Stationery Office.)

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 20, August. Pp. 68. (Hertford: Stephen Austin and Sons, Ltd.) 2*s*.

London County Council. Lectures and Classes for Teachers: Handbook for the Session 1933–34. Pp. 72. (London.)

Department of Scientific and Industrial Research: Food Investigation. Leaflet No. 3: The Care of the Trawler's Fish. By A. Lumley. Pp. 4. (London: Department of Scientific and Industrial Research.) Free.

OTHER COUNTRIES

Review of Agricultural Operations in India, 1929–30 and 1930–31. Pp. v+350. (Delhi: Manager of Publications.) 5 rupees; 8*s*. 3*d*.

Ministry of Public Works, Egypt: Physical Department. Helwan Observatory Bulletin No. 36: On the Choice of a Suitable Projection for representing the Aspect of the Heavens. By M. R. Madwar. Pp. 12+1 plate. (Cairo: Government Press.)

Agricultural Experiment Station: North Dakota Agricultural College. Bulletin 269: Wild Flowers of North Dakota. By O. A. Stevens. Pp. 51. (Fargo, N.D.)

The Pneumatic System of Plants, especially Trees. By D. T. MacDougal and Earl B. Working. (Publication No. 441.) Pp. 87. (Washington, D.C.: Carnegie Institution.)

Chemical Investigations of the Tobacco Plant. By Hubert Bradford Vickery, George W. Pucher, Alfred J. Wakeman and Charles S. Leavenworth; with Technical Assistance of Laurence S. Nolan. (Publication No. 445.) Pp. iv+77. (Washington, D.C.: Carnegie Institution.)

Annale van die (Annals of the) Transvaal Museum. Deel (Vol.) 15, Stuk (Part) 2. Pp. 123–280+14 plates. (Pretoria: Government Printer.) 7*s*. 6*d*.

Commonwealth Bureau of Census and Statistics, Canberra. Official Year Book of the Commonwealth of Australia. No. 25, 1932. Prepared by E. T. McPhee. Pp. xxxii+894. (Canberra: Commonwealth Government Printer.) 5*s*.

Proceedings of the American Philosophical Society. Vol. 72, No. 3. Pp. 101–214. (Philadelphia.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 435: Cathode Ray Oscillogram of Action Potential of Nerve. By Shumpei Watanabe and Kyogo Sasagawa. Pp. 139–148. 20 sen. Nos. 436–439: On the Production of Seborrhea in Rat by Feeding with Whale Oil, by Eiichi Somekawa; On the Precision of the Measurement of the Lo Surdo Stark Effect Patterns, by Yoshio Ishida and Tadashi Tamura; Ether-soluble Substances in Polished Rice and their Physiological Behaviour, by Yoshikazu Sahashi; The Solarization of Luminiferous Calcite, by Satoyasu Iimori. Pp. 149–231+plates 15–18. 80 sen. (Tokyo: Iwanami Shoten.)

Proceedings of the American Academy of Arts and Sciences. Vol. 68, No. 7: Gyromagnetic Experiments on the Process of Magnetization in Weak Fields. By S. J. Barnett. Pp. 229–249. 65 cents. Vol. 68, No. 8: The Significance of Cells as revealed by their Polyhedral Shapes, with Special Reference to Precartilage; and a Surmise concerning Nerve Cells and Neuroglia. By Frederic T. Lewis. Pp. 251–284+2 plates. 85 cents. (Boston, Mass.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 13, No. 8: Deep-Sea Isospondylous Fishes; Two New Genera and Four New Species. By William Beebe. Pp. 159–167. (New York City.)

Astrographic Catalogue 1900·0. Sydney Section, Dec. −51° to −65°. From Photographs taken at the Sydney Observatory, New South Wales, Australia. Vol. 9: R.A. 0^h to 6^h, Dec. −53° to −55°, Plate Centres Dec. −54°. Pp. 28. Vol. 10: R.A. 6^h to 12^h, Dec. −53° to −55°, Plate Centres Dec. −54°. Pp. 119. (Sydney: Government Printer.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 14, 1932. ii. Nederbörden i Sverige. Pp. 56. (Stockholm.) 2.50 kr.

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 2: Nationality of Ownership and Nature of Constitution of Rubber Estates in Malaya. By D. H. Grist. Pp. ii+26. 50 cents. General Series, No. 13: Tapioca in Malaya. By V. R. Greenstreet and J. Lambourne. Pp. vi+78+24 plates. 1 dollar; 2*s*. 4*d*. (Kuala Lumpur.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 75: *Nigrospora musæ* n.sp. and its Connexion with "Squirter" Disease in Bananas. By Prof. Ethel I. McLennan and Shirley Hoëtte. Pp. 36+1 plate. Pamphlet No. 40: A guide to the Seasoning of Australian Timbers. By C. Sibley Elliot. Pp. 53. (Melbourne: Government Printer.)

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