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SCIENTIFIC RESEARCH AND PATENTS

IN one of the recent series of articles on "Scientific and Industrial Research" published in these columns, it was stated that "When we have thus provided for the effective organization of research in the universities and under direct Government auspices, there will remain a large field of applied research to be undertaken by private industry". The strategy and tactics of research in each of the three divisions indicated in these words must differ from those of the other two, and the opinion was expressed that while "the funds at the disposal of research are utterly inadequate" and that while there will be required "expenditure ranging up to what might well approach 50 millions", there should be "no direct financial aid to research by private firms". There can be no doubt that Government expenditure on this scale and in this way would be greatly in the public interest and to the social advantage. Nevertheless, the view has been expressed that the extremely large expenditure to which the Government is otherwise committed during the next few years makes it unlikely that it will accept the further responsibility of the suggested £50 millions, without some clear indication of means by which it will be able to cover the expenditure more directly than by some possible consequent benefit to the public interest and social advantage. One way of removing this probable reluctance by the Government would be to stress that industrial development and increased employment result from expenditure on research, to make clear what is at present being achieved in this respect by industry, and to suggest how it can be increased.

The close relationship between industrial development, increased employment, and expenditure on research can be shown by reference to the annual reports of many of the larger industrial companies, and an indication of what is at present being achieved is illustrated by figures recently made public by Imperial Chemical Industries, Ltd. The directors of that company have offered to provide at nine universities of Great Britain eighty fellowships of the average value of £600 per annum to be held by senior workers in certain sciences ; the research organization of the Company consists of nearly nine hundred fully qualified chemists, physicists, biologists, engineers, and other scientific men, together with more than a thousand skilled assistants. During 1943, its expenditure on research and development in its own works was approximately £2,200,000 ; and, in addition, £12,500,000 became due to the British and Overseas Governments under the headings of Excess Profits Tax, National Defence Contribution, and income tax. Similar results on a smaller scale have been recorded by many other companies.

This achievement, so directly beneficial to research in the universities and to Government finance, has been made possible by the industrial use in Great Britain of patented inventions ; and it should be remembered that for a patentee to comply with the conditions on which he obtains his patent he must

work his invention in Britain. Patents for the "sole working or making of any manner of new manufacture" were by Section 6 exempted from the statute, passed in the year 1624, for the prohibition of monopolies and, under the present Patents Act, a patent may be held invalid if the invention is not being worked in Great Britain on a commercial scale. In spite of these facts, however, many patented inventions are not being so worked and, in other ways, the monopoly rights are being abused and the public interest detrimentally affected. Any amendment of the patent law which would more effectively compel manufacture in Great Britain of a patented invention, prevent other abuse of the monopoly rights, and increase the incentive to inventors, would develop industry and increase employment, and would incline the Government to give more generous assistance to research.

It would seem that the Government has appreciated this aspect of the matter, because some time ago the President of the Board of Trade appointed a representative Committee, with Mr. Kenneth Swan as chairman,

"To consider and report whether any, and if so what, changes are desirable in the Patents and Designs Acts, and in the practice of the Patent Office and the Courts in relation to matters arising therefrom."

In particular, the Committee is requested to give early consideration to, and to submit an interim report or reports on:

"(*a*) the initiation, conduct and determination of legal proceedings arising under or out of the Patents and Designs Acts, including the constitution of the appropriate tribunals; and

"(*b*) the provisions of these Acts for the prevention of the abuse of monopoly rights; and to suggest any amendments of the statutory provisions or of procedure thereunder which in their opinion would facilitate the expeditious settlement and the reduction of the cost of legal proceedings in patent cases and would encourage the use of inventions and the progress of industry and trade."

The Committee is now taking evidence on the two matters on which interim reports are asked for, and this evidence includes memoranda by the Trade Marks, Patents and Designs Federation* and by a Joint Chemical Committee†, consisting of representatives of the more important chemical societies and associations of Britain. These memoranda are drawn up in the form of replies to a questionnaire issued by the Government Committee for the guidance of witnesses and are in substantial agreement on the two matters under consideration.

On the important matter of abuse of monopoly rights, about which there has recently been much discussion in Great Britain and more in the United States, the Federation is of opinion that the complaints made on the score of the operation of cartels in Britain in relation to patents are in general not justified.

* Memorandum on Patent Law Reform. Part I. Prepared by the Trade Marks, Patents and Designs Federation. Ltd., 169 Bank Chambers, 329 High Holborn, London, W.C.1.

† Memorandum on Patent Law Reform. Part I. Prepared by the Joint Chemical Committee on Patents, 166 Piccadilly, London, W.1. 1*s*.

It is stated that no case is known where patents granted for inventions originating in Great Britain have been operated by a cartel to the detriment of the national interest. It is only in the case of international cartels regulating patent rights originating abroad and owned by German interests that there are recorded instances of operations that are to the detriment of the public interest here. The cases the Federation has in mind are those where there is a written agreement under which the parties agree that manufacture under a patent shall be prevented or restricted in Great Britain in favour of importation. It is recalled that British patents are intended to stimulate British manufactures; and if a patented invention is not being worked in Britain, the patented article being made abroad, for example in Germany, and imported into Great Britain, the whole object of the grant of patents is defeated. Examples are cited by the Federation in support of this view, the most interesting being the shortage of 'Atebrin', urgently required for the treatment of malaria when the sources of supply of quinine fell into enemy hands early in the War. The remedy suggested for this type of abuse of the monopoly rights is to grant licences under a patent to persons who are willing to manufacture in Great Britain and to transfer any subsequent beneficial interest in the patent from the patentee to the Crown.

On the matter of abuses of monopoly rights by the suppression of inventions, so often charged against patentees in the popular Press, the Joint Chemical Committee states that these allegations are usually found on examination to be non-existent or to be due to the abuse of wealth. The remedy lies, in its view, first in the grant of licences in the way just indicated; secondly, in giving the Comptroller of Patents power to refuse, subject to appeal to the Court, to grant a patent for an invention which he is satisfied is lacking in inventive merit or in novelty in view of prior user; and thirdly, in some considerable reduction of the costs in patent actions. Both the Committee and the Federation are of opinion that the attitude of the Courts is too 'legalistic' and not sufficiently 'scientific', and that the reinforcement of the Courts by members with some scientific or technological attainments would be in the public interest. They recommend the appointment of a patents tribunal to include one, two or three High Court judges experienced in patent cases and "one or two lay members selected from a permanent panel of, say, six or eight technologically or scientifically qualified persons" who should not undertake any other employment.

The suggestion for the compulsory licensing of all patents, which has been so fully discussed pro and con during the past two years, is opposed on various grounds. It is pointed out that the reason for granting patents is, as stated in the form of patent, "to encourage all inventions which may be for the public good", the encouragement being the right of sole working of the invention for a limited period. The evidence goes to show that patentees in general value highly this right of sole working, and the opinion is expressed that if, by endorsing patents "licences of

right", this right of sole working is destroyed, the encouragement of the inventor will to that extent be diminished, the flow of invention will be lessened, and the retention of inventions as secret processes will be increased. As regards the commercial exploitation of inventions, not many manufacturers will be prepared to lay down plant for the commercial exploitation of an invention with the risk that it may be a failure, if competitors are free to obtain a licence should it be a success.

It is clear from the memoranda that the evidence which is being submitted to the Committee appointed by the President of the Board of Trade is such as to strengthen the hope of amendment of the patent law so as more effectively to compel manufacture of a patented invention in Great Britain, and make more readily ascertainable the rights of the public in relation to patentees. By this means industry will be developed, employment increased, and the Government enabled to give more generous assistance to research.

THE CONTRIBUTION OF SCIENCE TO CIVILIZATION

Science and the Future

By Prof. A. E. Trueman. (The British Way Series, No. 7.) Pp. 64. (Glasgow: Craig and Wilson, Ltd., 1943.) 1*s*. 3*d*.

The Impact and Value of Science

By Dr. D. W. Hill. Pp. 88. (London, New York and Melbourne: Hutchinson's Scientific and Technical Publications, n.d.) 7*s*. 6*d*. net.

THERE could be no better tribute to the way in which Prof. A. E. Trueman's "Science and the Future" maintains the standard of the earlier pamphlets in "The British Way" series than the manner in which, without disparaging the British contribution to the advancement of science or encouraging the false idea that there are national brands of science, he justifies the inclusion of a pamphlet under this title in the present series. If the British outlook and way of life are to survive, and to continue to make an effective contribution to the building of the post-war world, due regard must be had to the place of science. It would be difficult to find in short compass an abler popular exposition of just what that contribution might be, and of the difficulties which must be faced in organizing science to secure that maximum contribution without endangering the advance of science itself. Prof. Trueman's exposition of the purposes and needs of the scientific investigator is as valuable to the ordinary citizen as his warning on some of the dangers of planning is to the scientific worker himself. One may fairly regard the whole pamphlet as an important contribution to the debate on the organization of scientific and industrial research from this point of view of exposition, and not merely on the grounds of the brief chapters in which those problems are actually discussed in the pamphlet.

This clear view of the fundamentals gives the main value to Prof. Trueman's pamphlet. His note on the characteristics of the scientific method—careful experiment and accurate observation, verification of the evidence, and the effort to eliminate preconceived ideas and personal feelings in forming a judgment or interpreting results—should help to dispel the idea of mystery with which popular thought sometimes still tends to cloak the man of science. So, too, his insistence on the right of independent inquiry, that science can develop only in an atmosphere of freedom and that the value of the scientific worker to the community lies in his originality, should help the conduct of popular discussion on scientific research —a discussion in which the decisions cannot all be taken by scientific men themselves.

Prof. Trueman's pamphlet should do something to bridge the gap between the scientific man and the ordinary citizen to which he himself directs attention. On this, after noting the cultural value of science, he has a chapter on science in education in which he urges that an outline of science is desirable for the appreciation of the world in which we live. The foundation of the intellectual life of any self-respecting man must be a grasp of the outstanding conclusions of science, and the essential feature of general science teaching is that from it should emerge the general picture of the world as seen by the man of science. Prof. Trueman notes the comparative neglect of science in adult education and by the newspaper Press, and indicates developments in extra-mural classes conducted by the universities and the Workers' Educational Association. In regard to the training of scientific workers themselves, he affirms his belief that an atmosphere of research and the cultivation of the outlook of an investigator are essential features of a university training in science. A combination of teaching and research in one individual, he holds, affords a most effective basis for the training of a man of science. In Prof. Trueman's opinion, a research worker who is not specially gifted as a teacher may be a more effective person to train advanced students than an excellent teacher who finds no pleasure in research.

That proposition may depend on particular conditions, but Prof. Trueman's further view that it is essential that intending teachers should not be cut off from the atmosphere of research but should gain some experience of scientific discovery is likely to command general approval.

Of no less interest to the scientific worker are the sections in which Prof. Trueman deals with the organization of science in Britain and with planning for the future. While he appears to admit that there is a lack of co-ordination in the whole national research programme, Prof. Trueman holds that, so far as the planning of science itself is possible, it can suitably be achieved within the organization already available. In this he is in sharp contrast to Prof. Harold Laski, who in an article, "Research, Intelligence and Administration", in the *Political Quarterly*, argued for major changes. Some of the criticism advanced by Prof. Laski would doubtless be conceded by Prof. Trueman, but the latter's survey is more objective and better balanced, and he has probably succeeded in his attempt to give a reasonable presentation in accord with the views of the majority of scientific men.

In any general plan of research, it is essential to make certain that the whole body of knowledge be kept in growth, and that nothing be neglected because it is not immediately useful. Whatever steps therefore we take to organize the study of particular and urgent problems, we must have the widest possible field for unorganized research workers with

free scope to choose their own problems and to tackle them in their own way. This freedom, coupled with responsibility, is essential whatever the nature of the organization which links the scientific worker with the problems to be solved. Here, no less than in indicating how essential a scientific outlook and a wider scientific education are to the scientific planning of the life of the nation, Prof. Trueman's pamphlet should help to keep discussion on the right lines, and it will be read with interest and profit by scientific workers as well as by the larger body of their fellow citizens to whom it is primarily addressed.

Dr. D. W. Hill covers a wider canvas in his book, though he has much ground in common with Prof. Trueman. He, too, is concerned to interpret the scientific outlook and to emphasize that science is a mental discipline and that its first object is not to control or to exploit but to understand. In a chapter on science and industry, he pleads for a better balance between those who may be classed as technologists and scientific workers and those who understand and can use the tools of company law and finance. Dr. Hill never overstates his case, and his plea that industry needs scientific workers, not so much for their professional knowledge as their ingrained method of thought, is more effective because he sees the limitations of technical skill alone. Sanity of outlook, a balanced judgment, ability to correlate the broadest issues and to see the relevance and implications of widely separated facts, a ranging, imaginative, disciplined mind—these also are wanted, but Dr. Hill never wavers from his conviction that a scientific training can develop such qualities.

This conviction he carries into his discussion of science and politics. Here he is less happy. He recognizes indeed that the full use of the scientific expert involves an educated community: the scientifically trained mind imbued with the idea of freedom of thought, grounded in the system of unbiased judgment, might arrive, after weighing the evidence, at a policy to pursue, but it could appeal only to similar minds for understanding and support. Seeing this, and seeing how easily the absence of such a community may lead to the totalitarian State, he has yet missed the essential element in the democratic system. He sees the affinity between the scientific method and the process of democracy; but much of this chapter is crude and lacks the perspicuity with which Prof. Mannheim and Sir Ernest Barker have discussed this problem in recent years.

No such criticism can be advanced against his discussion of science and war. The issues have rarely been laid bare more discerningly, and this chapter is an admirable reply alike to the loose thinking which saddles science with responsibility that lies on the shoulders of the community as a whole, and as an impetus to the impartial examination and study of the causes of war on which any real attempt to eliminate war must be based. So too in his chapters on science and education and on science and religion, we have a fine plea for educational research, for men with the divine gift of imagination, coupled with the inquiring mind that forces them into research, and men trained to appreciate, to apply and to expound the results of such research; and the conviction that the scientific method must be practised by men of goodwill whose faith in the end they serve is deep-rooted and firm. The hope of this civilization, Dr. Hill urges, lies in the discovery of men in whom the accurate thought born of a scientific training is imbued with the faith that moves mountains in all that is good and operates through a sense of service that outstrips all hope of reward.

Dr. Hill is liveliest in his final chapter on "Science and Leadership", where shrewd criticism of the weaknesses and limitations of scientific men is accompanied by a strong plea for their freer admission to positions of administrative responsibility, and for attention in their training to measures such as wider contacts and interchange of students and of staff which in the formative years contribute so much to widening their outlook. Despite their occasional lapses, Dr. Hill stoutly maintains that scientific workers are more likely to be objective in their judgments than most men, and that the combination of technical skill and knowledge with administrative ability is not rare. Finally, he drives home to scientific workers themselves the lesson that if they are to play their full part in human affairs, they must learn to express themselves adequately, abandon the attitude of aloofness and isolation, and recognize both the limitations of their experience and the importance of those considerations of quality in the realms of human relations, economics and politics, which their preoccupation with quantitative factors is apt to lead them to overlook.

R. BRIGHTMAN.

SCIENCE IN THE U.S.S.R.: AN AMERICAN SURVEY

Science in Soviet Russia

Papers presented at Congress of American-Soviet Friendship, New York City, November 7, 1943, under the auspices of the National Council of American-Soviet Friendship. Pp. ix+97. (Lancaster, Pa.: Jaques Cattell Press, 1944.) 1.50 dollars.

AFTER the Revolution in Russia in 1917, the United States Government severed diplomatic relations and did not resume them until 1933. To commemorate the ten-year period a meeting of the Science Panel of the Congress of American-Soviet Friendship was held in New York City on November 7, 1943. It was in two parts: one section under Prof. Harold C. Urey dealt with Soviet science and technology, and the other under Prof. Walter B. Cannon with public health and war-time medicine in the U.S.S.R. Fourteen papers were read, each dealing with a particular branch of science, and they are collected in this little volume, "Science in Soviet Russia".

One of the authors, D. Wilder Penfield, of the Montreal Neurological Institute, McGill University, had the advantage of a recent visit to the U.S.S.R. as a member of the Medical Mission that went there in July 1943. He gives a very interesting and well-balanced account of what he saw. He found Soviet war surgery well organized, efficient and modern, and medical education established on a sound and adequate basis. The use of sulphonamides was well understood, as were also plaster treatment of wounds and fractures, provision of blood and blood substitutes for hæmorrhage and shock, and evacuation of wounded by air. The organization of the surgical work was especially good, though in certain refinements of technique there was room for improvement. Medical education has developed rapidly. In 1940 there were 160,000 medical practitioners; in the five pre-war years, seventy-two medical institutes had turned out about 21,000 new ones

yearly: before the War, 50 per cent were women; now the proportion is about 85 per cent. Like others who know them, Dr. Penfield speaks very highly of the efficiency of the Russian women. He praises, too, the nurses, who not only tended their patients but also helped build the huts in which they were to live and work, besides being attractive partners in the dance given to welcome the Mission to a forward hospital. He saw no signs of malnutrition: the ration, he was told, was 1·75 lb. bread daily and 4·4 lb. meat or fish weekly for a worker; and 0·8 lb. bread daily and 1·3 lb. meat or fish weekly for a non-worker or child working less than three hours per day. Prof. Winslow describes what he saw of the work on public health in 1936. The death-rate from diphtheria, the incidence of syphilis, infant mortality-rate and death-rate in the larger cities had all been greatly reduced since 1913, and medical services were being pushed out into the villages as personnel became available. Malaria and dysentery remained as major menaces, but rodent carriers of plague were being dealt with. The outstanding feature of the public health programme was the provision for the care of maternity and infancy.

Two papers were devoted to geology in the U.S.S.R. Dr. Muller mentions the conversion of coal *in situ* into gas, which is then piped directly to the furnaces of industrial plants. British men of science remember with pride that the original suggestion was made by Sir William Ramsay: it was quickly taken up by Lenin, who saw in it the possibility of improving the coal workers' lot; the story has been told by Dr. E. B. Bailey in the *Journal of the Royal Society of Arts* (92, 540; 1944).

Dr. Muller also gives an account of the work on "Permafrost", that is, permanently frozen subsoil. Prof. Dunbar attended the Geological Congress in Moscow in 1937 and quotes figures showing the remarkable increase in mineral output:

	1921	1927	1937	1940
Aluminium	—	—	37,000	
Copper	2,000	12,000	92,000	125,000
Pig iron	112,000	2,900,000	14,520,000	15,500,000
Manganese	29,000	840,000	2,750,000	

Dr. Waksman deals with bacteriology in the Soviet Union, a subject on which he has encyclopædic knowledge. The great pioneers were Metchnikov, who worked on medical bacteriology at Odessa, and Siergei Winogradsky, whose investigations in general bacteriology were made at the Academy of Medicine, St. Petersburg. Subsequent developments in these directions are indicated, the names of the investigators and a brief statement of their contributions being given.

Dr. Stanley describes Soviet studies on viruses in an account which is the more interesting because he concentrates on a few important papers by Ivanovski, Rishkov and Goldin, and indicates only in a list of references the subsequent developments.

Brief sections on electrons and on soil and agriculture complete the book.

It is interesting to compare the American evaluation of the scientific work with the British. We should certainly have included a section on chemistry so as to include accounts of the work of Semenov, Frumkin and others, and mention would have been made of the mathematician Vinogoradov, the physicists Joffe and Kapitza, the agricultural botanist Lysenko and the soil scientists Dokuchaiev, Glinka and Polynov. Yet none of these names occurs. The book has the same title as one by J. G. Crowther, published in 1930, and a comparison of the two shows something of the change in the last fourteen years. In some way or other, British scientific workers must learn more about what their Russian colleagues are doing. Admittedly the difficulties are considerable. It is too much to expect British scientific workers to learn Russian on any extensive scale, and it is unfair to Russian science to judge the papers solely by the short summaries in English given at the ends. Perhaps the best way to ensure a proper appreciation of the work would be to arrange for the publication of systematic accounts of specific subjects, somewhat on the lines of those issued from time to time by the Imperial Bureaux of Soil Science and of Plant Genetics, and of translations of specially important papers.

E. JOHN RUSSELL.

INDUSTRIAL HAZARDS

The Analytical Chemistry of Industrial Poisons, Hazards and Solvents

By Dr. Morris B. Jacobs. (Chemical Analysis: a Series of Monographs on Analytical Chemistry and its Applications, Vol. 1.) Second revised reprint. Pp. xviii+661. (New York: Interscience Publishers, Inc., 1944.) 7 dollars.

WHETHER we work in office, shop or factory, with hand or brain, we are exposed throughout life to a number of hazards quite outside the powers of the police to prevent. Such hazards are detected by workers who wear no uniform unless it be the white coat of the laboratory, and come under the general heading of industrial hygiene. There is ever-increasing need for their watchfulness as industry and life grow more complex. Industrial poisons, gases, dusts, vapours of solvents, lurk around the corner ready to attack us once or repeatedly until we fall sick or lose our working efficiency.

The public has little knowledge of the extent to which they are guarded, while those who act as guardians are conscious of how much more remains to be done in the nature of staff and equipment.

Any new subject demands new methods; in general these have to be quick and simple. Hence the desire on the part of the author, who is senior chemist to the Department of Health in New York City, to bring together the analytical chemistry of industrial hygiene. He has produced a bulky volume, for such instructions, if they are to be explicit, have to be given in considerable detail. Workers in the smaller laboratories faced with the same multitude of problems as in a large city have little time to search for the best methods of attack or to devise new ones and will therefore be glad to have a book in which they are detailed.

The headings adopted for the detailed treatment are sampling—never an easy task—the measurement of gas volume and quantity, absorbers and absorbents. Then follows a description of the chemical and microscopic estimation of dust and silica, of the dangerous and other metals, of the common poisonous compounds of sulphur, nitrogen and phosphorus, the halogens, carbon compounds like carbon monoxide, hydrogen cyanide, etc. Further sections deal with organic compounds, particularly the growing class widely used as solvents. Lastly, the chemical warfare agents have to be considered, a necessary though tragic precaution in these days.

It would be unfair to criticize any of the methods on points of detail—they have all been tried out in the laboratory and serve their purpose. What is important is that their listing will save an immense amount of time for other workers.

Our life in the factory, even in travel to and from work, exposes us to hazards which we fail to appreciate until afflicted with some ailment which our medical adviser finds hard to diagnose. Acute poisoning is generally accidental and obvious, but the effects of slow and chronic poisoning are more deep-seated and often much more damaging. Once the causes are diagnosed and understood they can be removed, but to do this requires much careful work on the part of the chemist.

Chemical warfare agents are unlikely to be experienced in the United States as the result of enemy action, but during their manufacture and subsequent processing they do present serious risks. Many of them are hazards met in industry under another guise, either as industrial products like chlorine and phosgene, as by-products, or as decomposition products of other substances. It is a growing practice, for example, to transport chlorine and ammonia in tank wagons holding tons, or containers of several hundredweight capacity: a spill in transit might have most serious consequences, killing or injuring people over a wide area. A recent issue of a New York journal gave an alarming picture of an actual incident. 'Warfare agents' are also being developed for peace-time uses as fumigants, insecticides and even for extinguishing fires and refrigeration. A careful watch will have to be kept that rigid precautions are taken both in manufacture, storage, transport and use of such chemicals. In passing, it may be noted how few noxious chemicals are of any value in war: of more than three thousand substances tested less than a dozen were of any importance as warfare agents.

Incidentally this is the first of a projected series of monographs on analytical chemistry and its applications.

E. F. ARMSTRONG.

CONTROL OF BACTERIAL ENVIRONMENT

Micrurgical and Germ-Free Methods

Their Application to Experimental Biology and Medicine; a Symposium. Edited by James A. Reyniers. Pp. xiv+274. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 1943.) 5 dollars.

IN November 1939 a colloquium was held in the Laboratories of Bacteriology of Notre Dame University to discuss micrurgy, or microscopic surgery, the cultivation of plants and animals in the absence of bacteria, and the control of aerial cross-infection in hospital wards. The papers which were contributed are now published in an attractive book, profusely illustrated with good photographs and diagrams, with a common index at the end, and generous bibliographies for each contribution.

Three papers deal with micrurgy. James A. Reyniers describes and discusses the design of machines for making single-cell cultures of bacteria and spores. Various ingenious devices are presented; the paper is entirely technical. M. J. Kopak describes the technique of measuring surface tensions and the behaviour of oil-water interfaces inside cells by injecting small drops of oil into them through micropipettes. The hydrostatic pressure necessary to form the drop gives a measure of the oil-water surface tension. An oil drop formed at the point of a micropipette in a watery protein solution collects protein molecules in its surface; if the drop is sucked back into the pipette, the area of the surface film decreases and the protein molecules are compressed until a critical drop size is reached, when the compressed surface film wrinkles—the Devaux phenomenon. Observation of such drops in watery protein solutions, in disintegrated protoplasm and inside living *Arbacia* eggs, provides evidence concerning the state of proteins in living protoplasm—a subject which the author discusses. E. M. Hildebrand contributes a review of all the uses to which micrurgy has been put in botany.

The remaining eight papers deal with germ-free methods. Reyniers describes his system of closed apparatus in which germ-free vertebrates, born by Cæsarean section or hatched from germ-free eggs, can be reared, fed, watched and inoculated. Guinea pigs and chickens, completely free from bacteria, have been kept alive and healthy for six months. Two Rhesus monkeys were similarly raised; one died from an accident after forty-five days, the other was still alive and well after four months.

Oram C. Woolpert and N. Paul Hudson contribute a review of the use of the mammalian fœtus as an experimental animal in bacteriology, virology and immunology, and discuss the technique of intra-uterine inoculation.

R. W. Glaser, in a paper on the germ-free culture of certain invertebrates, describes methods of obtaining germ-free strains by multiple washing of Protozoa, or of the eggs or larvæ of worms or insects, with or without the use of bland disinfectants. Complex machinery is not needed. The chief difficulty is to devise suitable culture media on which germ-free strains can be grown. Certain Protozoa which are strongly geotropic can be made to swim clear of the bacteria which usually contaminate them. The germ-free method is particularly useful with certain parasitic species, cultivation of which in the past has generally failed on account of bacterial contamination. For example, germ-free cultivation of *Neoplectana glaseri*, parasitic on the Japanese beetle, *Popillia japonica*, has made possible mass cultivation of infective nematodes which can be used in the field to control the beetle. *Hæmonchus contortus* of sheep has been cultivated *in vitro* through some of its parasitic stages. Among insects, *Aedes ægypti* and *Musca domestica* can be bred indefinitely, by methods described in the paper, quite free from bacterial contamination.

Philip R. White discusses the cultivation of germ-free plants or parts of plants. The principles of technique resemble those applying to invertebrates. Sound aseptic practice is the main necessity, given which it is often possible to obtain uncontaminated cultures from growing tips, or from seeds in their fruits or pods, which are naturally germ-free.

The three remaining papers deal with control of the bacterial environment of man; or rather, with that of infants in hospital wards. James A. Reyniers describes a cubicle which he has devised in which infants can be raised without risk of aerial or contact cross-infection. By placing the infant in one cubicle, and the nurse who looks after it in another alongside, and controlling the ingress of bacteria to both cubicles by the usual aseptic methods and by regu-

lating air pressures so that the flow of air is always away from the infant, Reyniers considers that a mechanical system of barriers to cross-infection can be erected. I. Rosenstern and E. Kammerling describe an experiment designed to compare Reyniers' mechanical method of cubicle isolation with Wells' ultra-violet light barrier isolation method, and with ordinary air-conditioning as a control. Each system is being tested on a block of twelve cubicles at the Cradle, Evanston, Ill., the three groups of infants being comparable in point of age, general health, and respiratory infection rate. The result of the experiment is not recorded, but the authors give details of preliminary bacteriological tests made by spraying *Chromobacterium prodigiosum* into the air and following its distribution.

The last paper is a detailed description by William F. Wells of his method of reducing the bacterial flora of hospital air by means of ultra-violet light screens.

The greater part of all of the papers is devoted to technique, but the authors also discuss the many uses to which the methods they describe may be put.

PRACTICAL MALARIA CONTROL

Practical Malaria Control

A Handbook for Field Workers. By Dr. Carl E. M. Gunther. Pp. 91. (New York: Philosophical Library, Inc., 1944.) 2.50 dollars.

THE title of this book is an ambitious one, and our appetites are sharpened by the reputation of the author as an entomologist of repute, one fully acquainted with the literature of malaria, with practical experience in the field, as well as in the laboratory. In performance, however, the result is a little disappointing. The style is somewhat involved and confused, and the author has failed to make the most of what is a great opportunity. Many of the statements are dogmatic and open to criticism. For example, it is recommended that in conducting a malaria survey the best method is to collect adult *Anopheles* and post them to the nearest school of tropical medicine, or even the British Museum, for identification. At this point the student is left entirely in the air with the advice that no useful purpose can be served by detailing special control methods applicable to individual species of *Anopheles* which constitute the whole basis of species sanitation.

Under personal measures, the author declares himself a zealous advocate of prophylactic quinine, and, because of the excellent results he has obtained, insists on its use by every member of the non-immune population more than ten years of age. For small children quinine prophylaxis is not advised, as tending to produce the typical thin, pale and languid 'tropical' child. It will be noted that distinctions are drawn between measures applicable to those who are immune and those who are non-immune to malaria.

The author's brief instructions on the control of malaria in military campaigns can scarcely be of practical value under present war conditions.

The clinical section suffers from generalizations, and no attempt has been made to distinguish clinical syndromes produced by different species of *Plasmodium*, but one can infer from the sense of the text that the subtertian form is the one with which the author is most familiar. In treatment the author is by no means enthusiastic about 'Atebrin'; he prefers intramuscular injection to oral administration. When given by the mouth 'Atebrin' is, he avers, erratic in action, while 10 per cent of patients are highly sensitive and suffer from poisoning which is marked by "racking intractible bilious vomiting" lasting 12–14 hours. The treatment of blackwater fever does not follow on generally accepted lines; there is, for example, no evidence that blood transfusion aggravates intravascular hæmolysis. P. MANSON-BAHR.

THE BACKGROUND OF IMMATERIALISM

Immaterialism

Annual Philosophical Lecture, Henriette Hertz Trust, British Academy, 1944. (From *Proc. Brit. Acad.*, **30**.) By Dr. A. A. Luce. Pp. 16. (London: Oxford University Press, 1944.) 2*s*. net.

IN this lecture, given before the British Academy, Dr. A. A. Luce comes forth as an explicit defendant of the doctrine that there is no such thing as matter. There are periods in the history of philosophy when immaterialism becomes fashionable. Bishop Berkeley, in his "Principles", and Collier, in his "Clavis Universalis", arrived independently at the doctrine in the early years of the eighteenth century. Dr. Luce's lecture throws great light on the intellectual soil which gives rise to such a doctrine.

Just as Berkeley started from Locke's position that "all our knowledge is by way of ideas", so Dr. Luce starts from the position of Moore, Russell and Broad—in principle the same—that all our knowledge is by way of sense-data. Hence he substitutes for the question "Does matter exist?" the question "Is there material substance *over and above the sum total of sense-data*?" The negative answer which he gives to the second question has no tendency to show that matter does not exist except to a believer in sense-data.

As soon as philosophers analyse experience into components, whether ideas or sense-data, matter cannot be found; it lingers on only until someone like Bishop Berkeley or Dr. Luce gets up to say that, as it cannot be found, it would be as well not to keep on talking about it.

But the fault may lie in the original analysis, which omitted something of importance. Dr. Luce says: "When in Boswell's presence Dr. Johnson kicked the mighty stone and 'refuted' Berkeley, he was simply appealing to what he could touch and see, i.e. to sense-data and *sensibilia*, and if that be all that is meant by 'matter', any reasonable immaterialist would accept it" (p. 6). This way of dismissing Johnson's refutation under-estimates the innate good sense of that mass of English judiciousness. It is possible that Dr. Johnson was appealing not to sense-data but to a quite different experience, namely, a direct awareness of another body opposing my body, in which the sensations of touch are merely episodes, featuring in, but not exhausting, the total experience. If so, this kicking of the stone was a valuable commentary on a missing element in all such theories as Berkeley's. Those philosophers who speak of sense-data as 'presented' to us or as 'presentations' forget this element and talk as though life was like a cinematograph film unrolling before us, instead of what it is and is felt by us to be, an interaction of bodies. If we surrender this point, we surrender matter. WINSTON H. F. BARNES.

John Dalton

Some Unpublished Letters of Personal and Scientific Interest, with additional Information about his Colour-Vision and Atomic Theories. By Dr. E. M. Brockbank. (Publications of the University of Manchester, No. 287.) Pp. ii+62+5 plates. (Manchester: Manchester University Press, 1944.) Cloth, 7*s*. 6*d*. net; boards, 7*s*. net.

DR. BROCKBANK'S modest booklet, dated on the centenary of Dalton's death, does not bring forward any new material of primary importance bearing upon the philosopher's life and work; nevertheless, it will be welcomed by all who are interested in Daltoniana. It contains notes on Dalton's family history, on the Kendal and Manchester periods, on his appreciation of female society, and on his relationships with the Society of Friends and with Peter Clare, together with nine hitherto unpublished letters. There are also short chapters on colour-vision defects and the genesis of the atomic theory. It is revealing that Dalton found Boyle's style "so tedious and verbose" in his chemical tracts "that one cannot reap the full advantage from them, except they were condensed and digested a little better"; at the same time (1790) he regarded Boerhaave's "Elementa Chemiae", published in 1732, as "a capital" treatise, and approved also of the "essays of the present Bishop of Llandaff" (Richard Watson). Among other interesting details we may note that early in his career Dalton gave tuition for so little as a shilling an hour; that in 1792 he found London "a most surprising Place to a Stranger"; and that although he was often regarded as a gruff disciplinarian, somewhat uncouth or even morose in manner, yet in his younger days he used to write extempore verses in the diaries of his lady friends. J. R.

International River and Canal Transport

By Brig.-General Sir Osborne Mance, assisted by J. E. Wheeler. (International Transport and Communications.) (Issued under the auspices of the Royal Institute of International Affairs.) Pp. viii+116. (London: Oxford University Press, 1944.) 10*s*. 6*d*. net.

INLAND waterways have always been important lines of communication and transport, and the tendency in recent years has been to increase their use by canalization and control of flow, as their value is enhanced by hydro-electric schemes. But this new value of flowing water raises many acute problems of international control, since the most important rivers are seldom confined to one State.

Sir Osborne Mance has rendered considerable service to the river problems of to-morrow by compiling a general survey of existing international river arrangements with special reference to Europe. These arrangements will not necessarily remain, but they indicate many of the problems that will shortly have to be faced. The Rhine, Danube, Elbe and Vistula are four rivers that are hedged around with problems of this nature, each being vital to the well-being of more than one State.

It is a pity that the pamphlet gives little or no account of the depths, flow, width and lock systems of the rivers and canals, since these considerations obviously affect the problem. There are two rough sketch-maps showing the main waterways, and projected canals of central Europe.

But surely the price is high for a pamphlet of little more than a hundred pages.

The Application of Radiant Heat to Metal Finishing

A Critical Survey of the 'Infra-red' Process for the Stoving of Paints and Enamels. By Dr. J. H. Nelson and H. Silman. Pp. viii+79. (London: Chapman and Hall, Ltd., 1944.) 8*s*. 6*d*. net.

THIS useful little book is very rightly critical of the indiscriminate use of the term 'infra-red' to describe radiant heat sources, for one cannot but be amused to see a battery of brightly incandescent lamps referred to as an 'infra-red' lamp heating plant. After a short introductory chapter on radiant heat and its advantages, the authors describe the principles of heat transfer, giving the physical laws pertaining thereto and an elementary treatment of some of the mathematics involved. Thereafter, the study is essentially of a practical nature and includes the history of the 'infra-red' process, reflectors, plant construction and design, paint formulation and the field of application of radiant heating.

It is pointed out that while considerable progress has been made in the practice of radiant heat applied to the stoving of paints and enamels on metal surfaces, rapid developments in technique are to be expected in the very near future.

The book can be recommended to those needing guidance on the subject.

Direction Finding by the Stars

By J. B. Sidgwick. Pp. 88. (London: Faber and Faber, Ltd., 1944.) 5*s*. net.

MR. SIDGWICK'S little book provides much useful information for those who have only a rudimentary knowledge or no knowledge of the constellations and chief stars. Starting with the Great Bear, which most people recognize, directions are given for finding and recognizing the other constellations which appear at the different seasons. The stellar bearings are easily found from a date table and a number of graphs, and the use of the table and graphs is illustrated by examples which are fully worked out. Even the novice should find no difficulty in applying these to obtain his bearings if he carries a copy of the book in his pocket. In addition to finding one's bearings, directions are given which enable the reader to determine the time by means of the sun and a number of the brighter stars. Soldiers on active service will find much useful information in the book. M. D.

Good Soil

By S. Graham Brade-Birks. (Teach Yourself Farming Series.) Pp. 296. (Bickley: English Universities Press, Ltd., 1944.) 3*s*. net.

SOMEWHAT more academic than are other volumes in this series, this book covers a good deal of ground in small compass and presents an invaluable introduction to soil science—though possibly the section on cartography could have been fuller. The book is especially notable as making accessible the details of Dr. Linwood L. Lee's New Jersey method of recognizing textural groups by handling the soil, for its numerous and instructive illustrations, and for its useful outline of soil mineralogy. The book pays special attention to soil texture, describes world soil groups ("the soil-pattern of the world"), and has a practical chapter on finding the best crop for every soil under English conditions.

It can be cordially recommended to biologists and non-biologists as a clear exposition of a subject about which few books exist.

FUTURE OF BIOLOGY IN WORLD AFFAIRS*

By DR. FRANS VERDOORN

DURING the last months of the War of 1914–18, a period which—from many points of view—may be compared with the present, the plant scientists and zoologists of the world were less involved in the war effort than they are to-day. Nevertheless, as such addresses and papers as Lyman's "Contributions of American Botanists for More Active Prosecution of War Work" (1918) and Stevens's "American Botanists and the War" (1918) show, some of the foremost plant scientists of the United States were prevailing upon their colleagues to engage in activities which might help the war effort. At the same time much consideration was given to the War from a biological point of view, as such publications as Nicolai's "Biology of War" (1919) and Pearl's "Biology and War" (1918) testify. Just before the end of the War many interesting papers on the role of botany and biology in the post-war world were published. These included "Botany as a National Asset" (Coulter, 1917) and "Botany after the War" (Davis, 1918), and were followed by an unusual number of inspired discussions by men like Lyman, Peirce and Gager. Though during those years a number of biologists did accomplish useful things in such fields as pioneering in dehydration, raising the agricultural output and discovering substitutes of vegetable origin, the foremost trend of thought, especially in the Allied countries, was concerned with biology in the post-war world, in human relations as well as in agriculture, etc. The Germans of that time were, comparatively, much more concerned with problems directly relating to the war effort than were their colleagues in the Allied countries. Diels wrote an entire volume on botanical substitutes; Haber and other chemists revolutionized the fertilizer situation.

In the discussions in Allied countries the educational and humanizing value of biology was stressed much more than it is to-day. Many believed that a better knowledge of, and better training in, biology might well revolutionize the citizen's attitude towards essential problems of life and human relationships. This hope has not materialized—and that, without doubt, is a reason for the sceptical and negative attitude of many of us to-day.

In one field, however, enthusiasm, understanding and leadership on the part of the biologists of the Allied countries was scarcely progressive. It strikes the historian as strange that in those Wilsonian years very little was said, in either British or American discussions, about international work and relations in science, the re-establishment of international relations, etc. There was a much more patriotic (though not a soundly patriotic) tone in the discussions then than there is to-day, when it looks as though groups of men of science (not necessarily natural scientists) in Great Britain and the United States are at least as much interested in post-war international relations as are the large political groups. It was in 1919 that Livingston turned down Lotsy's generous offer to combine the planned *Botanical Abstracts* with the *Botanisches Centralblatt*, at that time—in spite of its name—a purely international journal and the official organ of the now defunct International Association of Botanists. This rejection killed that Association and much that it stood for, and postponed for years a resumption of international relations work in botany, so enthusiastically started before the War of 1914–18 by men like Scott, Goebel, Farlow, von Wettstein, Trelease and many others.

When war broke out in 1939, international relations work in science had not yet fully recovered, nor by any means reached the status of 1914—this in spite of the many congresses, meetings and commissions in our field about which I have reported in great detail, in an effort to stimulate interest in them, in special sections of *Chronica Botanica*, volumes 1–3. Reading those reports of the years before the present War and comparing them with those during 1912–14 creates the conviction that an unsound impetus was given during the years just before this World War by motives only slightly differing from national propaganda.

In this War the biologist has played a much larger part than in any previous war. Botanists, agronomists, zoologists, entomologists, psychologists and bacteriologists have contributed in larger numbers and in more intensive ways than ever before to the war effort. Men of science form one of the few groups in society which know that the concepts and ideas by which politicians and the accepted organizers of human relations are guided are mostly wrong, based on misconceptions, old superstitions and false intuitions. Yet the man of science has left not only the administration, but also most of the study, of the administration of human life and world affairs in the hands of people who are not very appreciative of what a century of progress in the science of life has achieved. Therefore, I cannot help feeling that men of science are more truly responsible for the chaos of to-day than any other part of society.

The resources, strength and endurance of the United States, the British Empire and the U.S.S.R. and their allies are bringing this War to an end, an end which will place the man of science once again in a very favourable position, as he will remain free in the post-war world, not in all but in much more than half of the Allied territory. How will he use this freedom of thought and action?

I want to begin a discussion of the peace tasks of the man of science with a most difficult problem, which logically does not come first at all. Yet it is so important and most of us are so consistently dodging it that I feel I must bring it up before anything else.

When we speak of the re-establishment of international relations, I believe that most of us think primarily of Great Britain and other Allied countries. Most of us do not think clearly about *the re-establishment of relations with the present enemy countries*, especially with Germany. Yet there can be no doubt that it is essential that workers in science, the humanities, and the arts understand that they are the members of society best fitted to pioneer in the re-establishment of relations with the enemy and that it is necessary for them to prepare to do so at short notice. Intellectual life, as Raymond Fosdick has said, is the most fundamental unity of modern civilization, and that life cannot be broken in parts without disaster. This is the most obvious reason, clear to anyone, for a demand for a quick and thorough re-establishment of international relations

* From an address entitled "The Plant Scientist in the World's Turmoils", contributed by Dr. Frans Verdoorn (of Arnold Arboretum and editor of *Chronica Botanica*) to a symposium on "Biologists and Rehabilitation" held by the Botanical Society of America and the American Association for the Advancement of Science at Cleveland, Ohio, on September 13.

in science and the humanities. But there is another reason with which not everyone may agree as quickly but which seems to me at least as important. Peace, progress and human well-being generally depend upon the integration of present enemy countries in some system of full international co-operation. Biologists know that our world needed millions of years to develop to its present status and that it will need some time to develop into a commonwealth of nations. Yet the trend of the development of mankind is in that direction, and the groups best fitted to do so have to go ahead and assume leadership. The necessity for this was expressed in more detail already early during this War by a manifesto of fifty-seven members of the Royal Society of London. It is the duty of the men of science to the world—and therefore also to their own countries—to re-establish relations with enemy colleagues *both* individually and through meetings, congresses and international commissions, *in all fields* (also where the activities of many Allied research workers are controlled by trusts) to the fullest possible degree and as soon as circumstances permit. We must do this whatever practical commands for dealing with Germany, German split States, etc., may be, in order that the German man of science will not 'go underground'. The world of science needs him, but the world at large needs him still more. The mistakes made after the War of 1914–18, when most international co-operation in science was started in France, more by politicians than by men of science, and restricted to Allied and neutral countries, must not be repeated, even though we know that some of our enemy colleagues will use purely scientific co-operation for other purposes.

To enter again into mutually useful relations with colleagues in enemy countries, it will be necessary to realize that some of them think as we do, but many of them do not. To deal with these men it is necessary to realize that the Totalitarian State, in which the younger ones especially believe and may continue to believe, is a form—evil, we may think—of world evolution. It has enabled men, men of science, social workers and others to do things in science, research, teaching, social applications, etc., which are not necessarily evil—as is often tacitly assumed only because they were made possible by a Fascist Government. Especially in the biological and agricultural sciences much that was excellent was done during the pre-war years in the Axis countries. Study, understanding and realization of these things is a necessary basis for a good programme of the re-establishment of relations, 're-education', etc. The politician, let us never forget, has to emphasize what divides; the man of science may well emphasize what unifies. Workers in pure and applied biology are in a specially favourable position to pioneer in this field. The problem of intellectual relations with Germany demands more than goodwill; it asks for effort and study.

Speaking of agriculture in the post-war world, Dr. Auchter, of the U.S. Department of Agriculture, in a recent address emphasized (1) improved nutrition for human beings, (2) methods of breeding and the use of substances that regulate growth, (3) world exploration to obtain and maintain material for breeding purposes, (4) the changed fertilizer situation, (5) utilization of waste and by-products, and (6) problems of insect and disease control. To them I should like to add research in a field about which we heard more at the end of the War of 1914–18 than to-day. In spite of the lack of emphasis on international relations at that time, there were in the minds of our colleagues, a generation ago, a number of ideas, or rather a feeling, for the necessity of closer relations between science and government (not necessarily human politics). We might call this borderland biopolitics. I miss a plea for it to-day. Is it because we have despaired of ever establishing such relations? Or is it a reaction against the close relations between biology and politics in the U.S.S.R. in which biology has occasionally been reduced to serfdom? If that is so, a word of warning must be expressed. To do so I just used the word *biopolitics*, which will recall a related field of research, *geopolitics*, developed by and first used in the Axis countries, but, once again, not evil on that account, as shown by the ways it is now being developed along purely scientific channels by American scholars. Biopolitics and geopolitics may well be the ways along which men of science will find it possible to reach those groups which they hitherto failed to influence.

It is not true that the two World Wars are simply conflicts between have and have-not nations; yet the conflicts between these two groups are more responsible for the twentieth century chaos than are any other conditions. The practical politician will deny this vehemently; the man of science knows better. H. G. Wells in 1940, in "The New World Order", considered it the second most important of the four major causes of war. The man of science, the only reliable authority on natural resources and the possibilities of their development, may well contribute a major share to the establishment of a durable peace. He also knows that a durable peace will have to be plastic—a consideration which the practical politician again considers absurd.

One of the resolutions of the United Nations Conference on Food and Agriculture states: "The natural sciences are a particularly fruitful field for international co-operation because they are themselves international; basic physical and biological laws are the same anywhere and universally accepted". This is true, but it is also true that co-operation demands an attitude which is not typical of the average biologist. Considering the matter psychologically, most of the better workers in botany and zoology turned to this pursuit because early frustrating experiences resulted not in the normal, human response of aggression, but in a desire for isolation. It is perhaps a bit hard to demand now that these men become enthusiastic co-operators. We will, however, have to assume that at least some of them have learned that even in a Nature research it is true that 'united we stand, divided we fall'.

Sometimes I speak of plant scientists, sometimes of biologists, sometimes of botanists. This inconsistency is not due to carelessness, but to a tragic fact, to the greatest professional problem we have: there are no longer biologists or even animal scientists and plant scientists.

There was a discussion some months ago in the columns of *Science* about whether there still exists to-day such a subject as biology. Some of the writers stated that it was a fraud to speak of biology any longer, as we always mean something else. There is, of course, such a subject as pure biology when considered from a purely scientific or philosophical point of view, but there are no longer professional biologists. There are only specialists in the various branches of the pure and applied plant and animal sciences. What makes it bad is that these specialists do not keep together or think and plan together

with reference to their professional interests as medical and chemical workers do. Though very large in number (22 per cent of the men of science included in "American Men of Science" (ed. 7) are "Biologists" *sensu antiq.*), our position both as a group and as individuals is extremely weak. As wage earners we are in many cases not able to give our families the comforts and education which we received in our youth or which the families of our friends in college receive; as men of science we have either to teach or to work in applied biology, with the result that many branches, especially of descriptive biology, have an anachronistic status; as a group we cannot exercise an influence commensurate with our knowledge.

Mutatis mutandis, this situation is the same all over the world. From this it appears that the situation is the result of internal factors, and that it cannot be changed easily, for example, by establishing professional biological societies, unions, etc., especially not so long as—another curse of biology—its great men of science continue to refuse to give professional guidance.

With every generation an increase in specialization seems to become necessary. This may be really essential, but the result is that many workers spend their enthusiasm and greatest mental output in their youth, and end with years of not-too-inspired routine research. Great as the literature and body of facts of any branch of biology may be, I do not agree that all this specialization is necessary. The organization of most of our institutions is such that it forces the so-called free worker into a steady and dull routine.

We all, but the administrators of research especially, should distinguish between deep and permanent specialization. But even if we feel that permanent and deep specialization is necessary, can we not educate our pupils with the feeling that they are in the first place biologists, whatever they do, and specialists in some branch of the pure or applied plant or animal sciences in the second place? No improvement of the status of biologists is possible if they do not recognize the very close interdependency between pure biology and applied biology on one hand, and between biology and world economy and government on the other hand. Also all biology, in contrast to physics, mathematics, etc., continues to have close ties with the humanities. We cannot fulfil our mission if these facts are disregarded; we cannot raise a satisfactory crop of young biologists if we and they are not governed by this knowledge.

Now let us consider the aims of international co-operation in science:

(1) The exchange of information (scientific, professional and practical) in such a way that it will be available to anyone who can profit by it.

(2) The attainment of objectives which individuals or men of science of a single institution or nation cannot accomplish. These may be either in pure or applied scientific research, or they may be co-operative scientific or practical publications.

(3) The forming of an *esprit de corps* which may, at least at some time and at some place, counteract the evils of human international politics and contribute towards the establishment of a commonwealth of nations.

How can we best accomplish these aims?

(1) By the oldest and most important form: the publication of original research, in which every man of science takes part, uninterrupted even by war, every time he has an article or a book published. I find an increasing assumption that scientific publications, not research or knowledge, are the most important thing to-day. We all know that the number of publications is increasing more rapidly than our real knowledge. In two fields with which I am familiar enough to express a judgment, bryology and history, about half the papers of the last forty years have brought only material that needs revision, checking or completion, and that does not really, or only very immaterially, add to our knowledge. Many workers in these fields die without ever having contributed anything to the real advancement of their chosen field. A single monograph, a single well-planned handbook, could have been prepared in the same time now wasted on many little papers. Unfortunately for many of us, the question no longer seems to be how to contribute best to the advancement of science (the fact that many of us can contribute better to our science as a whole by various forms of organizing work is also too often forgotten), but how to make the best impression.

(2) By abstracting journals, international as well as regional.

(3) By international congresses and meetings.

(4) By international societies or commissions, responsible for the organization of international co-operative research. In biology most research is individual, or at most institutional; whereas in other fields of science, for example, astronomy and geodetics, research has developed markedly along lines of direct co-operation, national and international.

Though it is clear that most research in biology will remain quite individual (this should be recognized as the cause of the comparative lack of interest of many foremost biologists in international relations work), there are many scientific and especially applied scientific problems which could more easily and better be solved by some form of international co-operation. In taxonomy, for example, the terrible status of exotic cryptogamic taxonomy cries for some kind of concentrated attack; in plant pathology, a study, on an international basis, of the methods of disease control is greatly desired; in horticulture, an international centralization and further experimentation on the results obtained by the use of hormones in propagation has been asked for by the Permanent Committee of the International Horticultural Congresses.

(5) By international societies or commissions responsible for the organization of practical international activities. In botanical and zoological nomenclature the need for such co-operation was felt at so early a time that much has already been accomplished in this field. There are, however, many other things which could and should be done in the same way: the unification of botanical terminology, colour codification, etc. Such work as has been initiated by Prof. Record's International Association of Wood Anatomists could usefully be done in many other fields. A special war-time problem—and an immense one—is the reconstruction of herbaria and botanic gardens destroyed during the War; this is an international, not a national, task.

(6) By publications not reporting the results of scientific research (either in original form or in abstracts), but bringing together various kinds of information and intelligence. In some cases these may be only stimulating; in other cases, of direct use for the research worker. Publications of this type have played a great part in biology; and I have always been especially interested in them. We may distinguish:

(*a*) Address-books, either the old-fashioned lists of research workers or the more modern combination of such lists with a census of current research.

(*b*) Indexes of various kinds; for example, the *Index Herbariorum*, started by Dr. Hitchcock and now actively continued by Dr. Lanjouw.

(*c*) Such journals as the early *Botanische Zeitung*, early *Botanical Gazette*, *Dörfleria*, the *Chronica Botanica* when it was published as an "International News-magazine". Such journals which bring together various kinds of information and intelligence, discussions, notes, news, etc., have in the past always been published by individuals who after some time could not continue to give them the necessary time and money. They should, of course, be the official professional organ of an international society.

(*d*) A very great need exists also for a new and complete guide to the literature of the plant sciences. This also will be possible only with international co-operation.

(*e*) Then there are many publications, semi-scientific, semi-practical, like the "Index Kewensis" and "Index Londinensis" and my planned "Index Botanicorum", which were formerly compiled on an institutional or national basis, but which, in the future, will probably ask for an international effort.

None of these things in itself is very important, but together they make a complex mass of activities both inspiring and helpful, and well worth the effort, even if we realize that to do this work well some of those who will do it will have to give up projects in pure research dear to their hearts.

Just as a commonwealth of nations, the goal of almost all thinking men, is not yet in sight, it is clear that the time for some of the activities just enumerated is not yet here. The tendency of human development, in any field whatever, is, however, toward greater unity. Before there can be anything like a world-embracing commonwealth of nations, regional commonwealths may be more immediately feasible. Pan-Europe as planned by Briand and Coudenhove Kalergi is one of them; a united Western Hemisphere as planned by Simon Bolivar and Henry Clay, and to some degree established by Sumner Welles, is another. One does not have to be very familiar with international politics and relations to realize that a united Western Hemisphere is one of the greatest conceivable guarantees of a durable peace. Unfortunately we have learned during the past years that differences in race, temperament and economic interests make a united Western Hemisphere—which, at no time, seemed too Utopian—not so easy to accomplish.

Here the biologist meets opportunities such as he has never, if ever, met before. Agriculture, biology and medicine are fields in which Inter-American co-operation has an opportunity to do things so great that no one can question their usefulness and need; moreover, they are things which have a very strong bearing upon Inter-American economic and political relations. Though many of us in the countries of the Western Hemisphere realize these simple facts and this dramatic opportunity thrown in our lap, not too many of us seem aroused, in spite of the support of the Government and our large foundations. Is it due to the intuitive reluctance of the man of science to get mixed up in Government projects? Among biologists all over the world there is a feeling that relations with government (I do not mean any specific political group) should be avoided whenever possible. This may be a sound attitude from the point of view of pure research; from all other points of view it is a mistake. It reveals poor ability to read the signs of the times. Who should know better than the biologist that with the development of organisms their ecology becomes more and more intricate?

The structure of human society has become so complicated that it can no longer function well without regulation. This is not a political creed; it is a fact which we can observe all over the world. The government—to use a simple colloquialism—is there to stay, and we biologists should make of this opportunity what we can. Let us hope the biologist may see his opportunity and duty, for never before has he been in such a position to influence with simple means and little, if any, sacrifice the course of development of the Western Hemisphere directly and the world at large indirectly.

Much has been written during the past years about the form, aims and scope of inter-American co-operation in the pure and applied, plant and animal sciences. I will restrict myself to a few remarks and desiderata:

(1) Co-operative studies of the flora and fauna of tropical America are necessary, and more workers must be found for this work, even if it means some discontinuance of research of the Old World tropics.

(2) Students must be exchanged on a much larger scale.

(3) The problem of a common language must be solved in some way. Very probably it will find its solution best if the Latin American men of science make an increased use of English in their scientific publications and correspondence abroad. Their North American neighbour, however, must be able to read Spanish, both to understand the publications of his Hispanic colleagues and to appreciate their culture, which differs considerably more from the North American than, for example, the British or Scandinavian.

(4) An inter-American professional biological journal, with articles and notes in the three languages, if possible backed by an inter-American biological society, seems desperately needed to establish a common meeting ground.

(5) An inter-American biological station of the Woods Hole type, somewhere in Latin America, could do much good, especially if organized by biologists and agronomists, on a truly inter-American basis. It is very sad that the Inter-American Institute of Agriculture has not been organized by representative men of science. With the same means and effort something better could have resulted. But the biologists of the Americas are also at a fault for having watched (or not having watched at all) the development of this Institute with such an utter detachment.

I have devoted much space in my *Chronica Bolanica* for the past few years to the promotion of inter-American relations and will shortly issue a volume entitled "Plants and Plant Science in Latin America". A single individual, however, cannot do very much. An inter-American biological society, an inter-American biological journal, and an inter-American biological station are needed; the latter will assure us of more satisfaction than merely a pleasant scientific holiday.

The biologists of the United Nations are, or will soon find themselves, in a truly unique position.

Some of them will have the opportunity of assuming leadership in the conduct of international relations work, with its profound implications.

A group of them can be instrumental in assisting in making the Western Hemisphere strong and influential, one of the least Utopian guarantees of a durable peace.

Further, they will all be in a position to assist with the creation not of a planned supreme State, which is the criterion of all values, but of a government of free responsible men, which will guide human relations and world affairs according to the laws of living Nature, as discovered and set forth by biologists.

CONSTITUTIONAL ISSUES IN SOUTH-EAST AFRICA

By PROF. DARYLL FORDE
International African Institute

THE recent announcement by the Secretary of State for the Colonies concerning the establishment of a standing Central African Council for the three territories of Southern Rhodesia, Northern Rhodesia and Nyasaland represents a further step in the attempt to secure an orderly solution of economic problems and political issues that have been intensified by the War. These three contiguous territories, each with an African population of about one and a half millions, share in varying degrees the problems that arise from the introduction of Western technology and white settlement in Africa. The issues are, however, by no means identical in each territory, and these differences, together with a conflict between the British Government and local white sentiment over long-term native policy, present serious obstacles to satisfactory constitutional development.

Southern Rhodesia, with a European population of about 69,000, has had virtual Dominion status since 1923, and its executive government is responsible through the legislature to an electorate practically confined to whites. Although its constitution reserves to the Secretary of State for the Dominions considerable control over native affairs, this is of limited practical effect. The segregation of the native population and their exclusion from some occupations, in order to protect Europeans from native competition, are, as in South Africa, avowed objects of both the Government and the European population.

A substantial majority of the white population of about 13,000 in the Protectorate of Northern Rhodesia, most of them directly or indirectly dependent on the mining industries, share the sentiments of the white Southern Rhodesians. Despite the absence of any legal sanctions and the positive legislation of the Protectorate, they too are able, in practice, to impose restrictions on the employment and status of the native population.

In the Protectorate of Nyasaland, on the other hand, with a small white population of less than 2,000 planters, the principle of trusteeship and "the paramountcy of native interests" which is accepted by the British Government and so widely endorsed in Great Britain meets with less effective local opposition.

The whole problem is still further complicated by the fact that a very large proportion of the African male population, amounting to more than 100,000 in each of the territories, is employed as migrant labour on European farms and mines away from its native settlements. This has not only produced serious dislocation in native agriculture and community life, which is bitterly resented by champions of the African cause, but also, since there is a large-scale migration of labour across frontiers, calls for co-ordinated action in all the territories concerned.

The Southern Rhodesia Government has, over a number of years, pressed for the unification of the three territories under a responsible government which could, among other things, deal with the labour problems of the area as a whole. The evidence given to the Bledisloe Commission of 1938 revealed strong native opposition to amalgamation on which the Commission itself could not agree; but the impact of the War and the contribution of the white peoples of Africa to the defence of the Empire have sharpened the issue. The regional grouping of colonies in the interests of technical development and administrative efficiency has gained increasing support, while General Smuts, in his speech at the end of last year, claimed for the Dominions a larger share of responsibility for the colonial territories in their respective spheres—in other words, the increasing influence of South Africa in the development of the southern African territories. The Prime Minister of Southern Rhodesia, Sir Godfrey Huggins, had earlier secured an undertaking that the question of amalgamation should not necessarily be postponed until after the War; while to meet the urgent needs of production and supply during the War, the Governors' Conference of these three south-east African territories has been supplemented by a joint secretariat.

The British Government now proposes to set up a standing Central African Council with a permanent secretariat, to deal with matters of common interest to the three territories. While only consultative, it is designed to provide machinery for the permanent co-operation of the administrative and technical services of the three Governments in such fields as industry, agriculture, labour, education and medical services. It is intended, in the words of the statement, that "leading unofficials in Southern Rhodesia and Nyasaland should be closely associated with the work of the Council", and it is recognized "that the Southern Rhodesia Government still adhere to their view that the three territories should be amalgamated". Amalgamation is, however, regarded as not being practicable "in existing circumstances", which, as Colonel Stanley explained in answer to questions in the House of Commons, refers not merely to the continuance of the War but also to "the difference in African policy between the territories".

At the same time it is proposed to take a further step forward in the constitutional development of the Northern Rhodesia Protectorate by increasing the unofficial membership of the Legislative Council from one to five, of whom three will represent the interests of the African community. The statement declares that "it is intended that African interests in the Legislative Council should be represented by Africans as soon as a suitable basis of representation can be built up", and the British Government is looking to the recently established Provincial African Councils as a political nursery for this development. This announcement concerning Northern Rhodesia, together with the express limitations on the powers of the Central African Council, makes it clear that the British Government still seeks to promote the growth of an educated and politically experienced African population which shall play its part in government.

APPLICATIONS OF D.D.T.

TYPHUS can upset the plans and frustrate the might of the most powerfully armed forces. During the War of 1914–18 it killed some 10,000 people in six months in Serbia; after the Russian Revolution it killed some three million Russians. It has been recorded that during the siege of Granada and in the Thirty Years' War and the campaigns of Napoleon, it killed more people than the military weapons then in use. A disease which frequently attacks starved and disorganized populations and flourishes in times of national disaster, it broke out in Spain in 1908 and again in 1941, and it is a constant problem in the South American States and elsewhere. It has to be watched constantly, and the pages of the *Tropical Diseases Bulletin*, the *Bulletin of War Medicine*, the *Boletin de la Oficina Sanitaria Panamericana* and other medical journals record the work that is being done on all its aspects.

Epidemic typhus is caused by *Rickettsia prowazeki* transmitted rapidly from man to man by head and body lice. It should be distinguished carefully from endemic typhus, which is transmitted from rats to man by the rat flea. The old epidemiological rule "no lice, no typhus", quoted by the *Lancet* (115, July 22, 1944) still applies to epidemic typhus, and the best method of control is to attack this link in the epidemiological chain. Until recently, the lice have been attacked by heat and fumigation, and the organization and conduct of delousing stations has been no easy task, especially when large populations have had to be deloused. These methods, moreover, do not keep a population free from re-infestation with lice, which quickly occurs. Until comparat vely recently, no insecticide was known which would keep a person free from lice for longer than two days or so. Early in this War, work was undertaken to find new insecticides. A general review of the discovery and properties of D.D.T. was contributed to *Nature* of September 16, p. 352, by Prof. J. W. Munro. The story, so far as it concerns typhus, is briefly told in the *Lancet* (115, July 22, 1944) and the *British Medical Journal* (217, August 22, 1944).

Early in the War, British scientific men produced an insecticide called AL 63, which protected persons from lice for five–six days when it was dusted on to their underwear. Organic thiocyanates sprayed on to underwear protected the wearer for a month and could also be used on a belt so devised that it attracted the lice and then killed them; but these thiocyanates caused smarting when those who used them began to sweat. When the United States entered the War, teams of workers were put on this problem, and a dust called MYL was produced (*Soap and Sanitary Chemicals*, 105, November 1942), which was recommended by the U.S. Bureau of Entomology and Plant Quarantine. Russian workers had, in the meantime, developed two synthetic compounds, a powder containing diphenylamine, which was successfully used on civilians in Moscow (Fedder, M. L., *Gigiena i Zdorov'e*, No. 10, 12; 1942; quoted by the *Lancet*, *loc. cit.*) and *bis*-ethyl-xanthogen, with which garments worn by Russian soldiers in Bessarabia were impregnated (Gorkina, A. N., *Med. Parasitol., Moscow*, **11**, 90; 1942; quoted by the *Lancet*, *loc. cit.*). Then came the discovery that the synthetic compound 2,2-*bis* (parachlorphenyl) 1,1,1,-trichlorethane), which has been called D.D.T., from the generic name dichlor-diphenyl-trichlorethane, has insecticidal properties of considerable promise. D.D.T. was first synthesized by the German chemist O. Ziedler in 1874 (*Deutch. Chem. Gesell.*, **7**, 1180; 1874). Its insecticidal properties were apparently first made known by Paul Müller in Switzerland, when he reported his work with it on moths, flies and plant lice. In 1940 the Swiss firm of Geigy and Co., of Basle, patented it. Preparations of it are available under the name "Gesarol", either as a spray containing 5 per cent of D.D.T. with a wetting agent, or a dust containing 3 per cent of D.D.T.; another dust, called "Neocid", containing 5 per cent D.D.T. was produced for treating human lice.

Methods of manufacture were quickly improved and the toxicity of D.D.T. to a large number of insect pests, as well as to human lice, has been tested. An account of this work has been given by P. N. Annand and his co-workers (*J. Econ. Entom.*, **125**, 37, February 1944), and the earlier work done with D.D.T. in Switzerland and Germany is there noted.

Annand concludes that D.D.T. is "one of the more promising synthetic organics" for the control of insects—a sober statement which should be borne in mind in these days when publicity is apt to exalt new discoveries far beyond the claims made for them by scientific workers. A reaction of some insects suggests, Annand says, that it acts as a nerve poison. It is distinctly toxic when it is dissolved in solvents such as oil, which can penetrate the skin, or when it is ingested; and more work is needed on its toxicity to man and animals. Appropriate precautions should therefore be taken by personnel who employ it as a dust likely to be inhaled or swallowed or in oily solvents. But in the concentrations in which it has been used for the control of human lice, it is apparently safe if reasonable precautions are taken: in these concentrations it does not appear to irritate the human skin.

D.D.T. is a crystalline solid, practically colourless and practically odourless, which results from the interaction of anhydrous chloral and chlorobenzene in the presence of concentrated sulphuric acid. It is insoluble in water, but soluble in most organic solvents. It is 'rather stable' and its volatility is low, so that loss of it from spray deposits is too slow to decrease its activity appreciably.

The tests of its action on human body and head lice and also on the human crab louse recorded by P. N. Annand (*loc. cit.*) indicate that it is highly effective and that its action lasts longer than that of any other louse treatment. It is better than MYL. It can be used as a powder diluted with kaolin or pyrophyllite, and such powders will protect grossly infested persons against lice for two to three weeks and will give effective control of lice for longer periods. It is equally effective against head or crab lice. The powder can be blown up the sleeves or down the necks of dressed persons, and this was done in controlling the outbreak of typhus earlier this year at Naples. The method is quick and has enabled the Naples authorities to treat a maximum number of 73,000 persons in a single day—a feat which could not be equalled by any other method. Another way of using it is to impregnate undergarments with it by dipping them in a solution containing D.D.T. in volatile solvents or in aqueous emulsions containing it. Both methods are good for either cotton or woollen garments. It is claimed that such garments will protect their wearers for three to five weeks without washing. Garments washed once a week protect for two to three weeks, or with stronger solutions for five to six weekly washes. Even stronger solutions will

protect for nine weekly washings. For the troops, a solution rendering garments protective for six to eight weekly washings has been recommended, and arrangements for large-scale treatment of such garments have been made.

Apart from its value for the control of typhus, D.D.T. may prove valuable for the control of a wide variety of insect pests. Annand and his co-workers (*loc. cit.*) report the results of their tests of its action on the bedbug, the house- and stable-fly, ticks and fleas of dogs, goat lice, "German" cockroaches (*Blattella germanica*), ants and termites, larvæ of the house-fly and numerous plant pests. For the control of the larvæ of malaria-carrying mosquitoes it is being tried as an emulsion sprayed over waters containing them, and the method of spraying it from the air is also being tried in an attempt to kill mosquitoes infected with malaria in areas in which troops have to operate. For the control of some species of cockroach it certainly seems to be effective. Recently an appeal reached the writer from a Manchester hospital for some means of exterminating a pest of 'steamflies' (*Blattella germanica*) on the hospital premises; Dr. H. Hurst sent a supply of a preparation containing D.D.T. and pyrethrum, with very good results. J. M. Ginsburg records (*J. Econ. Entom., loc. cit.*) the results of his experiments on the action of D.D.T. on this species of cockroach, which is a growing and serious pest in various parts of North and South America. Ginsburg found that the minimal concentration of D.D.T. required to kill 100 per cent of these cockroaches in jars in 48 hours was 7 per cent, while 33 per cent of sodium fluoride was required to kill 100 per cent of the cockroaches under the same conditions. In the same time a dust containing 33 per cent of derris killed only 30 per cent of them, while a dust containing 33 per cent of pyrethrum killed 90 per cent. If D.D.T. is as toxic as this to *Blatella germanica*, the work now being done on its action on locusts should be interesting.

Much of the work on D.D.T. is summarized by V. H. Chambers, G. L. Hey and N. K. Smitt, of the Murphy Chemical Company, Wheathampstead, in a reprint of an article in the *Market Grower* (62 Doughty Street, W.C.1—the date of the issue of this journal containing this article is not given). These authors refer to the work with D.D.T. done in Switzerland by R. Wiesmann (*Schweitz. Z. Obst.-u. Weinbau*, **51**, 155, 206, 245 and 329; 1942) on its effect on bees and fruit and vine pests and (*Anz. Schadlingskunde*, Berlin, **19**, 5; 1943) on flies in cowsheds. These authors also describe their own work with D.D.T. in the form of the Murphy Chemical Company's proprietary spray called 'DeDeTane' and with this Company's other preparations of D.D.T. Encouraging results were obtained against caterpillars of the tomato moth and against the grain weevil and the apple blossom weevil. 'DeDeTane' was, however, not so effective as nicotine against the apple sawfly, and it failed to control the plum leaf-curling aphis. Its possibilities as a means of controlling other insect pests are discussed, and the American work is summarized. D.D.T. may, according to this article, partly replace pyrethrum in the aerosol 'bombs' widely used by the United States Army for the disinfestation of tents, aeroplanes, buildings, etc. (But Mr. Lyttelton has announced in Parliament that the entire output of D.D.T. is being taken for military use and that, apart from a small quantity released for use in air-raid shelters, none can be released for civilian use (*The Lancet*, 485, Oct. 7, 1944).) In a reprint from *Fruit* (W. Seabrook and Sons, Chelmsford—the date of the issue of this journal containing this article is not given) it is claimed that in a field trial of 'DeDeTane' against the apple blossom weevil, a "very large reduction of infestation was secured". It is concluded, however, that much more work is required before the efficacy of D.D.T. against this weevil can be finally assessed.

It is clear that D.D.T. will have many uses other than the control of the lice which transmit typhus. Field tests should be made on its action on such insect pests of domesticated animals as the blowfly and the lice of mammals and birds. It might even prove useful against human scabies and the scab mites of animals. But we must not expect too much of it. Local factors in the environment will always affect the action of even the best insecticide. It is one thing, for example, to kill 100 per cent of houseflies or mosquito larvæ with D.D.T. or any other substance in the laboratory, and quite another to kill these quickly on a large scale in a tropical area where they are causing the deaths or illnesses of large numbers of human beings; or to do the same thing among populations whose normal habits, or disorganization during disaster, stultify the best of sanitary plans; or to apply such a remedy to large herds and flocks of domesticated animals or to extensive crops in the spacious areas of America or Australia. All remedies of this nature are subject to this kind of limitation. We are fortunate, indeed, in having, while the War lasts, opportunities for the control of both the experimental man or animal and of their environment which should enable us to investigate these aspects of the problem more thoroughly than we could investigate them in times of peace. In this respect, our partial and, we hope, temporary, loss of freedom is a help rather than a hindrance to progress.

G. LAPAGE.

OBITUARIES

Mr. H. P. Marks

HENRY PERCY MARKS, a member of the scientific staff of the Medical Research Council at the National Institute for Medical Research, died on September 13 after a short illness. After serving in the Navy in the War of 1914–18, Marks joined the Medical Research Council as an attached worker at Hampstead in 1922, and was appointed a member of the staff in 1927. His work at Hampstead was mainly concerned with insulin and carbohydrate metabolism although, in collaboration with others at the Institute, he also carried out interesting work on the mechanism of action of calciferol. More recently, Marks had become interested in the influence of the pituitary gland on carbohydrate metabolism and had published a number of papers on this aspect of the subject. For the two years immediately preceding his death he had been assisting in research work of national importance in connexion with the War, and had undertaken the arduous duties involved with the enthusiasm of a man many years younger. His untimely death will be mourned by his many colleagues and friends at Hampstead and elsewhere.

Marks's most important work was concerned with the standardization of insulin and more recently with the standardization of potamine zinc insulin. He visited both Copenhagen and Toronto in this con-

nexion, and was in part responsible for the biological assays which finally fixed the activity of the international standard preparations. As the result of his work on the standardization of insulin, Marks became interested in statistical analysis in relation to biological assay, and made some important contributions to this aspect of the subject. He was also a microchemist of some standing and had visited Graz in 1925 to attend the special course in this subject which was held there.

Personally Marks was rather shy and was not so well known among his scientific colleagues as might otherwise have been the case. But those who came into contact with him at Hampstead and elsewhere were always attracted by his charm of manner, and it is no exaggeration to say that he never failed to be on good terms with all his many colleagues. The early death of 'H. P.' will leave a gap which will be difficult to fill.

WE regret to announce the following deaths :

Dr. Alexis Carrel, known for his medical researches chiefly at the Rockefeller Institute of Medical Research, New York, aged seventy-one.

Prof. J. H. Priestley, professor of botany in the University of Leeds, on October 31, aged sixty-one.

Dr. D. S. Raitt, naturalist at the Marine Laboratory (Aberdeen) of the Scottish Home Department, on October 4.

NEWS and VIEWS

Royal Society : Medal Awards

THE following awards of Royal Society Medals for 1944 are announced :

Copley Medal to Sir Geoffrey Taylor, Yarrow research professor of the Royal Society, in recognition of his many contributions to aerodynamics, hydrodynamics, and the structure of metals, which have had a profound influence on the advance of physical science and its applications.

Rumford Medal to Dr. H. R. Ricardo, in recognition of his important contributions to research on the internal combustion engine, which have greatly influenced the development of the various types.

Davy Medal to Sir Robert Robertson, lately Government Chemist, in recognition of his researches on explosives, analytical methods, the internal structure of the diamond, and infra-red absorption spectra.

Darwin Medal to Prof. J. Stanley Gardiner, lately professor of zoology and comparative zoology in the University of Cambridge, in recognition of his work on coral reefs and on the organisms associated with such habitats.

Hughes Medal to Prof. G. I. Finch, professor of applied physical chemistry at the Imperial College of Science and Technology, in recognition of his fundamental contributions to the study of the structure and properties of surfaces, and for his important work on the electrical ignition of gases.

Nobel Prize for Physiology and Medicine for 1943 : Profs. H. Dam and E. A. Doisy

IT is announced that the Nobel Prize in Medicine for 1943 has been awarded jointly to Prof. Henrik Dam and Prof. E. A. Doisy for work on vitamin K. Looking back, we may recall that it is now fifteen years since the first Nobel Prize given for research on vitamins was shared by Sir Frederick Gowland Hopkins and Prof. C. Eijkman, as a tribute to their pioneer observations in this field of science. Prof. Eijkman had been concerned specifically with one vitamin factor, namely, vitamin B_1 ; and since then other Nobel Prizes have been awarded at various times for researches on vitamins A, C and certain components of the B complex. It is fitting that the latest prize should mark the completion of an important chapter in nutritional knowledge, namely, that concerned with vitamin K, for it is one of the vitamins, still relatively few, which have so far been proved to have important clinical uses.

It was in 1929 that Dam, working at Copenhagen, recorded haemorrhages which occurred in chicks raised on synthetic diets poor in certain fat-soluble vitamins. In 1934 Dam and Schønheyder concluded that this disorder was due to deficiency of some new vitamin which they not inappropriately called vitamin K ("Koagulations Vitamin"). Soon afterwards they published their fundamental finding regarding the mode of action of vitamin K, namely, that it is concerned in maintaining the normal value of the prothrombin in the blood. In the course of the next year or so, several groups of workers, including Dam, demonstrated the clinical usefulness of vitamin K. It finds its application in two main directions, namely, in preventing the haemorrhagic disease of new-born babies, and in controlling haemorrhages after the surgical treatment of obstructive jaundice, a condition which had often proved fatal in the past. The routine method commonly used for assessing the effectiveness of vitamin K therapy, or detecting the presence of a deficiency, is based on Dam's work, namely, a determination of the level of prothrombin in the blood. Dam, who published his earlier investigations from Copenhagen, has been living in the United States of America since 1940.

The two most important forms of vitamin K occurring naturally are those known as vitamins K_1 and K_2. Like all vitamin-K active substances, they are both naphthoquinone derivatives, and both have been synthesized in recent years. Numerous active synthetic analogues are also known, and now largely replace natural K_1 or K_2 in treatment. The isolation of pure vitamin K_1 was reported in 1939 by Dam in collaboration with Prof. Karrer and their several co-workers ; and almost simultaneously Doisy and his colleagues of the University of St. Louis isolated K_2. In the very same year three laboratories independently achieved the synthesis of vitamin K_1, namely those of Doisy, of Almquist and of Fieser. The demonstration of the vitamin activity of the relatively simple compound, 2-methyl-1,4-naphthoquinone, which can be regarded as the prototype of the K vitamins, was due to Ansbacher and Fernholz. In the following year Doisy with his collaborators crowned their chemical studies of the K group by elucidating the structure of vitamin K_2.

Chair of Natural Philosophy at St. Andrews: Prof. H. Stanley Allen, F.R.S.

PROF. H. STANLEY ALLEN has retired from the chair of natural philosophy in the University of St. Andrews. His life in St. Andrews has been one of quiet painstaking work characterized by thoroughness in everything he undertook. His highest quality was a constant striving for the clearest, the best, way in which he could present a point. A simple example is his treatment of entropy. He has stated that in his opinion it is necessary that the beginner in a scientific subject should be given at the outset some familiar mental picture. He then points out that momentum is a vector quantity depending on the first power of the velocity, and remarks that therefore it is not likely to be a suitable analogy for entropy. It has to be remembered that Kelvin's definition of entropy makes it vary directly with the heat and inversely with the temperature. He then points out that on the basis of the kinetic theory of gases, not only the square of the velocity is involved, but also the time taken by one molecule to pass over the space in the near neighbourhood of any other. He finally shows that Callendar's identification of the energy with the form $\frac{1}{2}QV^2$ gives agreement. Prof. Allen has spent twenty years of his life in St. Andrews, and the sympathy of everyone who knows him will go out to him in his recent great loss through the death of his wife. All will entertain the hope that the greater freedom from routine labour consequent on his retirement may enable him to devote more time directly to the service of the science in which he takes his delight.

Prof. J. T. Randall

DR. J. T. RANDALL has been appointed to the chair of natural philosophy in the United College, St. Andrews, in succession to Prof. H. Stanley Allen. Dr. Randall was educated at the Victoria University of Manchester under Prof. W. L. Bragg, and before joining the staff of the Research Laboratories of the General Electric Company, Ltd., Wembley, carried out research work on the scattering powers of atoms for X-rays. In 1937 he was elected a Royal Society Warren research fellow, and joined Prof. M. L. E. Oliphant in the University of Birmingham, where an intensive study of the mechanism of luminescence in solids was carried out. Publication of much of this work has been delayed for security reasons. At the outbreak of war Dr. Randall turned his attention to problems associated with radiolocation, and succeeded with Dr. H. A. H. Boot in introducing a new type of apparatus which has resulted in the saving of many lives at sea. For this work Dr. Randall and Dr. Boot were recently awarded the Thomas Gray Memorial Prize of the Royal Society of Arts. Since 1943 Dr. Randall has been a temporary lecturer in the Cavendish Laboratory, Cambridge.

Prof. William Wilson, F.R.S.

PROF. WILLIAM WILSON, who has recently retired from the Hildred Carlile chair of physics at Bedford College, University of London, spent his student days at the Universities of London and Leipzig, and he found much to admire in the freedom of the German university system of those days and in the men who sustained it. In his early years as a physicist, he carried out much pioneer experimental work on photo-electric emission and developed a quantum theory of thermionic emission, which was published in 1912. By 1915 he had discovered the quantum relation $\int p.dq = n.h$, and by introducing two quantum numbers, he found an expression for the eccentricities of the elliptic orbits of electrons; thus he opened up a large field of progress in the study of atomic structure. In 1921 he introduced the concept of generalized momentum into the theory of the electromagnetic field, and has since become much interested in Kaluza's five-dimensional theory of relativity. He was elected a fellow of the Royal Society in 1923.

It is only possible to mention a few of Prof. Wilson's many contributions to physics; he is more familiar than many scientific men with the work of physicists and mathematicians of the past, and his own work has in consequence a rare maturity and understanding. He thinks in an original way about all the fundamental principles of physics. Besides his writings in scientific journals, he completed in 1940 the third volume of a work on "Theoretical Physics", which is the culmination of his lectures to advanced students. It is a unifying account of many aspects of the subject and has great elegance of style. Prof. Wilson has always delighted to share his knowledge and wisdom with others and this makes him a great teacher. Besides his official pupils, many of his colleagues and fellow workers have sought and obtained help and instruction from him. He has served the University of London in many capacities, including that of senator, member of the External Council and chairman of the Board of Studies in Physics.

Structure of the Kiogar Mountains

DR. E. B. BAILEY, director of the Geological Survey of Great Britain, gave a Friday discourse on November 3 at the Royal Institution on "Mountains that have Travelled Over Volcanoes". Many mountain chains present a complexity of internal structure which recalls, with great magnification, that of pack ice piled sheet upon sheet by a tempest of yesterday. In 1893 it was realized by geologists studying the Alps that a far-travelled thrust-sheet may often be distinguished by the foreign characteristics of its constituent geological formations, just as clearly as a far-travelled man by the foreign characteristics of his face and dress. The Kiogar mountains on the borders of Tibet and India illustrate this phenomenon to perfection. The rock formations making the summits have very special characters spoken of collectively as Tibetan. The underlying formations making the lower slopes are shown by their fossils to be of the same geological age as the Tibetan formations overhead; but they have much more familiar characters spoken of collectively as Himalayan. Between the Tibetan and the Himalayan developments lies a thick separating complex layer of igneous rocks. Some of these igneous rocks are submarine lavas, following in normal succession upon the underlying Himalayan sediments. Some, however, exhibit intrusive relations and penetrate the overlying Tibetan sediments. The conclusion is reached that in the days before the upheaval of the local sea bottom to give the Himalayan mountains, an invading thrust-sheet penetrated the area from the north. On its way it passed over a group of submarine volcanoes, which, driven underground, maintained a guerilla attack by injection of molten material from below. Wear and tear due to withdrawal of over-run, overloaded mobile sediments added to the general confusion.

Problems of the Gas Industry

ON October 24 Mr. A. E. Sylvester addressed the Fuel Luncheon Club on some immediate problems of the gas industry in Great Britain. The speaker, as managing director of the Gas Light and Coke Co., London, spoke on administrative rather than technical problems. He appealed for freedom of choice for the consumer of fuels, while recognizing the need for some sort of control to see that prices are reasonably related to cost of supply taking into account all the circumstances. The gas industry includes far too many small units, which, though possibly manufacturing gas satisfactorily, are unable to maintain the technical staffs adequate to give the service to consumers which present-day conditions require. The aggregation of the industry into larger groups would provide openings for more specialist technicians, while a national pension scheme would favour a freedom of movement which would be beneficial both to themselves and to an industry national in scope. Mr. Sylvester pleaded for sales tariffs which deal justly as between one type of consumer and another. It is sound policy to relate changes to cost as closely as circumstances permit, otherwise one article has to subsidize another. When gas is supplied to a factory, the charge must cover not only manufacture but also capital costs up to the works, and little more. For domestic fuel the charge must go further, covering the heavy costs of services to the consumer. The resultant charges must differ, otherwise justice is not done as between consumers. It was emphasized that gas is a refined fuel and is used because of the service it gives ; this emphasis implying the necessity for a high standard of service throughout the country.

A Study of Reason

PROF. H. J. PATON, in his lecture to the British Academy entitled "Can Reason be Practical ?" (London : Oxford University Press, 1944. 4*s*. net), defends against recent attacks the view that moral principles are rules of reason. Some have maintained that moral judgments are merely the expression of private emotions or merely the result of pressure of the social environment, and that the attempt to justify them is 'rationalization' in the bad sense. Against these critics he argues that if they would only apply their theories to their own judgments they would see their absurdity. Those who oppose instinct or intuition to reason are making a false antithesis. The infant sucks by instinct, but ought to realize later that it was the most reasonable thing to do in the circumstances. Prof. Paton develops the positive side of his argument from the starting point that human conduct should at least be intelligent, that is to say, consistent and orderly, so that means are adapted to ends and conflicting impulses subordinated. The principles of practical reason are the result of taking this notion of order and consistency as far as it will go and generalizing as completely as possible. The rest of Prof. Paton's exposition is on Kantian lines, but with some useful clarification and, perhaps, some modification in the direction of what Kant ought to have said.

Collaboration with French Men of Science

THE executive committee of the Association of Scientific Workers has sent a message of greeting to French men of science who have taken part in the Resistance Movement in France. "It looks forward to close collaboration between the scientific workers of both our countries for the progress of our common aims : the development of science and its use to advance the living and cultural standards of all peoples". The Association des Travailleurs Scientifiques, formed from the Resistance Movement a few days after the liberation of France, has acknowledged this greeting conveyed through Prof. Joliot-Curie. "In its refusal to accept the defeat of France as final and to submit to the subsequent German domination, the Resistance movement has, since 1940, been animated by that same spirit which inspired the entire British nation when it decided to continue the struggle. This community of ideas concerning the conduct of the war must continue in the maintenance of peace. The great contribution made by science to the national defence can be continued in the economic and social spheres of the peace-time world organization of to-morrow."

Announcements

SIR HAROLD HARTLEY will deliver the Lavoisier Bicentenary Lecture of the Royal Society on November 16, at 4.30 p.m.

THE Club for Research on Ageing (c/o Department of Zoology and Comparative Anatomy, University, Oxford) has received from Lord Nuffield a donation of £3,000, which will enable Dr. V. Korenchevsky to continue his gerontological investigations for a period of three years. Clinical trials of the effects of vitamins on aged persons at the Tooting Bec Hospital will be finished at the end of the year. These were rendered possible during the last two years by substantial grants from Lord Nuffield and the Nuffield Foundation. The Club expresses its heartfelt thanks for these benefactions and is also very much indebted to the London County Council for most valuable co-operation.

THE Trustees of the Miners' Welfare National Scholarship Scheme invite applications for a limited number of university scholarships and exhibitions. Candidates must be either workers in or about coal mines in Great Britain, or sons or daughters of such workers, and normally should not be less than seventeen years of age on January 25. Forms of application and full particulars may be obtained from the Secretary, Miners' Welfare National Scholarship Scheme, Ashley Court, Ashtead, Surrey. Applicants for forms must state whether they apply as workers in or about mines or as children of such workers ; those who come within both categories should apply as workers. Completed applications must be received by January 25.

THE Council of the Institution of Civil Engineers has set up a special War Service Committee to deal with the cases of prospective candidates for election whose engineering training has been interrupted by the War, with a view to these candidates being advised in regard to the periods of practical training and/or engineering experience and the examination qualifications they will be required to obtain before the Council will consider them qualified for election to corporate membership of the Institution. Intending candidates for election who are serving in H.M. Forces, or who have been directed into work of national service, and who were less than thirty-one years of age on November 1, should apply to the secretary for particulars.

The vacancies advertised in these columns are available only to applicants to whom the Employment of Women (Control of Engagement) Orders, 1942-3, do not apply.

THE UNIVERSITY OF LIVERPOOL

DEPARTMENT OF ZOOLOGY.

Applications are invited for the post of LECTURER in EXPERIMENTAL ZOOLOGY. The lecturer will be required to develop experimental research and assist in the teaching of General Zoology.

Salary £400 to £450 per annum, according to qualifications and experience.

The appointment will be for one year in the first instance, the successful candidate to begin duties upon appointment, or, if engaged on work of national importance, from date to be arranged.

Applications, together with three testimonials, should be forwarded to the undersigned not later than Jan. 5, 1945.

STANLEY DUMBELL,
Registrar.

UNIVERSITY COLLEGE SOUTHAMPTON

Applications are invited for the post of LECTURER IN MATHEMATICS (man or woman), for the year beginning Jan. 1, 1945. Salary £400. The person appointed will be required to lecture in Pure and Applied Mathematics to the standard of the London Degrees.

Applications, with three testimonials (one copy), should be sent by Dec. 1 to the Registrar, University College, Southampton, from whom further information may be obtained.

THE UNIVERSITY OF MANCHESTER

MANCHESTER MUSEUM

Applications are invited for the post of ASSISTANT KEEPER to be responsible for the Zoological Collections in the Manchester Museum. Duties to commence Dec. 25, 1944, or as soon as possible thereafter. Salary £350 to £400 per annum, according to qualifications.—Applications should be sent, not later than Dec. 1, to the Registrar, The University, Manchester 13, from whom further particulars may be obtained.

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of DEMONSTRATOR IN HUMAN PHYSIOLOGY. Duties to commence Dec. 25, 1944, or as soon thereafter as may be possible. Salary £350 per annum. Candidates should possess a registrable medical qualification.—Applications, not later than Dec. 1, 1944, to the Registrar, The University, Manchester 13, from whom further particulars may be obtained.

BEDFORD COLLEGE FOR WOMEN

(University of London)

REGENT'S PARK, LONDON, N.W.1

The Council of Bedford College invites applications for the post of Senior Laboratory Assistant in the Department of Zoology. Salary £3 15s.—£5 15s. p.w. Initial salary according to qualifications.—Applications, as soon as possible, to the Secretary.

THE BRITISH INTERNAL COMBUSTION ENGINE RESEARCH ASSOCIATION

The Association proposes to appoint a Director of Research, for its laboratory at Slough, at a salary of £1,500 to £2,000 per annum, according to experience.

An essential requirement is an intimate knowledge of internal combustion engine practice, combined with sound scientific training and experience of research work. Applicants should state their attainments in science and engineering, and furnish evidence of their ability to build up and direct a research station and staff.

Applications should reach the Secretary, BICERA, 111-112 Buckingham Avenue, Slough, Bucks, not later than Dec. 31, 1944.

The British Coal Utilization Research Association invite applications for the post of DIRECTOR. The qualifications which will be regarded as necessary are: (a) scientific training and research experience which will enable the Director to initiate and to direct fundamental research into the constitution of coal and its use both as a fuel and as a source of chemical derivatives; and (b) such technical and administrative experience as is required for directing work on the practical development of the results of research and for the general management of a large scientific and technical organization. The remuneration will depend on the qualifications and experience of the applicant who may be selected, but a commencing salary of the order of £2,500 per annum is envisaged, with provision for pension. Applicants should give particulars of education, training, scientific, and technical qualifications and past experience, and should state when they would be in a position to take up an appointment.—Applications should be addressed to: The President, British Coal Utilization Research Association, 13 Grosvenor Gardens, London, S.W.1, not later than Jan. 31, 1945.

A number of Chemists with good academic qualifications, aged 30 to 40, required for a large chemical firm of high repute in London. They will be in charge of departments concerned with plant and development work in chemotherapy and biochemistry. Experience in this field desirable but not essential. Salary £750 or more, according to experience and qualifications. Good post-war prospects. The posts are permanent and carry superannuation.—Box 259, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Applications are invited for the post of Head of Research and Development Department for well-known Chemical Engineering Company. Previous similar experience an advantage. Only those with highest technical qualifications and experience in administration considered. Applications, which will be treated in confidence, should state details of training, positions held, and present age.—Box 257, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Laboratory Assistant (Male) required to start work in January. New Science Block in Boys' Public School. Duration appointment. Salary up to £5 per week, according to qualifications.—Headmaster, St. Albans School, Abbey Gateway, St. Albans.

Required: Assistant in Technical Information Section. Candidates should have a sound knowledge of Chemistry and Physics, and should preferably be conversant with technical French and German. Good typing qualifications essential.—Apply, stating age, qualifications, experience, and salary required, to the Mond Nickel Co. Ltd., Grosvenor House, Park Lane, London, W.1, marking envelope "A.T. Confidential."

Chemists with initiative required for development and technical control of processes in Meat Processing Factories in Kenya and S. Rhodesia. Salary according to qualifications and experience.—Write, "F. C.," c/o Streets, 6 Gracechurch Street, E.C.3.

If you are qualified in a science or well informed about a major industry or technology you may be interested in a scheme of advisory collaboration and journalism which would take up a little of your spare time and earn a reasonable regular fee.—Box 260, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Wanted: Laboratory Assistant, under military age or exempt. Salary according to age and qualification. Resident or non-resident.—Apply, Headmaster, Ellesmere College, Salop.

Designs, development work, workshop details, and illustrations undertaken. Speciality: optical, photographic, and scientific instruments; light machinery.—"D.O. Service," Julian, Wood End Close, Farnham Common, Bucks.

Infra-red and Violet High-speed flashlight photography by means of dual-purpose flexible filter bag, as used in the blackout by the Press since 1939. Snapshots possible up to 1/50th sec. at F/4.5 or 1/100th sec. at F/8.5 at 5 yards in the blackout. British, American, and Canadian patents. Price, with detailed instructions, 25s. to order.—Arthur Barrett, F.R.P.S., F.R.G.S., Balks House, Walker's Lane, Leeds 12.

Zeiss microscope apochromatic objectives for Sale, 2 mm. oil immersion, N.A.1.40; 8 mm., N.A. 0.95; with correction collar. 16 mm., N.A. 0.30. Watson "Holos" oil immersion condenser.—Box 258, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Secondhand Bausch & Lomb Microscope; 2 eyepieces, 1.9, 4, 16 mm. objectives, triple nosepiece, condenser; £32 or offer.—Lt. Warwick, R.A.F. Station, Medmenham, Marlow.

Microcopying. — Typescripts, Rare Books, Scarce References Copied. 2d. per page (minimum 3s. 6d.). Send by registered post to: Adrian Cotes, 68 Carlton Hill, N.W.8.

Microscopes, of all descriptions, only a few available, second-hand, perfect condition. Send details of your requirements, enclosing 3d. stamp.—Telephone or correspondence only: Chards, Forest Hill, S.E.23 (Spring Park 1628).

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LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Crystal Structure of Coronene

THE structure of the coronene molecule, $C_{24}H_{12}$, is of particular interest in view of its peculiarly high symmetry (Fig. 1). With regard to electron distribution and bond-lengths, the structure should be somewhat intermediate between benzene and graphite. The optical and magnetic anisotropies of the molecule should also be of interest, and as a first stage in the accurate study of all these properties it is necessary to make a precise determination of the crystal structure.

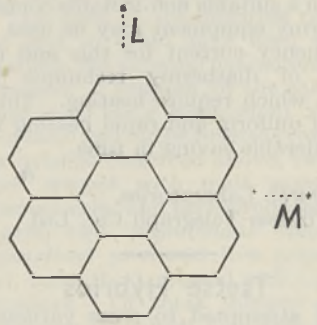

FIG. 1.

Some difficulty was experienced in growing good single crystals of the substance, but suitable specimens were finally obtained from a solution in tetrahydronaphthalene. The lath- or needle-shaped monoclinic crystals were greatly elongated along the *b*-axis, and in the best specimens the (001), (100), $(10\bar{1})$ and $(20\bar{1})$ faces were developed, the (001) usually being the most prominent. X-ray examination gave the unit cell dimensions as $a = 16{\cdot}10$ A., $b = 4{\cdot}695$ A., $c = 10{\cdot}15$ A., $\beta = 110{\cdot}8°$. The $(h0l)$ reflexions are absent when h is odd, and the $(0k0)$ when k is odd. The space group is therefore C_{2h}^5 $(P2_1/a)$. There are two centrosymmetrical molecules of $C_{24}H_{12}$ in the unit cell. (Density, measured 1·377, calc. 1·387.)

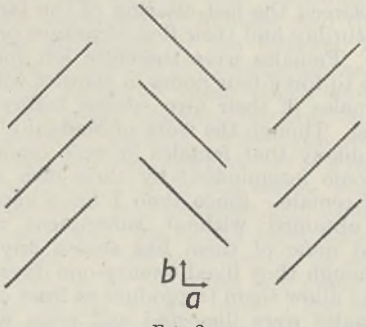

FIG. 2.

The crystal habit and especially the very short *b* axis are similar to those of the phthalocyanines[1], and this suggested that these large flat molecules might be similarly arranged in the crystal. Detailed analysis has now shown this to be the case. The plane of the coronene molecule is inclined at approximately 45° to the *b* crystal axis, an end view of the arrangement being roughly as shown in Fig. 2. The perpendicular distance between the molecular planes is between 3·3 and 3·4 A., just a little less than the interplanar spacing in graphite (3·41 A.).

The orientation of the coronene molecules in the crystal can be stated more precisely with reference to the molecular axes *L* and *M* (Fig. 1) and their normal, *N*. If χ_L, ψ_L, ω_L; χ_M, ψ_M, ω_M; and χ_N, ψ_N, ω_N, are the angles which these molecular axes make with the *a* and *b* crystal axes and their perpendicular, then we find

$\chi_L = 85{\cdot}0°$	$\chi_M = 45{\cdot}3°$	$\chi_N = 134{\cdot}9°$
$\psi_L = 85{\cdot}1°$	$\psi_M = 45{\cdot}5°$	$\psi_N = 44{\cdot}9°$
$\omega_L = 7{\cdot}0°$	$\omega_M = 97{\cdot}0°$	$\omega_N = 89{\cdot}9°$

The figures are probably accurate to within 1–2°.

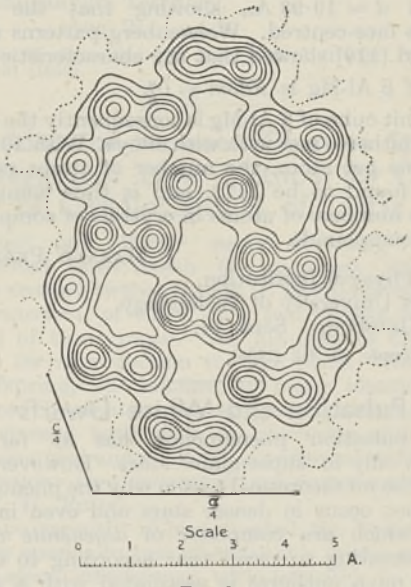

FIG. 3.

The structure is such that it is possible to compute an accurate two-dimensional projection of the electron density distribution on the (010) plane (that is, along the direction of the *b* crystal axis) by the method of double Fourier series. The result of this calculation is shown in Fig. 3, where each line represents a density increment of approximately one electron per A.^{2} (the one-electron line is dotted). It will be noted that every carbon atom in the molecule is very clearly resolved, and with further refinement of the measurements and calculations it should be possible to make very accurate determinations of the interatomic distances. When allowance is made for the 45° inclination of the molecular plane to the plane of the projection (010), it is found that the hexagons are regular, and already there are indications that the average C—C distance is slightly greater than the accepted value for benzene (1·39 A.). This distance is probably nearer to the graphite value of 1·42 A., but more accurate measurements and the inclusion of higher order terms are necessary before this can be definitely established. The Fourier series used for the calculation of Fig. 3 contained about eighty terms.

We are indebted to Mr. E. J. Bowen and to Messrs. Imperial Chemical Industries, Ltd., for specimens of the hydrocarbon coronene.

J. MONTEATH ROBERTSON.
J. G. WHITE.
Department of Chemistry,
University of Glasgow. Sept. 29.

[1] Robertson, J. M., *J. Chem. Soc.*, 615 (1935).

Crystal Structure of β-Aluminium-Magnesium Alloy

A PIECE of β-aluminium-magnesium alloy of irregular shape, when examined by the Laue method, showed all the characteristics of the Laue symmetry $m3m = 0_h$, which proves conclusively that β Al-Mg is cubic and not hexagonal as assumed by K. Riederer[1]. By means of rotation photograms the length of the edge of the unit cube was determined to be $a = 28{\cdot}13$ A. and the period of identity along a face diagonal $d = 19{\cdot}93$ A., showing that the space-lattice is face-centred. Weissenberg patterns around [100] and [110] showed that the characteristic space-group of β Al-Mg is $Fd3m = O_h^7$.

The unit cube of β Al-Mg is consequently the largest unit cell hitherto met with with alloys. With 19·04 A.^{3} as volume per atom, the number of atoms per unit cube is found to be 1172, and is thus comparable with the numbers of atoms in crystals of complicated organic compounds.

HARALD PERLITZ.
Physical Institution,
Chalmers University of Technology,
Göteborg. Sept. 14.

[1] *Z. Metallkunde*, 28, 312 (1936).

Pulsation and White Dwarfs

THE pulsation phenomenon has so far been observed only in 'super-giant' stars. However, there seems to be no theoretical reason why the phenomenon should not occur in denser stars and even in white dwarfs which are composed of *degenerate* matter. It is interesting to recall that according to current views a nova outburst is associated with a sudden collapse of the star, which after the disturbance settles down as a white dwarf. It is very likely that after such a cataclysmic disturbance the star would be left pulsating. Even if the physical conditions be not favourable for the maintenance of pulsation, yet the pulsation once started should last for a period comparable to 10^3 years. For a white dwarf the period of pulsation corresponding to the fundamental mode is easily estimated. Assuming the 'homogeneous model', the period P is given by

$$P = \left\{\frac{9h^3}{16\pi m^{3/2} H^{5/2} G^2}\right\}^{\frac{1}{2}} \frac{1}{\mu^{5/2} M} \sim 10 \frac{\odot}{M} \text{ sec.},$$

where M is the mass of the white dwarf, h is Planck's constant, m the electron mass, H the proton mass, G the gravitational constant, μ the mean molecular weight and $\odot$ the solar mass. In deriving the expression for the period, the effect of relativistic mechanics has been ignored. For the Stoner–Chandrasekhar critical mass the period tends to zero. The pulsation-period for a white dwarf is too small to be directly observable, and therefore the existence of pulsation in white dwarfs has to be looked for through its secondary effects.

P. L. BHATNAGAR.
University of Delhi.

Thermogenic Properties of High-Frequency Currents

IN view of the interest now being taken in high-frequency heating, as a logical development of medical diathermy, successful experiments have been made in the rapid production of crustless bread, cakes and light pastries. This technique is particularly suitable for the last two named purposes. The power used was 650 watts, and the frequency 50×10^6 c.p.s. Owing to the War, further developments have not been possible.

It may be mentioned that successful experiments were made also in heating through rapidly, and in promoting the plastic flow of, kaolin ('Antiphlogistine') poultices. Our experiments indicated that this preparation is of a polar nature. It has a loss factor of about 0·118. The dielectric constant is also of high value, but this has yet to be determined.

If placed in a suitable non-metallic container, short-wave diathermy equipment may be used as a source of high-frequency current for this and many other applications of diathermy technique to medical preparations which require heating. This offers the advantage of uniform and rapid heating throughout, with a considerable saving in time.

A. W. LAY.
Research Laboratories,
Marconi's Wireless Telegraph Co., Ltd.

Tsetse Hybrids

IN 1936 I attempted to cross various species of tsetse (*Glossina*) with the idea that, should they hybridize readily, and should the resultant hybrids prove sterile, this might be tried as a measure of control. Corson had already, in 1932, obtained three offspring from crosses between male *G. swynnertoni* and female *G. morsitans*; he suggested, however, that these might not be true hybrids, but the result of parthenogenesis (see further details in the accompanying communication by Mr. F. L. Vanderplank). I obtained a number of offspring from this and other crosses, but as a slight doubt arose as to whether they were authentic hybrids, the results were never published.

The doubts arose because the females used had not come from pupæ kept isolated in single tubes, but from collections of pupæ from which the emergent imagines were cleared three times a day except during the week-end, when forty-four hours elapsed between the last clearing of the jars at midday on Saturday and their first clearance on Monday at 8 a.m. Females were therefore left for varying periods up to forty-four hours in contact with freshly emerged males of their own species before isolation for crossing. Though the work of Mellanby[1] rendered it very unlikely that females in such circumstances could become inseminated by their own species, a doubt did remain. Since then I have kept females similarly obtained without subsequent access to males, and none of them has shown any signs of fertility though they lived twenty-one days or more, sufficient to allow them to produce at least one larva; eighty females were dissected and none was found to have been inseminated. Mr. Vanderplank and I have both found that the external characters of *swynnertoni* are completely dominant in the offspring of these crosses, and the production of a *swynnertoni*-like fly by a *morsitans* female is conclusive evidence that a true hybrid has been obtained; recent exam-

ination of the genitalia of the male 'hybrids' has shown them to differ from those of both parents. Since also recent experiments by my colleague, Mr. F. L. Vanderplank (see accompanying communication), using females obtained from pupæ kept singly in tubes, have resulted in the production of similar offspring, an account of my earlier results is perhaps desirable.

Of twenty-eight female *G. swynnertoni*, paired with male *G. morsitans* and surviving twenty-one days or more, three (10·7 per cent) produced seven pupæ (2, 4 and 1 respectively) of which one was accidentally destroyed, one failed to emerge, and five produced imagines—2 ♂♂ and 2 ♀♀ and one the sex of which was not determined before it escaped. All these resembled the female parent in appearance and so might not have been true hybrids. But of forty female *G. morsitans* paired with male *G. swynnertoni*, three (7·5 per cent) produced five pupæ (2, 1 and 2 respectively), all of which produced imagines (2 ♂♂ and 3 ♀♀). This time all the offspring resembled the male parent and so must have been hybrids; as already remarked, the external characters of *swynnertoni* are dominant. I propose for the sake of brevity to call the results of the ♂ *swynnertoni* × ♀ *morsitans* cross '*swynnertans*' and of the reverse cross '*morsitoni*'.

Using the hybrids described above, two '*morsitoni*' females were crossed with male *swynnertoni* and *morsitans* respectively, and each produced pupæ, four apiece. Again, two '*swynnertans*' females crossed with ♂ *swynnertoni* produced five pupæ (3 and 2 respectively), but a third, crossed with a ♂ '*morsitoni*', failed to produce. Of these thirteen pupæ seven produced imagines, of which five were females, one was a male and one escaped before its sex could be determined. Of the five females two were crossed with pure-bred ♂ *swynnertoni* and *morsitans* respectively, two with '*morsitoni*' ♂♂, and the fifth with the one second generation male hybrid. None produced any offspring.

A series of controls (*morsitans* × *morsitans* and *swynnertoni* × *swynnertoni*) was kept simultaneously and under similar conditions (in single tubes, the pair generally remaining together until the male died). These continued to a fourth generation, which was still producing pupæ when the observations ceased.

My observations, the results of which are summarized above, and a fuller account of which is in preparation, seemed to show that the inter-specific couplings were undertaken with greater reluctance than the intra-specific ones, so that this, combined with the very scanty production of hybrids, and the fertility of the first generation of the hybrids, led to an abandonment of this line of investigation as a possible means for the control of tsetse, which seemed to me to depend on ready cross-mating and on free production of sterile hybrids. The more recent work of Mr. Vanderplank has, however, led to a reconsideration of the project, for he has shown that the two species mate freely, and are also likely to do so under natural conditions; his results have also suggested that I was lucky in the reproduction by my hybrids, for he has not, so far, obtained any pupæ from such hybrids as he has worked with. He has further pointed out that the poor production of first generation hybrids is itself a very possible means of control since it means that, where the introduced species can be released in numbers greatly exceeding those of the indigenous species, a large number of the indigenous females will be rendered sterile.

Briefly, the proposed measure of control involves the introduction of large numbers of pupæ of the alien species into country in which the infestation by the indigenous species is naturally low or artificially reduced. The hope is that the indigenous species will be sterilized and exterminated; and that thereafter, when introductions of the alien species are discontinued, it also will eventually die out, because the environment is not of a type suited to its permanent survival.

Other experiments were carried out with the above two species and *G. pallidipes*, *G. palpalis* and *G. austeni*, in various combinations, but though in each case evidence of the insemination of females by the alien males was obtained, no pupæ were produced; the numbers used, however, were too small to allow the possibility of success in these further crosses to be completely denied.

W. H. POTTS.

Tsetse Research Department,
Old Shinyanga,
Tanganyika Territory,
Aug. 21.

[1] Mellanby, H., *Proc. Roy. Ent. Soc.*, A, 12, 1 (1937); *Parasitology*, 29, 131 (1937).

Hybridization between Glossina Species and Suggested New Method for Control of Certain Species of Tsetse

Corson[1] and Potts[2] record crossing *Glossina swynnertoni* Aust. with *G. morsitans* Westwood. Corson crossed twelve female *G. morsitans* with male *G. swynnertoni*, of which only two females produced a total of three pupæ. All his females lived long enough for reproduction to take place. He records the offspring, all females, as being identical with pure-bred *G. morsitans*, and suggested parthenogenesis. Potts crossed both male *G. morsitans* with female *G. swynnertoni* and male *G. swynnertoni* with female *G. morsitans* (see accompanying communication by Mr. W. H. Potts).

I have recently re-investigated the hybridization of these species to test whether this might not result in sufficient interference with breeding to allow it to be used as a control measure.

All the females used in the experiments were obtained from pupæ kept singly in tubes or were isolated immediately on emergence from collections of pupæ; the females were kept individually in tubes and carefully fed; at death each female was dissected. The results are summarized in the accompanying table.

The *swynnertoni* females emerged from pupæ collected in the Shinyanga area where *G. pallidipes* were also present, but not *G. morsitans*, and the *morsitans* females were from pupæ collected in a pure *morsitans* belt at Kondoa Irangi.

The table shows: (1) that insemination of the females in inter-specific crosses took place as readily as in the intra-specific when no choice was offered, and (2) that inter-specific crosses were far less successful in producing pupæ in spite of the fact that the average life of these females was not appreciably different from that of the intra-specific controls.

G. pallidipes males and females were very reluctant to mate with either *G. morsitans* or *G. swynnertoni* and only could be mated in special circumstances. No successful mating took place between female *G. pallidipes* and the other species; one male *G.*

Nature of cross ♂	Percentage of ♀♀ inseminated	Percentage of inseminated ♀♀ living over 21 days which produced pupæ	No. of pupæ produced per inseminated ♀ living over 21 days	Average life of ♀♀ in days
G. morsitans♂♂ Expt. X *G. swynnertoni*♀♀	92% (37)	10% (31)	0·1 (3)	70 (40)
G. swynnertoni♂♂ Control X *G. swynnertoni*♀♀	80% (12)	100% (7)	2·4 (17)	61 (12)
G. swynnertoni♂♂ Expt. X *G. morsitans*♀♀	96% (45)	24% (33)	0·4 (13)	68 (47)
G. morsitans♂♂ Control *G. morsitans*♀♀	76% (19)	100% (10)	4·0 (40)	75 (19)

N.B.—The numbers in brackets give the totals on which the percentages or averages are based; these are not the same throughout the table, as some females, counted as inseminated on the evidence of dissection, did not live long enough to produce pupæ, and also some of the females which were used to give the average life were not dissected to show insemination.

pallidipes mated with but failed to inseminate a female *G. morsitans*, and four male *G. pallidipes* mated with and inseminated four female *G. swynnertoni*, none of which had offspring.

The numbers of tsetse in these experiments were limited by the amount of work involved in their maintenance; to feed these adequately took six African assistants full time daily, including Sundays. The longevities of the various batches are not significantly different from each other by Student's *t* test, nor are the percentages of each group, inseminated or not, significantly different by the χ_c test, but the number of inter-specifically mated females that produced and numbers of pupæ produced by them are significantly smaller than their controls (χ_c test).

Other experiments, in which equal numbers of male and female *G. swynnertoni*, *G. morsitans* and *G. pallidipes* were mixed in a cage 30 × 30 × 30 cm., showed that mating between *G. swynnertoni* and *G. morsitans* not only occurred as readily as between the opposite sexes of the same species when no choice was offered, but also took place at random, but *G. pallidipes* did not mate with either, nor did any of the male *G. swynnertoni* or *G. morsitans* mate with *G. pallidipes*. A field experiment releasing 600 *G. morsitans* from pupæ in a *G. swynnertoni* area by Dr. C. H. N. Jackson, of this Department, showed similar results to those obtained in the laboratory. The recaptured females were kept alive, and the male genitalia of the offspring were examined.

The male hybrids have distinct genitalia and show affinities to the female parent. All the hybrids were similar to *G. swynnertoni* in external markings, contrary to Corson's observations. Both types of male and female hybrids have been crossed with each other and with pure-bred male and female *G. swynnertoni* and *G. morsitans*. The male hybrids inseminate the females, both hybrid and pure-bred, but none has reproduced or showed signs of successful fertilization. So far attempts to cross female hybrids with pure-bred males of both species have failed. Though the hybrid females were laboratory-produced flies, they lived even longer than their female parents, averaging 106·0 days.

Experiments have also shown that a few hours after a female is inseminated she is no longer attractive to males and will not permit further coitus.

Work is being continued with other species and pupæ of the same species collected in other areas.

A field-scale experiment to exterminate *G. swynnertoni* by releasing large numbers of *G. morsitans* has been begun in an isolated block of scanty *G. swynnertoni* country. It appears likely that *G. morsitans* would be unable to survive permanently in the area.

It is hoped to publish full details of this work shortly elsewhere. I am indebted to Mr. W. H. Potts and Dr. C. H. N. Jackson for their help and co-operation in this work, and to Mr. S. Napier Bax, the acting director, for permission to publish this.

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Fertilization of *A. maculipennis* var. *labranchiae* in the Laboratory

A. maculipennis var. *labranchiæ* is reported to swarm readily in a small cage (1 m. high and 50 cm. wide) if a blue light of intensity about 3 f.c. at a distance of 30 cm. is placed on top of the cage[1]. No record is known of laboratory mating of this variety without these experimental conditions.

A. maculipennis var. *labranchiæ* was reared in the laboratory from eggs, and the adults allowed to emerge in a cage of wire mesh, dimensions 47 cm. × 47 cm. × 60 cm. The cage was situated approximately 5 metres from the window of the laboratory, and the end nearest the window covered with a damp cloth. Under these conditions *labranchiæ* fed readily at any hour of the day on an arm introduced into the cage. After a period of ten days, viable eggs were laid in bowls of tap-water in the cage, although no artificial light of any kind was provided. Swarming was not observed.

The experiments are continuing.

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Relation of 'Folic Acid' to the Nutritional Requirements of the Mosquito Larva

IN our investigations on the nutritional requirements of the larva of *Aedes ægypti*, our procedure has been based on the methods employed by Trager[1]. Various modifications have been introduced which make for increased accuracy of observation and clearer interpretation of the results. Thus larger groups of larvæ were used, each larva being placed in a separate tube and its stage of development noted every morning and evening. All liquid media were sterilized by Seitz filtration and the contents of the tubes tested for sterility at the conclusion of each experiment.

In media capable of supporting growth, we have constantly noted that the length of time taken to reach the second, third and fourth larval instars, as well as the pupa, depends directly on the degree of adequacy of the medium. On this also depends the proportion of larvæ surviving. By suitable choice of media it is possible to interrupt larval development

at any stage, the larvæ dying in that stage, often only after many weeks have elapsed. In the wide variety of media we have used, the time taken for the change from pupa to adult has proved to be independent of the diet. In sixty experiments involving more than a thousand pupæ, this period ranged from two to three days (mean $2{\cdot}4 \pm 0{\cdot}46$ days). Ninety-seven per cent of these pupæ emerged as adults, indicating that as a rule emergence also is unaffected by the medium.

As originally reported by Trager[1], a medium comprising autoclaved yeast and liver extract is adequate for normal growth of mosquito larvæ. We have found it possible to bring to maturity 65–95 per cent of larvæ in groups grown in a sterile medium of autoclaved brewer's yeast suspended in 0·01 *M* solution of calcium chloride. A number of simple treatments have an adverse effect on the growth-promoting properties of autoclaved yeast. Thus prolonged autoclaving, and the storage of autoclaved yeast for a long period, both lead to reduced survival of the larvæ and an extended time for the change from one stage of development to the next. With dried brewer's yeast variable results were obtained; they appeared to depend on the conditions of drying and the period of storage of the dried material. On autolysing fresh brewer's yeast it was found that neither the autolysate, nor the residue, nor a combination of both was capable of promoting the same rate of growth and survival as the whole yeast had done. The autolysate and residue could not be made equivalent to the original yeast by the addition of any one of, or of all, the following substances: thiamin, riboflavin, pyridoxin, calcium pantothenate, nicotinic and *p*-aminobenzoic acids, biotin, *i*-inositol, choline and glutathione. The desired effect could, however, be brought about by the inclusion of liver extract (Armour) in the medium.

An insoluble yeast residue was prepared by exhaustive extraction of fresh brewer's yeast with boiling water. The autoclaved residue was used in conjunction with a large number of media containing some or all of the compounds listed above. The media also contained glucose, salt mixture and yeast nucleic acid. They were adjusted to *p*H 5·8. In the absence of added thiamin, riboflavin, pyridoxin, pantothenate or nicotinic acid, little or no growth occurred. On the other hand, the addition of the following substances had no apparent effect on the growth of the larvæ: biotin, inositol, *p*-aminobenzoic acid, choline and glutathione. Microbiological assay, using *Lactobacillus casei*, revealed the presence of bound biotin in the yeast residue, and the inclusion of avidin in the medium so clearly inhibited growth as to leave little doubt that biotin is an essential growth-factor for mosquito larvæ. Choline and glutathione could not be detected in the yeast residue; it seems that these compounds are not essential nutritional factors for mosquito larvæ, as claimed by Trager[2].

In all these experiments, one especially significant fact emerged: although the media employed were capable of supporting good growth to the fourth instar, *pupation did not occur*. The active, fully grown larvæ died in the fourth instar, usually after surviving for periods up to six weeks. In many instances, too, they were incapable of completely disengaging their third instar pelts, and died with the pelts still attached. Although the chitinous portions of the head and siphon were normally pigmented, the bodies of the larvæ were entirely free from pigment. The regularity with which failure to pupate was observed under these conditions is indicated by the fact that in thirty-five experiments using insoluble yeast residue and involving a total of more than seven hundred larvæ, of which two thirds reached the fourth instar, only 1·3 per cent were transformed into pupæ. It was obvious, therefore, that at least one water-soluble, heat-labile factor was still missing from our media.

Investigations on the effect of adding various other compounds, such as vitamins, amino-acids, purine and pyrimidine bases to the above media, have brought to light only three preparations capable of bringing about pupation. They are: a concentrate of vitamin B_{12}, the chick anti-anæmia factor, prepared from liver according to the directions of O'Dell and Hogan[3]; a concentrate of the ammonium salt of folic acid of potency 5,000, kindly supplied by Prof. R. J. Williams; the 'Norite eluate factor' of Peterson[4], kindly supplied by Lederle Laboratories.

These concentrates have been found to exercise a four-fold effect: (1) they induce pupation with striking regularity; (2) they improve the rate of growth to that observed with our best media (for example, fresh brewer's yeast and liver extract); (3) they effect an increase in the size of the larvæ; (4) they produce pigmentation of the bodies of the larvæ.

These findings serve to emphasize the close relationship known to exist between these factors and to indicate their possible identity. From the work of Elvehjem and his collaborators[5] it would seem that such concentrates as these may contain vitamins B_{10} and B_{11} in addition to folic acid. Thus while it is probable that the active factor in our preparations is folic acid, it cannot be regarded as certain.

It is known that xanthopterin may be present in concentrates of folic acid, and Mitchell[6] has provided some evidence of a structural similarity between the molecules of xanthopterin and of folic acid. The possibility that xanthopterin is active in bringing about pupation of *Aedes* larvæ was investigated, using the pure substance synthesized by a modification of the method of Purrmann[7]. It failed to bring about pupation, or any of the other changes characteristic of folic acid.

It is interesting to consider the possible mechanism by which these nutritional factors induce pupation. A number of workers have shown that moulting and pupation are caused by one or more hormones. In some insects the corpora allata have been proved to be the source of the hormone, while in others the source is uncertain. Our examination of 'Weismann's ring', which is thought by some to represent the corpora allata in mosquito larvæ, was inconclusive when carried out on normal fourth-stage larvæ from the insectary and on larvæ from a medium in which pupation will not occur. We have, however, noted a striking difference in the large œnocytes. In the larvæ from the insectary they are large, measuring up to 44 μ, and the cytoplasm is filled with numbers of vacuoles. In fourth-stage larvæ grown in a folic acid-free medium they are small, the largest measuring only 16 μ, and vacuoles are minute or entirely absent.

It is unlikely that 'folic acid' is itself a pupation hormone. This is indicated by the fact that transference of fourth-stage larvæ from a folic acid-free medium to one containing folic acid concentrate or brewer's yeast does not cause metamorphosis, whether the larvæ are transferred immediately after reaching the fourth instar, or eleven days later. On the other

hand, similar transference of newly moulted second- or third-stage larvæ results in normal growth, pigmentation and pupation. It seems probable, therefore, that folic acid functions by stimulating the production of a pupation hormone within the growing larva; but that it is incapable of doing so in a fully grown larva.

One final observation must be recorded here. In the insectary it is most unusual to find a weak adult mosquito, that is, one which on emerging cannot rise from the water. In our experiments, however, even on the most complete media, a large proportion of the adults were weak, irrespective of sex. Under the same conditions, when grown on contaminated media, all the adults were vigorous. There is thus some further factor, the nature of which we have not yet investigated, which is responsible for the development of vigorous adult mosquitoes.

We wish to thank the commanding officer, Technical Staff, Medical Laboratory Service, South African Medical Corps, who enabled one of us (M.L.) to participate in this investigation.

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Effects of Secretions

SOME secretions of some organisms found to be inimical to some metabolic step necessary to the normal processes of some other organisms have come to be referred to as 'antibiotics'[1,2]. As has been pointed out by Lucas[3], it seems likely that it will be found profitable to regard such secretions as special cases of that great class of substances, distinguished by being physiologically active, the study of which constitutes a large branch of comparative physiology, and to consider their effects in terms of the evolution, by natural selection, of the organisms concerned. Their adverse effects on some organisms are presumably an example of these organisms not being adapted in a particular respect, comparable, in principle, with many other examples in ecology.

If this much be granted, then it would seem to become important that the nomenclature used in considering them shall be such as shall fit easily into the language of biological discussion. I suggest that 'antibiotic' is not such a word, and, further, that it contains implications contrary to what we believe to be the truth.

The word as it stands will, I think, suggest to nearly everyone 'opposed in general to the act of living'—in fact, a poison. But if my life is saved by penicillin, is the fact sufficiently reflected by calling penicillin an antibiotic in this sense? I think consideration of this difficulty, thus presented, may show that two mistakes have been made:

(1) It is not true, though it is implied, that penicillin (for example) is opposed to life in general. Few things are: one man's poison is notoriously another man's meat.

(2) It is true, though it is not stated, that because of the peculiar fact that penicillin (for example) is produced by certain organisms and adversely affects certain other organisms, it possesses the function, in Nature, not of forbidding life, but of precluding certain associations of living things, while permitting, or even encouraging, others. It acts upon a relationship.

Whether, on balance, life is increased or decreased as a result of the effects of one of these substances is likely to be almost impossible to determine. Whether more or fewer molecules are organized for life at any time than would have been without the action of the substance is a question which can scarcely be readily answered. Yet, this is just the question that the word 'antibiotic' appears to presume to answer.

Now, in medical practice, and in other branches of applied biology, the precluding of certain associations may seem to be the important thing. This one effect among many, therefore, is chosen as wanting a name. But this precluding of certain associations is not described in the word 'antibiotic'.

What we need is two words, one of which shall mean 'promoting certain associations of (perhaps named) living things', or, better 'promoting certain symbioses', and the opposite of that.

If, singling out for our own purposes one of its actions, we call a substance promoting certain such relationships a 'prosymbiotic', as I think we might, then perhaps we could call its opposite an 'antisymbiotic'. Thus penicillin could be called an antisymbiotic between *Penicillium notatum* and certain organisms which could be named as a group or individually as the context required. Penicillin could also be called a prosymbiotic between *Penicillium notatum* and certain other organisms as and when these came to be distinguished.

I make this suggestion tentatively, to direct attention to what I believe to be a serious conceptual confusion. I hope that others may improve upon it.

I think that these words can be applied in wider fields than that of bacteriology. They refer to the function of such substances, and to their origin in Nature. Of course, we may be able, for example, to take an antisymbiotic away from the organism producing it, or synthesize it, and use it in our attack on some organism adversely affected. But this artificiality does not affect the validity of the term.

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Protective Action of Potassium Iodide on Thiourea Poisoning in Rats

KENNEDY[1], in reporting the goitrogenic action of the thioureas in rats, mentioned that doses of 200 mgm. of thiourea had no toxic action. This accords with the experience of Astwood[2]. On the other hand, MacKenzie and MacKenzie[3] found thiourea to be highly toxic to adult rats. During 1943 thiourea was administered to large numbers of rats in our laboratory with only infrequent deaths. Such deaths as did take place occurred on the first day of thiourea

administration, and autopsy disclosed a condition of pulmonary œdema and pleural effusion, as described by MacKenzie and MacKenzie. From the beginning of 1944 we have, however, experienced a heavy mortality in rats receiving thiourea. Up to 66 per cent of rats have died and the remainder have recovered only after a period of severe respiratory distress. The severity of the symptoms does not seem to be proportional to the dose of thiourea administered, and in susceptible groups of rats the provision of drinking water containing 0·025 per cent of thiourea has resulted in the death of 50 per cent of the animals. Plainly the response of our rats to thiourea administration has undergone an abrupt change. The same change in response was observed in two separate strains of rats, while no variation of composition of diet or environment had been consciously introduced. We are unable to account for this change but our investigations have confirmed the reported immunity[3] of young rats, and also of adult rats which have survived the first dose of thiourea.

Recently, it has been found that treatment with potassium iodide (1·3 mgm. by subcutaneous injection for four days) prevents the acute toxicity of subsequently administered thiourea. The iodide gave the same protection in thyroidectomized animals as in intact animals, so that this protection, like the toxicity, is unrelated to thyroid activity. Potassium bromide and potassium chloride in equivalent dosage did not exert a protective action.

The acute toxicity of thiourea resulting in pulmonary œdema has not been recorded in human beings. A number of minor toxic manifestations related to capillary permeability, namely, œdema of legs and of eyelids, watering of the eyes, and skin rashes have been recorded[4] in patients receiving thiourea for treatment of thyrotoxicosis. It is at present being tested whether simultaneous administration of iodide to such patients will lessen the incidence of such manifestations.

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Graphical Representation of Growth Gradients

Growth gradients in animals have been represented by a method described by Huxley[1], based on growth constants, that is, the values of α in the allometry formula[2], $y = bx^{\alpha}$. Huxley[1] has discussed the inadequacy of his graphical method and the formal difficulties of devising a better, but no attempt seems to have been made to overcome these difficulties. It is thought that the simple mathematical considerations below constitute a solution to the formal obstacles in the way of the quantitatively accurate representation of certain types of growth gradient. The gradients referred to here are gradients in heterauxesis[3] in which the growth intensities are in the direction of the axis along which the gradient lies. Multiplicative growth in length only is discussed, but similar concepts apply to multiplicative growth in area, volume and weight.

If there is a growing axis, and in it a morphologically differentiated point of reference, O, and other similarly differentiated points A, B, C, . . ., Y, . . . , the lengths of the regions OA, OB, OC, . . . , OY, . . . , can be considered in two ways, namely, (1) throughout growth, as functions of the length of some standard region of the body, and (2) at any particular moment during growth, as special values of the length OR, where R is a point of variable position in the axis, that is, OR is an independent variable. Regarding the above regions in sense (1), the significant expression of the growth-rate of a morphologically differentiated region OY, of length y, relative to the standard dimension, x, may be given by the relative specific growth-rate, or growth potential, of OY, $P_{OY} = \frac{dy}{dx} \cdot \frac{x}{y}$. As defined, P_{OY} may or may not remain constant during growth, so that it is not necessarily equivalent to a growth constant. Growth potential is adopted for the present purpose because it is a more general conception than growth constant, and because the mathematical inconsistencies in the additive properties of growth ratios are avoided. Regarding the regions in sense (2), when the standard dimension equals x, the growth potential p_R, *at the point* R in the direction of the axis, may be defined as the limit of P_{RS} as RS tends to zero, where S is another point of variable position in the axis. The direction of the growth potential at a point must obviously be specified.

Let $OR = z$, which, it should be emphasized, is an independent variable. Now, if growth potential is an adequate indication of growth intensity, and if the idea of growth gradients is fully justified, at any stage of growth p_R should be a function of x and z, that is,

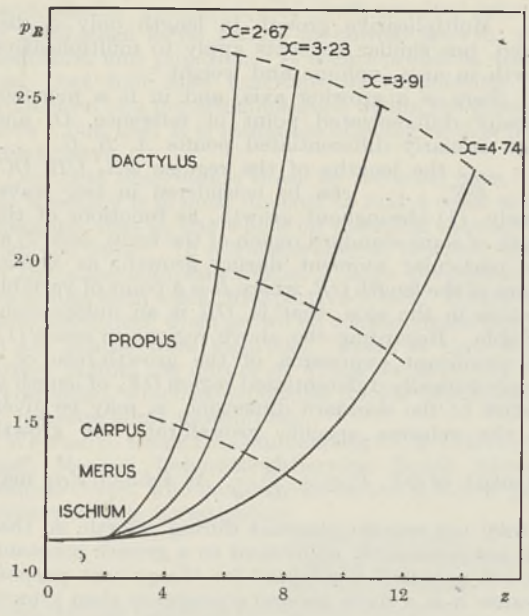
$$p_R = f(x,z). \qquad (1)$$

Furthermore, for any particular value of x, p_R should be a *continuous* function of z. Equation (1) can be represented by a number of curves in one plane, and such a curve diagram will be a quantitatively accurate picture of the growth gradient. The curve for any particular value, say k, of x, may be derived as follows. It can be shown mathematically that P_{OR} is equal to the arithmetic mean of the growth potentials in the direction of the axis at all points in OR. Combining this fact with equation (1) we have

$$[P_{OR}]_{x=k} = \frac{1}{z}\int_0^z [p_R]_{x=k}\, dz. \qquad (2)$$

Hence, if particular values of P_{OR}, namely, P_{OA}, P_{OB}, . . . , are known, and if the morphologically differentiated points A, B, . . . , are sufficiently numerous and suitably spaced, a graphical representation of equation (1) may be obtained graphically by means of equation (2) or a transformation of equation (2).

For the above method of analysis it is necessary to know the lengths of several successive morphological regions, adjoining end to end, for a number of different body sizes. There are very few data of this kind in the literature, but the accompanying figure is the outcome of an analysis of the data given by Tazelaar[4] for the segment lengths of the chela of the male prawn *Palæmon carcinus*, for carapace



GRADIENT OF LENGTH-GROWTH IN THE CHELA OF THE MALE *Palæmon carcinus*.
The growth potentials, p_R, at points have been plotted against the distance, z, in cm. distal to the basal end of the ischium for different carapace lengths, x, also in cm.

length 2·67–4·74 cm. The data were not designed for this purpose, however, and the figure should be regarded as an example of the method rather than a very accurate representation of the growth gradient. It was found convenient to employ a transformation of equation (2), namely,

$$p_R = [P_{OR}]_{x=k} + z\frac{d}{dz}[P_{OR}]_{x=k}. \qquad (3)$$

The curves of the figure correspond to values of x in geometrical progression, which seems logical since growth is a multiplicative process.

It has been pointed out to me by Mr. E. D. van Rest, to whom I am much indebted for criticisms and suggestions, that there is more to the problem than this short account might suggest. For example, growth potential at a point as defined is determined partly by the length of the standard region, which may itself be subject to variations in growth potential from point to point. It is hoped to discuss this and other questions elsewhere.

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Kemp in New Zealand Romney Sheep and its Significance for Mountain Breeds

SELECTION against kemp in the Romney is a simple matter, scarcely amounting to a breeder's problem, but facts learnt from Romneys may be offered to breeders of mountain sheep that characteristically have hairy birthcoats. In Romney sheep, selection against high abundance of halo-hairs is a sufficient safeguard against kemp, and selection against halo-hairs is effective. On the backs of lambs with abundant halo-hairs (large birthcoat kemps of generation I, G_1), there may or may not be secondary kemp. Birthcoat kemps are shed around the third month after birth. Halo-hairs are nearly always all shed. Occasionally an odd halo-hair is of indeterminate growth. Super-sickle-fibres, whether in non-plateau or plateau arrays, sickle-fibres which are the key type in non-plateau arrays, and hairy-tip-curly-tip fibres which are the key type in plateau, vary in their shedding from all to none. The shed birthcoat fibres are succeeded by other fibres which when they are shed are later, or secondary, kemps. In non-plateau, later kemp is grown mostly in the follicles of the halo-hairs, occasionally, as we conclude, in some super-sickle-fibre follicles, scarcely ever in those of sickle-fibres. In plateau, super-sickle-fibres and hairy-tip-curly-tip fibres, as well as the very abundant halo-hairs, are readily followed by kemps, so that there is often a huge amount of secondary kemp in N-type lambs.

In non-plateau fibre type arrays the successors (G_2 fibres) of halo-hairs are shed freely, that is, are kemps, only when a substantial majority of the sickle-fibres with bigger sickle-ends are shed. When the shedding of sickle-fibres is less than very free, there is a certain correspondence in extent of shedding of sickle-fibres and of G_2 fibres. Kemp is plentiful among the successors (G_3), grown at seven months and later, of the shed successors (G_2) of halo-hairs, only when the array is one indicative of a weak pre-natal check, namely, saddle or a near approach to saddle. When the array is valley there is little G_3 kemp, and saddle *v.* valley is a matter of strong inheritance.

When kemp succession relations were defined in non-plateau arrays it was expected that a corresponding generalization could be made for plateau array. This is the array, typically lacking sickle-fibres, of N-type lambs, these being like hairy mountain lambs. A study (by J. M. R.) of succession on the back of eighty covered lambs has improved upon an earlier generalization. When the shedding of hairy-tip-curly-tip fibres is very free (on present data more than 45 per cent) there is much G_2 kemp. When there is no shedding of hairy-tip-curly-tip fibres there is little G_2 kemp. When the shedding of hairy-tip-curly-tip fibres is intermediate there is great diversity in the G_2 kemp figures. Higher abundance of hairy-tip-curly-tip fibres (on present data more than 26 per 500 fibres of the lamb's full fleece) is then accompanied by much G_2 kemp, lower abundance of hairy-tip-curly-tip fibres by little G_2 kemp. Intermediate abundance of G_2 kemp shows signs of being associated with very poor shedding of hairy-tip-curly-tip fibres, or with low numbers of these fibres. In plateau array abundant G_2 kemp is almost always followed by plentiful G_3 kemp. In both non-plateau and plateau arrays when G_3 kemp is plentiful, G_4 kemps have often at least started to grow before shearing at about fifteen months. The expectation that kemp succession relations in plateau would show a general similarity to those in non-plateau has been justified. In both non-plateau and plateau arrays a small number of exceptions to our generalizations have been found, but they lend themselves to explanations that seem both reasonable and instructive.

There is some evidence that abundance of secondary kemp in N-type is inherited. In breeding experiments on the genetics of N-type it has often happened, partly incidentally, partly by choice, that both parents have had much G_2 kemp. The large proportion of resulting lambs with much G_2 kemp suggests that this selection has been effective. Small attempts

to breed against G_2 kemp in N-type have, however, achieved little, but the rams hitherto available have not been so free from G_2 kemp as one would have wished. There is also an argument by analogy from the inheritance of birthcoat characters. Abundance of halo-hairs and fibre type array, as stated earlier, are strongly inherited. The freedom from chalkiness, that is, no medulla or no appreciable medulla, in the post-natal region and, besides, in the sickle-end, of all sickle-fibres in numerous Wensleydale specimens sent from England by Dr. K. M. Rudall, is manifestly inherited. These facts, and especially the last detail, suggest that the hairiness (chalkiness) of the tips of fibres of the curly-tip group in N-type is likewise genetically determined, and consequently that the abundance of secondary kemp is inherited. Bryant secured direct evidence from a Scottish Blackface flock.

Our fundamental aim is to understand the interaction of forces at work in the follicles. Our present purpose is to point to possible application of our findings in selection against later kemp in mountain sheep in which a kempy birthcoat is accepted and desired. In particular, it may prove practicable to judge very young lambs for later kempiness. Biological work on the fleece is slow, especially when breeding is involved, and we are therefore presenting this preliminary report on new facts about secondary kemp in N-type Romney lambs.

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High Fertility of Buckwheat Tetraploids obtained by Means of Colchicine Treatment

IN the summer of 1941, extensive experiments were performed on producing buckwheat tetraploids by means of colchicine treatment. In 1942 the root tips of a thousand seedlings grown from seeds of the initial experimental plants were studied cytologically. Among the seedlings verified cytologically, 250 bore the tetraploid chromosome set (32 instead of the normal 16). Tetraploids were obtained from 79 initial plants of the following nine buckwheat varieties: 'Bolshevik', 37 initial plants; 'Kharkovskaya', 10; 'Bogatyr', 6; 'BTSKA' (-Timiriasev Agricultural Academy), 6; 'Altaiskaya', 5; 'Ispanskaya serebristaya', 5; 'Kazakskaya', 5; 'Belorusskaya', 3; and 'Buriat-Mongolskaya', 2.

In the summer of 1942, the non-crossability of the buckwheat tetraploids with buckwheat diploids was confirmed, this fact being of outstanding importance for selection.

The comparative study of tetraploid plants carried on in 1942 and 1943 invariably showed a marked increase in size of seed (on the average surpassing the weight of the diploid seeds by 42–85 per cent along with general enlargement of the plants).

As is usually the case in autopolyploidy, the majority of the new buckwheat forms were marked by a pronounced decrease in fertility as compared with the diploid plants. However, our extensive initial material, hereditarily different both as regards the nine varieties and within each variety as well, made it possible to select for reproduction those plants which were marked by the largest seeds and by greatest fertility. Subsequent selection of their progeny (for some stocks four generations of tetraploids were obtained for two years) already in 1943 showed a number of autotetraploid highly fertile buckwheat stocks with large seeds.

In the progeny of the best tetraploids of the variety 'Bolshevik', we obtained on the average from double to four times more seeds than from the diploids. Thus along with the greater weight of the seeds (1·5 times heavier) this latter fact increased the crop from the tetraploid plants from three to six times as compared with the normal diploids. Alone, 'Bolshevik' had produced in 1943 more than 15 kgm. of seeds.

The main theoretical importance of the data obtained consists in the fact that buckwheat is the first case illustrating high fertility of an experimentally produced, agriculturally valuable autopolyploid form. Of practical importance is the fact that during the shortest possible period (two and a half years) highly fertile buckwheat forms with large seeds have been produced, non-crossable with the initial diploid plants.

Some data point to the assumption that owing to their vigorous growth tetraploids show a higher percentage of germinating seeds under field conditions, as compared with the diploids. They are more frost-resistant and they show more pronounced self-pollination, which is seldom noted for normal buckwheat forms.

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Lunar Coronæ

A DISPLAY of lunar coronæ was seen here in altocumulus cloud on October 2 between 10.30 and 11.30 p.m. At its greatest extent the red ring of the third order was visible, but those parts of the corona outside the second red ring were fragmentary. On at least one other occasion the whole corona up to the green of the second order was seen.

Some measurements were made towards the end of the observations, and these and the calculated diameters of cloud droplets are recorded in the accompanying table. The unit of angular measurement is the moon's radius.

Cloud	Aureole radius	Droplet size (mm.)	Second red ring radius	Droplet size (mm.)
A	13 ± 1	0·012 ± 0·001	—	—
B	6 ± 1	0·025 ± 0·004	12½ ± 1	0·022 ± 0·002
B	7 ± 1	0·022 ± 0·004	—	—

In addition to the error due to the crudity of the measurements, the finite diameter of the moon introduces an uncertainty about which little appears to be known.

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RESEARCH ITEMS

Irish Fisheries

CONTINUING his researches on Irish freshwater fisheries Arthur E. J. Went has published a further study of the sea trout of the Waterville (Currane) River (*Sci. Proc. Roy. Dublin Soc.*, **23** (N.S.), No. 20; 1944), following the work of Went and Barker (1943). It was found in the latter report that the calculated smolt-length of the spring-running sea trout was exceedingly high and the question arose as to whether the later-running smolts had similar high mean lengths, and if so whether these were taken inadvertently by anglers before their descent to the sea in the belief that they were small adult sea trout. It is found by examining new material that the spring-running fish are merely part of the general stocks of sea trout in the Waterville River system and not different from the late-running fish. The rapid growth in fresh water and the large size attained by the smolts are, more or less, unique so far as sea trout have been investigated to date. A second paper by A. E. J. Went (*Proc. Irish Acad.*, **49**, C, No. 5; May 1944) gives an account of the modes of fishing in the Galway Fishery. In 1942 Mr. Went gave a detailed review of the ownership of the fishery in the same publication (**48**, C, No. 5). In the present work the various fishery methods are described, the sites of the fishing engines and certain other data, in order to make it more or less complete.

Some Primitive Bony Fish of the Middle Coal Measures

A MONOGRAPH on the Haplolepidæ, published by T. S. Westoll (*Bull. Amer. Mus. Nat. Hist.*, **83**, 1; 1944), is an important contribution to the analysis of the group of primitive bony fishes included in the Palæoniscidæ. It includes not only an exceptionally complete and detailed account of the superficial anatomy of these fish, but also a most interesting discussion of the functional significance of their peculiarities, and of their possible habitat. The family includes two genera only, one divided into two sub-genera, all being found in the "Middle Coal Measures" of Europe and North America in identical form. Dr. Westoll points out the remarkable fact that in four out of six of the localities in which Haplolepids are found they are accompanied by highly peculiar and specialized amphibians, Nectridia and Asistopoda, which are known from only one other "M. Coal Measure" locality, although they occur unaccompanied by Haplolepids in some six localities of later date. This remarkable association, taken in connexion with the very small size of the fish and Amphibia, raises very interesting consideration of Coal Measure geography. Finally, Dr. Westoll's monograph includes a series of very interesting discussions of the morphology of Actinopterygians in general and the course of evolution of their early members.

Development of Male Daphnia

D. J. SCOURFIELD has investigated the post-embryonal development of the male of *Daphnia magna* (*J. Quek. Micro. Club*, (4), **1**, No. 6; 1943). Although the development of the female has long been known to a certain extent, this is not the case with the male, and these observations are new. Males are much rarer than females, but the author has obtained the first post-embryonal stage by isolating females until they give off broods of males. This first stage, the so-called neonata, is very like that of the female except for the larger antennules, which are distinctly jointed to the head, and a rounded instead of a pointed rostrum. The changes undergone during the post-embryonal stages (usually four) are significant though small. Perhaps the most interesting point in the life-history is the fact that many species of *Daphnia* hatch while still enclosed in an embryonic cuticle in which the young may swim about for some hours, although not feeding. The shell spine is held between the ventral edges of the valves. Traces of antennæ which are free and traces of claws and setæ seem to show that this represents an embryonic stage (presumably a nauplius) usually passed through before hatching; in this it resembles the embryonic cuticle (pre-zoeal) of the decapod Crustacea, which in all probability also represents a nauplius stage.

Nutritional Physiology of the Silkworm

IN a recent review of Soviet researches on the physiology of the silkworm, S. Y. Demyanovski (*Advances in Modern Biology, Moscow*, **16**, 1; 1943) summarizes some outstanding findings referring to protein metabolism in relation to silk secretion. Tryptase proved to be the chief proteolytic enzyme, while dipeptases and polypeptases are absent, and such proteases as may be introduced with plant food are inhibited by the high *p*H value (9·9–10·1) of the digestive juice. Studies of the digestive process established that the proteolytic activity of the digestive juice can be augmented by the addition to food of saccharose or of fructose, the first increasing that activity by 10–12 per cent and the second by 20–50 per cent. This discovery has important practical implications, since by feeding silkworms on mulberry leaves with the addition of saccharose the weight of the larvæ was increased by 38 per cent, as compared with the controls fed on untreated leaves; the weight of cocoons rose by 12 per cent; the length of silk thread increased by 4·5 per cent, its weight by 19 per cent, the thickness by 7 per cent; and the output of silk was 7·8 per cent above that of controls. These experiments were repeated for four years on a number of varieties of silkworm, with consistent results. The best results were obtained when the ratio of saccharose to fresh leaves was 1·5 per cent by fresh weight; greater amounts of saccharose produced a further increase in the weight of the larvæ and fresh cocoons, but not in the output of silk; additional saccharose appears, however, to result in an increased fertility of the moths.

Genic Action

C. STERN (*Genetics*, **28**, 441; 1943) has published the first of a series of papers on the phenotypic reactions of *Cubitus interruptus* which affects the veins of *Drosophila melanogaster*. He shows that there is a dosage effect of this gene in that an increase in their number approaches the normal wing type of the wild-type allelomorph. On the other hand, the presence of a wild-type allelomorph produces an antagonistic effect when the *ci* gene is increased in number. In such cases the *ci* gene may behave as a dominant instead of as a recessive. The addition of the residue of chromosome IV may also transform *Cubitus interruptus* into a normal phenotype. The author tentatively suggests that each allelomorph has two properties, (1) a combining power, or the degree

of interaction with the substratum, and (2) an efficiency factor which measures the effectiveness of interaction to form the product which is efficient in the elaboration of a normal phenotype. This hypothesis leads to statements regarding the excess or deficiency of combining power and the amount of substratum in relation to the *ci* and wild-type allelomorph.

Chromosome Numbers in Guayule and Mariola

Parthenium argentatum, guayule and *P. incanum*, mariola, have come into prominence as sources of rubber. G. L. Stebbins and M. Kodani (*J. Hered.*, 35, 163; 1944) have made a cytological examination of strains of these shrubs from various wild sources and of their progenies. There is a large variation in chromosome number; *P. argentatum* had chromosome numbers of 36, 38, 54, 72, 74 and 108–111; *P. incanum* had 54, 72 and 90 chromosomes in the somatic tissue. This large range in polyploidy appears to have a basic chromosome of nine. Plants with 72 chromosomes in *P. argentatum* produce both pseudo haploids (36 chromosomes) and autotriploids (108–111). The fertility and seed fertility bear a relationship to the meiotic irregularities seen in the different polyploid plants. The evolution and relationships of the forms are discussed.

Combustion Mechanisms and Continuous Spectra in Flames

In following the details of combustion mechanisms, little information can be got from line spectra. Whereas band spectra are of value in telling us what molecules and radicals are present under flame conditions, still more information about *processes* such as dissociation, ionization and association can be got from studying continuous spectra. The causes and types of continuous spectra emitted by flames have been discussed by A. G. Gaydon (*Proc. Roy. Soc.*, A, 183, 111; 1944). It is shown that the yellow-green continuous spectrum emitted by some flames containing oxides of nitrogen is probably identical with the spectrum of the air afterglow and is therefore due to a reaction between nitric oxide and atomic oxygen. The presence of atomic oxygen in a flame can therefore be tested by admitting nitric oxide and observing if a yellow-green emission results. For the carbon monoxide flame there appears to be a high concentration of atomic oxygen, both for the dry and moist flame. The combustion mechanism is discussed in detail using this knowledge. For the hydrogen flame a little atomic oxygen is present, but results do not permit of definite conclusions. For hydrocarbon flames there is no sign of atomic oxygen in the inner cone, and this is taken as strong evidence in favour of a peroxide rather than a hydroxylation mechanism.

Existence of Ammonium Hydroxide

The question whether ammonium hydroxide really is present in aqueous solutions of ammonia has frequently been raised and some chemists hold that its existence has never been definitely proved. Both Walker in 1903 and Blackman in 1907 adduced evidence, based upon conductivity measurements, in support of the view that ammonium hydroxide was present in relatively small concentrations, and the matter has again been investigated by Briegleb (*Naturwiss.*, 30, 506; 1942), who sought to discover (1) how ammonia is bound with water in solution, and (2) whether ammonium hydroxide does exist and, if so, whether it is a strong or weak base. In the gas phase the heat of reaction

$$NH_3 + H_2O = NH_4OH$$

was found from proton affinity and polarization methods to be − 49 kcal., if the intramolar distance is 2·5 A. If it is 3 A. then the heat absorbed is 74 kcal. This strongly endothermic reaction is taken to prove that ammonium hydroxide does not exist in the gaseous state. The heat of formation of aqueous ammonium hydroxide is calculated at − 30 (or − 50) kcal., while the heat of reaction

$$NH_3 + H_2O = NH_4^+ aq. + OH^- aq.$$

was found to be between − 1·5 to − 2·0 kcal. The experimental evidence also points to the existence of the hydrates NH_3,H_2O and $2NH_3,H_2O$ with but little formation of NH_4OH, which would therefore be almost completely dissociated into ammonium and hydroxyl ions. The thermochemical data are said to accord with observed Raman effects and it is equally evident that ammonium hydroxide is a strong base. The evolution of ammonia from ammonium salts by stronger bases, the neutralization of acids by solutions of ammonia and the hydrolysis of ammonium salts are all explicable, according to Briegleb, in terms of proton affinity.

Peculiar Stars

George H. Herbig has an article with the above title in Leaflet No. 182, April 1944, of the Astronomical Society of the Pacific. He deals with a number of abnormal stars such as ε Aurigae, ζ Aurigae, β Lyrae, etc., and gives a brief outline of the most recent theories advanced to explain these freakish stars. In the case of ε Aurigae we now regard it as a hot, yellowish-white giant accompanied by a huge dim star which is invisible, and which has a diameter 2,700 times that of the sun. Its surface temperature is about 2,000° F., and hence most of its radiation must lie in the infra-red. The β Lyrae system is composed of two giant stars distorted by their mutual gravitation into egg-shaped bodies, their period of revolution around their common centre of gravity being 12 days. An incandescent torrent of gas pours from the larger star, and passing round the smaller one, is ejected into space, where it forms a gigantic expanding pin-wheel about the system. The variable star RW Tauri is a most remarkable system. The smaller white component is hotter and brighter than the larger, cooler, orange companion, and owing to the inclination of their orbit to our line of sight, the principal eclipse is total. Using the 100-in. telescope at Mount Wilson, A. H. Joy has obtained results which indicate the presence of an extended gaseous ring above the equatorial regions of the smaller, brighter star. This suggests an analogy with the rings of Saturn, though a difference arises from the fact that the ring of the RW system is gaseous. The diameter of the ring is about four times that of the sun and its orbital velocity is two hundred miles a second. When the larger star has just covered the disk of the smaller one an edge of the glowing ring is visible for a short time. The question of the existence of such appendages in other stars arises, and it is owing to the relative sizes of the components of RW Tauri and the orbital tilt that the ring has been detected. It is very probable that other stars have similar rings, and if so, some new and interesting problems confront the astronomer.

ANOMALOUS DISINTEGRATION OF NUCLEI BY COSMIC RAYS

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AS is well known[1], one effective method for the observation of the disintegration of atomic nuclei by cosmic rays is the method of the 'thick-layer' photographic plates suggested and developed in the Radium Institute of the Academy of Sciences of the U.S.S.R.[2]. The tracks of these disintegrations in such plates are mostly in the form of forks with irregular angular distribution ('stars'). They correspond chiefly to protons, more seldom to α-particles and still more seldom to particles with a stronger 'ionization power'. The 'yield' of nuclear disintegrations at sea-level is approximately 8×10^{-3} disintegrations in an hour per 1 cm.^{2} of the area of the plate. This yield rapidly increases with height, reaching a value fifty times greater at a height of 7,000 metres[3]. At sea-level the greatest percentage of disintegrations corresponds to the triple forks. Forks with five tracks are met comparatively seldom, and only with the increase of height is the slow increase of the number of ejected particles in one disintegration observed. In addition to the disintegrations in the form of stars, there are observed also disintegrations in the form of 'showers', that is, in the form of forks with a pronounced unilateral direction of tracks (inside the narrow solid angle). Tracks in the showers may belong to protons as well as to mesotrons. We suggested in previous papers[4] the possibility of the registration of slow mesotrons in the 'thick-layer' plates, and also the possibility of estimating their mass from the average distance between two neighbouring developed grains. In one of our papers[5] there was shown a shower consisting of about a hundred heavy particles, which was obtained on a plate exposed at a height of about 9,000 metres.

At the end of November 1942 we observed[6] the anomalous 'yield' of nuclear disintegrations; here and there on several plates this yield exceeds by 10^3 times the normal value (10^{-3}). (We take account only of those disintegrations and single tracks for which the range is more than 10 cm. of air equivalent.) Just about the same time we succeeded in registering a series of the showers at sea-level. These showers are probably in many cases the complete disintegration of a nucleus into all its components. Such disintegration may be called an 'anomalous' one. Below are given the description and the results of the measurements of two showers, photographs of which are shown in Figs. 1 and 2 (stereomicrophotographs). In Fig. 3 the energy spectra of protons are shown; the number of tracks is plotted against the energy in MeV. at intervals of 0·5 MeV. (positions of

FIG. 1.

separate tracks are indicated by points). The first shower consists of 35 tracks, all corresponding to protons, and it is quite natural to attribute it to the anomalous disintegration of the nucleus of bromine in the photographic emulsion. Measurement of the ranges gives the total energy of protons as $\Sigma E_H \sim 80$ MeV. Assuming that the emitted neutrons have on the average the same energy as protons and taking into account the binding energy of the nucleus $\Delta M \sim 8{\cdot}5\,A$ MeV., where A is the mass number, we obtain for the minimal energy of the incident particle $E_N = \Sigma E_n + \Sigma E_n + \Delta M \sim 900$ MeV.

It is of interest also to consider the momentum of all the particles emitted. Measurement shows that

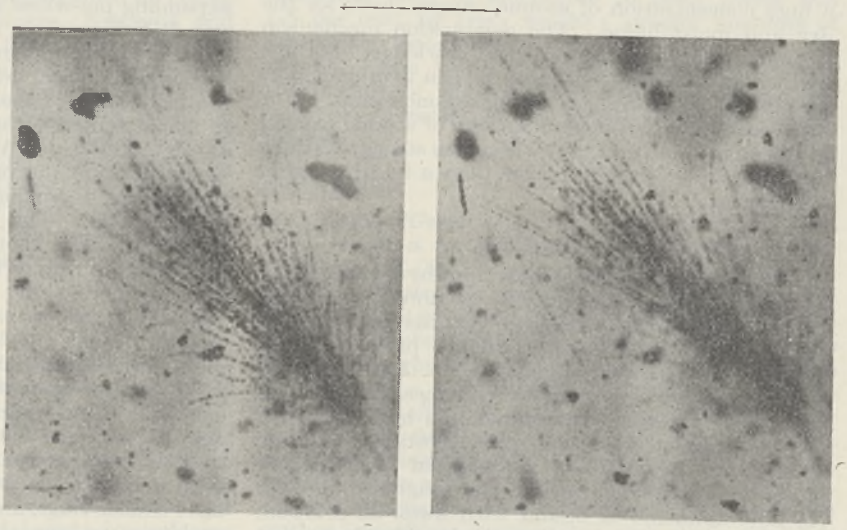

FIG. 2.

the sum of the projections of the momenta of protons on the axis of the shower is $P_H = \Sigma\sqrt{E_H m_H}\cos\alpha = 17{\cdot}6 \sim 20$. Assuming that the total momentum of the neutrons has approximately the same value as that of the protons, we obtain the value of ~ 40 for all the particles from nucleus. If we calculate the momentum, $P_N = \sqrt{E_N m_N}$ from the value of the energy of the incident particle, we obtain $P_N \sim 30$ in the case of $m_N = 1$. This number is in satisfactory agreement with the value measured from the photographs.

In the second shower there are about fifty tracks and therefore it is reasonable to consider it as the anomalous disintegration of the silver nucleus. Measurement of the particles of the shower shows that $\Sigma E_H \sim 150$ and $P_H = \sim 70$. In this case the minimum energy of the incident particle is $E_N \sim 1{,}300$ MeV. and $P_N \sim 35$ (for $m_N = 1$).

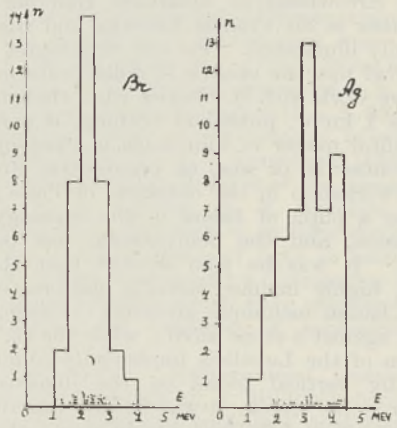

FIG. 3.

It should be noticed that P_N is in both cases somewhat less than $P_H + P_n$.

If the disintegrations were due to photons, electrons or even to mesotrons, the momentum would have quite another order of magnitude. It is interesting to notice that all the particles in the showers are emitted within a cone the cross-section of which is a very eccentric ellipse. For example, in our cases the ratios of the axes of the ellipses are 0·13 and 0·15, and for the shower described in the previous paper[5] is 0·1. This eccentricity of disintegrations can be explained by the fact that the collision between the cosmic particles and the nucleus is non-central.

Thus the existence of the showers shows the presence of heavy particles of mass $m \cong 1$ and energy $\sim 10^9$ eV. in the cosmic radiation at sea-level.

Further details and examples of anomalous disintegration of nuclei will be submitted to the *Physical Review*.

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INDIAN FOREST WAR-TIME PRODUCTS

WHEN Lord Curzon, Viceroy of India, sanctioned in 1906 the institution of a Forest Research Institute, with headquarters at Dehra Dun, even so wide-visioned a man as he could not have anticipated the great benefits it was to confer on India. Even during the War of 1914–18 the imports into India of what had previously been deemed necessaries of life were curtailed, and forest research at once stepped into the breach and by the close of that War had not only established its position but had outgrown all the buildings, equipment and so forth for which provision was made by 1914, although it was considered sufficient for the next score of years. A great new building and much additional equipment was sanctioned by 1920 and has long been functioning. During the present War, in some directions the Institute has been able to answer urgent imperative calls of both Army and public. Curiously enough, although the chief branches of forestry were catered for, including utilization, which assumes such an important place in war-time, it was not until comparatively late in its existence that the importance of the minor products of the Indian forests, admittedly a sub-branch of utilization, received due recognition at the Institute—or perhaps at the hands of Government—a special branch being at length formed which has proved of the very highest value, especially in combination with the Chemical Branch, during the present War. Some of this work has already been noted in these columns. Two *Indian Forest Leaflets*, Nos. 60 and 64, Sylviculture (Forest Research Institute, Dehra Dun, 1944), issued recently, deal with two further products of the Indian forest.

No. 60 is entitled "Short Note of the Beedi Leaf Industry". Beedis are locally made Indian cigarettes with leaf wrappers. As an article of merchandise the industry is believed to have started between 1905 and 1916 in different parts of India, chiefly in Bihar, the Central Provinces, the Eastern States and Patna. The traditional smoke of the Indian is the hookha and chilam. For purely agricultural pursuits the hookha is not an encumbrance, but it is difficult to carry about, and the chilam is a fragile article. With increased industrialism and faster travel by rail and motor-car, the need for a cheap and more portable smoke was met by the cheap foreign cigarette. Supplies of these became difficult to obtain during the War of 1914–18, and the beedi began to become known. The use of leaves of local tree species for making pipes was a common practice of many tribes; it was a short step therefrom to using leaves for preparing cheap cigarettes, and the present War has given a great impetus to this manufacture, expanding industry and the great increase in the Indian Army being two important factors.

The leaves of many indigenous plants are used for wrapping tobacco in, but *Diospyros Melanoxylon* is the one generally preferred owing to its peculiar flavour, flexibility in texture and resistance to early decay. It occurs in the southern two thirds of India proper from, roughly, an east and west line approximately a hundred miles to the north of Calcutta. Other leaves used are those of *Bauhinia racemosa* and *B. vahlii*, *Butea frondosa*, *Castanopsis indica* and *Shorea robusta*. The supply of the leaves is eminently a forestry industry, and the best methods of obtaining the maximum crop of leaves, whether

by pollarding, coppicing or root-suckers, are being closely investigated. The pamphlet deals with the financial and industrial aspects, period of collection of the leaves and grading, drying, still under experiment, storage, packing and transport.

Leaflet No. 64, on "The Growing of *Cryptostegia grandiflora* as a War-time Emergency Crop", describes another and more important war-time object, namely, the production of rubber. *Cryptostegia grandiflora* is indigenous to Madagascar and probably to Africa. The plant is described as a scrambler; it grows erect until about 1½ ft. high and then it climbs and scrambles until after some years it can again stand by itself. It is therefore greatly helped in its early development if it has something to climb on. It was imported into India many years ago as a garden plant for its flowers. It has since run wild in many places, generally in arid or semi-arid climates; for example, Kalka near Delhi, Muttra near Poona, Hyderabad (Sind), etc., with a rainfall of 5–25 in. and elevations up to 1,500 ft. In such situations it was noticed that the best development occurred on land subject to local inundations, but it obviously could withstand arid conditions. A survey by the Indian Agricultural Research Institute revealed the fact that it was present in all parts of India in various soils; namely, black, brown, red, laterite, Indo-Gangetic alluvium, sands, clays, acid and alkaline soils; in all climates without regard to temperature, rainfall, humidity, light, wind and exposure; on river banks and where the subsoil water table is high—an amazing power of adaptation. It is considered probable that a well-drained fertile soil with a gentle slope at about 1,000 ft. elevation and a rainfall of 60 in. will suit it best, particularly if it can be irrigated during periods of dry weather.

Since the Japanese occupation of Malaya and the Dutch East Indies, which deprived the Allies of some 90 per cent of their supplies of raw rubber, much work has been done on the possibilities of developing additional war-time supplies of vegetable rubber. The *Cryptostegia* in question has proved a most promising plant, and in the past eighteen months or so experimental work has been carried out and large-scale experience gained. Most of the publications on this work have been academic rather than practical. The present pamphlet, it is emphasized, only sets out to give the information at present available, based on a year's practice in planting plantations of the plant for the sole purpose of obtaining the maximum production of rubber in the minimum time, the question of costs not being of primary importance. A better plantation technique will be a matter for the future should this type of cultivation be found remunerative after the War. The seed is sown in nurseries and the seedlings put out at the outbreak of the rains when about two months old. They are planted in lines or double lines about 6 ft. apart to allow room for the tapping operations to be undertaken. Each row has a simple form of fence 4 ft. 6 in. high on which the plants can climb. Since the object is to obtain maximum results in the shortest time, dense planting is necessary. "Tapping," it is said, "has of necessity to be of a few shoots per bush; therefore we have to grow these shoots at such a height and by such an arrangement that the labour can tap as many shoots as possible in the smallest area with the minimum of trouble."

The pamphlet gives full details of all the operations necessary to form a plantation and to exploit it, but emphasizes the fact that the methods at present employed are the results of, and therefore to some extent due to, the fact that during the past year it has been a 'rush-job'. From the descriptions given of the work it seems to be very satisfactory, and to reflect great credit on the careful research work which has enabled it to be carried out at so critical a time for the Allies' rubber resources.

FLINT KNAPPING

TO fashion a flint implement both knowledge of the tricks of the trade and skill in execution are required. Watching the flint knappers at Brandon can teach the student many a 'wrinkle', but any attempt to do likewise soon demonstrates the overriding importance of long and patient practice. The Pitt Rivers Museum authorities at Oxford have recently issued their first Occasional Paper on Technology, and it is entitled "The Manufacture of a Flint Arrowhead by Quartzite Hammer-stone"*. The author is Sir Francis Knowles and the work is plentifully illustrated. One can only regret that the writer had not the chance to collaborate in a more extensive work with M. Contier who, though he has, so far as I know, published nothing, is perhaps the most skilful maker of flint tools in existence.

M. Contier is, or was, an ornamental stonemason with a workshop in the outskirts of Paris; but he was also a pupil of Breuil in the typology of flint implements, and the combination has been very fruitful. It was he who showed that the single-faceted, highly inclined striking platform of the so-called Clacton technique involved the swinging of a nucleus against a stone anvil; while the right-angled platform of the Levallois implements could be produced by vertical blows on the nucleus with a hammer-stone. Again, it was Contier who discovered the possibilities of the 'wood technique': the striking of the core, held in the hand, with a baton of wood instead of with a hammer-stone, whereby flaking similar to that long recognized as characteristic of Acheulean tools can be produced. Actually, the use of the softer hammer partially resolves the phenomenon of percussion produced by a stone hammer into that of pressure. A dictum of Contier's used to run—the Chellean technique is that of the anvil, but Acheulean man held the flint core in his hand and hit it with a wooden baton. He also, like Dr. Leakey, had definite views as to how the various types of burins were made.

But Contier was essentially a craftsman. Sir Francis Knowles, though with a limited, definite objective, has given us the written word upon this subject of technique. He is concerned only with the manufacture of arrowheads, using a quartzite hammer-stone, not an iron hammer as do the knappers of Brandon. His paper is the book of words for doing this. He tells us how to choose the materials, how to hold and hit them, how to 'turn the edge' of the flake, etc. His instructions are indeed what a cook would call the 'recepe' for the production of a complicated and beautiful piece of craftsmanship. Very definitely papers of this kind have value; still far too little is known about the material flint and the various ways in which it can be fractured. Incidentally, anyone who has tried his hand at it will know the difficulty of describing in words

* Pitt Rivers Museum, University of Oxford. Occasional Papers on Technology, 1: The Manufacture of a Flint Arrow-head by Quartzite Hammer-stone. By Sir Francis Knowles. Pp. 38+6 plates. 5*s*.

knapping techniques and processes, and Sir Francis is to be congratulated that in the work under notice the reader, with only a very little concentration, will readily appreciate the way the author sets to work to make his specimens. M. C. BURKITT.

GEOPHYSICS AND GEOMORPHOLOGY IN U.S.S.R.

THREE numbers of the *Bulletin de l'Académie des Sciences de l'URSS*, Série Géographique et Géophysique (Nos. 4–5, 1941; No. 2, 1943; No. 3, 1943), which have recently reached us, give some idea of the progress made in geophysics and geomorphology in U.S.S.R. For convenience the papers are grouped under four headings: (1) Atmosphere, (2) Hydrosphere, (3) Lithosphere, and (4) Climatology.

(1) *Atmosphere.* A. M. Obuhov (453; 1941) presents a mathematical study of the energy distribution in the spectrum of a turbulent flow; M. E. Schwez, in his first paper (467; 1941), gives a mathematical study of the vertical velocities in a moving air mass, and in the second paper (No. 2, 55; 1943), a mathematical study of the velocity of wind and the turbulent diffusion; S. L. Ponisovski (432; 1941) discusses the state of the *E*-layer of the ionosphere at twilight; A. J. Driving, A. V. Mironov, V. M. Morozov and I. A. Khvostikov, in their study of the polarization and absorption of light in natural fogs (No. 2, 70; 1943), have found a discrepancy between observation and theory which they propose to solve by postulating the presence of submicroscopical droplets.

(2) *Hydrosphere.* Mathematical treatment of turbulence is attempted by M. Millionshchikov (433; 1941), who discusses the turbulent heat conduction of sea water; by W. Stockmann (483; 1941), who discusses the horizontal components of velocity of sea currents; and by K. V. Shutilov (447; 1941). L. S. Leibenson (411; 1941) presents a mathematical treatment of the movements of gas-containing liquid in a porous medium.

(3) *Lithosphere.* Magnetic anomalies in the Moscow region are discussed by A. G. Kalashnikov (No. 2, 83; 1943), thermal anomalies in the earth's crust caused by strata and rock masses of different thermal conductivities are discussed by N. N. Korytnikova (No. 3, 115; 1943); a new method of measurement of temperature in salt mines is proposed by S. A. Kraskovsky (No. 3, 134; 1943); a mathematical study of the processes of freezing and thawing is given by S. S. Kovner (No. 3, 143; 1943); and V. V. Beloussov (No. 3, 147; 1943) outlines a new hypothesis of the development of the earth's crust as due to the migration of radioactive elements. J. A. Skvorzov (Nos. 4–5, 501; 1941) discusses the methods of geomorphological analysis and mapping; and V. V. Galitzky (No. 2, 89; 1943) gives an account of the geomorphology of the Kara-Tau region (north-west Tian-Shan).

(4) *Climatology.* The problem of the gradual rise of the temperature of the arctic regions is discussed by B. L. Dserdsejevsky (No. 2, 60; 1943) and the effectiveness of synoptical weather predictions is discussed by M. A. Omshansky (No. 3, 161; 1943).

All papers are provided with summaries, either in English or German, but some of these summaries are too brief to be of much value. S. I. TOMKEIEFF.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Tuesday, November 14

SOCIETY OF CHEMICAL INDUSTRY (joint meeting of the CHEMICAL ENGINEERING GROUP, the AGRICULTURE GROUP, and the INSTITUTION OF CHEMICAL ENGINEERS) (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 2 p.m.—Conference on "Grass Drying" (Dr. S. J. Watson: "Grass Drying—Chemical Aspects"; Mr. A. Goldberg and Mr. A. C. Bartelli: "Grass Drying—Engineering Aspects"; Mr. D. Fairclough: "Grass Drying—The Farmer's Viewpoint").

CHADWICK LECTURE (at the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1), at 2.30 p.m.—Mr. Guy Howard Humphreys: 'Some Modern Trends in Sanitary Engineering" (Bossom Gift Lecture).*

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 5.15 p.m.—Mr. Christopher F. C. Hawkes: "Prehistoric Britain", (ii) "The Later Prehistoric Centuries".

ILLUMINATING ENGINEERING SOCIETY (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, Strand, London, W.C.2), at 5.30 p.m.—Mr. J. N. Aldington: "Bright Light Sources".

INSTITUTION OF CIVIL ENGINEERS (ROAD ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Mr. A. H. D. Markwick: "The Basic Principles of Soil Compaction and their Application".

Wednesday, November 15

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. L. Hartshorn: "High-Frequency Heating".

INSTITUTE OF FUEL (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 2.30 p.m.—Mr. B. F. Karthauser: 'The Development and Design of Shell Type Boilers".

BRITISH INSTITUTION OF RADIO ENGINEERS (NORTH-EASTERN SECTION) (at the Neville Hall, Westgate Road, Newcastle-upon-Tyne), at 6 p.m.—Mr. A. H. Hoult: "Theory of Rectification".

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP) (joint meeting with the CARDIFF SECTION and the CARDIFF SECTION OF THE ROYAL INSTITUTE OF CHEMISTRY) (at the Newport Technical College, Clarence Place, Newport, Mon.), at 6.30 p.m.—Dr. E. B. Hughes: "Chemistry in the Kitchen".

SOCIETY OF CHEMICAL INDUSTRY (BIRMINGHAM SECTION) (joint meeting with the ROYAL INSTITUTE OF CHEMISTRY) (in the Chamber of Commerce, New Street, Birmingham), at 6.30 p.m.—Mr. C. W. Bonniksen: "Some Properties and Applications of Alginic Acids and Alginates".

Thursday, November 16

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. G. M. Phillips, Mr. J. S. Hunter and Mr. L. E. Sutton: "Investigation of the Occurrence of the Co-ordinate or Dative Link by Electric Dipole Moment Measurements"; Mrs. G. A. Gilbert, Mr. F. Smith and Mr. M. Stacey: "A Constitutional Synthesis of Cellobiose and Gentiobiose".

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 2.30 p.m.—Sir James Jeans, O.M., F.R.S.: "Old and New Descriptions of the Astronomical Universe", (iii) "Galaxies".

ROYAL SOCIETY OF ARTS (INDIA AND BURMA SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Dr. R. Maclagan Gorrie: "The Place of Mechanized Equipment in Indian Soil Conservation".

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Prof. S. Mandelbrojt: "On the Regularization of Sequences".

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Sir Harold Hartley, F.R.S.: "Antoine Laurent Lavoisier" (Lavoisier Bicentenary Lecture).

CHEMICAL SOCIETY (in the Department of Chemistry, University College of North Wales, Bangor), at 5.30 p.m.—Prof. R. D. Haworth, F.R.S.: "Oxidation of Phenols".

BRITISH INSTITUTE OF RADIOLOGY (in the Reid-Knox Hall, 32 Welbeck Street, London, W.1), at 8 p.m.—Symposium on "Physical, Biochemical and Therapeutic Aspects of Volume Dose".

Friday, November 17

SOCIETY OF CHEMICAL INDUSTRY (PLASTICS GROUP) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Discussion on "Polymer-Plasticiser Interaction" (to be opened by Dr. R. F. Tuckett and Miss E. M. Frith).

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 5 p.m.—Vice-Admiral Sir John A. Edgell, K.B.E., F.R.S.: "Ocean Passages, Depths and Currents—the Work of the Hydrographic Department in Peace and War".

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Dr. H. E. Wimperis: "Research and Development in Aeronautics" (Thirty-first Thomas Hawksley Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (MEASUREMENTS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. G. E. Moore: "Planning the Future Electricity Meter".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. J. S. Thompson: "In Search of Efficiency".

CHEMICAL SOCIETY (in the Royal Technical College, Glasgow), at 7.15 p.m.—Mr. R. P. Bell, F.R.S.: "The Value of the Resonance Concept in Chemistry".

Saturday, November 18

QUEKETT MICROSCOPICAL SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Papers.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield, 1), at 2.30 p.m.—Mr. R. A. Hacking: "Technical and Economic Problems in the Heavy Iron and Steel Industry".

APPOINTMENTS VACANT

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

LECTURER (full-time) in the Ashington Mining School (applicants should possess a Degree in Physics or General Science and be prepared to take MATHEMATICS to School Certificate standard)—The Director of Education, County Hall, Newcastle-upon-Tyne 1 (November 15).

GRADUATE LECTURER (full-time) IN MATHEMATICS in the Medway Technical College, Gillingham—The District Education Officer, Fort Pitt House, Rochester (November 16).

LECTURER (full-time) IN MECHANICAL ENGINEERING in the Schools of Technology, Art and Commerce, Oxford—The Chief Education Officer, City Education Office, 77 George Street, Oxford (November 17).

SPEECH THERAPIST (full-time) to undertake duties in the areas of the Bridgwater, Taunton and Yeovil Education Committees—The Clerk to the Taunton Borough Education Committee, Education Office, Municipal Buildings, Taunton (November 18).

AGRICULTURAL TRAINING OFFICER to organize the scheme for the training in Agriculture and Horticulture of men and women released from War service—The Chief Executive Officer, Herefordshire War Agricultural Executive Committee, 4 St. John Street, Hereford (November 20).

HEAD OF THE ENGINEERING DEPARTMENT—The Principal, Stockport College for Further Education, Stockport (November 20).

LECTURER IN BIOLOGY, with Botany or Physiology as subsidiary subject—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (November 20).

LECTURER IN GEOGRAPHY—The Principal and Clerk to the Governing Body, Wigan and District Mining and Technical College, Wigan (November 22).

LECTURER (man or woman) IN MATHEMATICS—The Registrar, University College, Southampton (December 1).

ASSISTANT (temporary) IN THE DEPARTMENT OF ZOOLOGY—The Deputy Director, Museum and Art Gallery, Bristol 8 (December 9).

ENGINEERS by the Government of Nigeria for the Posts and Telegraphs Department—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. D.971.A) (December 11).

DIRECTOR OF RESEARCH—The Secretary, British Internal Combustion Engine Research Association, 111–112 Buckingham Avenue, Slough, Bucks. (December 31).

LECTURER IN EXPERIMENTAL ZOOLOGY—The Registrar, The University, Liverpool (January 5).

DIRECTOR—The President, British Coal Utilisation Research Association, 13 Grosvenor Gardens, London, S.W.1 (January 31).

MASTER FOR ENGINEERING SUBJECTS, including Workshop Practice—The Principal, Erith Technical College, Belvedere, Kent.

TEACHER FOR PHYSICS AND CHEMISTRY—The Acting Principal, Technical Institute, Sheerness.

GRADUATE ASSISTANT (temporary) to teach chiefly PHYSICS and MATHEMATICS in the Thomas Richards Technical Institute, Tredegar—The Acting Director of Education, Higher Education Department, County Hall, Newport, Mon.

SPEECH THERAPIST—The Director of Education, Shire Hall, Nottingham.

BOTANIST (male) IN THE BRANCH OF PLANT PATHOLOGY AND BOTANY of the Department of Agriculture, Southern Rhodesia—The Official Secretary, Rhodesia House, 49 Strand, London, W.C.2.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Geological Survey of Great Britain. Wartime Pamphlet No. 13: Limestones of Scotland. Area 5: Central Grampians. By Dr. J. G. C. Anderson: with Analyses by H. G. M. Hardie. Second edition. Pp. 20. 1*s*. Area 6: Banffshire and the North-East Grampians. By Dr. J. G. C. Anderson; with Analyses by Dr. A. Muir. Second edition. Pp. 22. 1*s*. 3*d*. (London: Geological Survey and Museum.) [139

Health Abounding: the Social Credit National Health Service; an Outline. By Aubrey T. Westlake. Second edition, revised and enlarged. Pp. 52. (London: Social Credit Party.) 1*s*. [159

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences). Vol. 62, Part 1, No. 9: On the Line-Geometry of the Riemann Tensor. By H. S. Ruse. Pp. 64–73. 1*s*. 6*d*. Vol. 62, Part 1, No. 10: The Factorial Analysis of Multiple Item Tests. By D. N. Lawley. Pp. 74–82. 1*s*. 6*d*. Vol. 62, Part 1, No. 11: The Identification of Klein's Quartic. By Dr. W. L. Edge. Pp. 83–91. 1*s*. 6*d*. (Edinburgh and London: Oliver and Boyd.) [189

Ministry of Home Security. F.G. Leaflet No. 19: Methods of Reducing the Fire Risk in Fibre Building Boards in Wartime Building. Pp. 8. (London: Ministry of Home Security.) [199

Motherhood in the Post-War World. An Address by Dr. Grantly Dick Read. (Published for the Council of Seven Beliefs.) Pp. ii+20. (London: William Heinemann (Medical Books), Ltd.) 6*d*. net. [209

Institute of Welding: Welding Research Council. Recommended Technique for making Fillet Welds in the Downhand, Vertical and Overhead Positions. (T. 13.) Pp. 8. (London: Institute of Welding.) [219

National Trust for Places of Historic Interest or Natural Beauty. Report of the Council for the Years 1943–1944. Pp. 62+8 plates. (London: National Trust.) [219

The Heather Beetle (*Lochmea suturalis*): an Enquiry into its Biology and Control. Made on behalf of the British Field Sports Society by Dr. A. E. Cameron, J. W. McHardy and Dr. A. H. Bennett. Pp. 69+13 plates. (Petworth: British Field Sports Society.) 1*s*. [229

The Church and the Planning of Britain. Report of the Social and Industrial Commission of the Church Assembly, 1944. (C.A. 753.) Pp. 32. (London: Church Assembly.) 2*s*. [259

British Astronomical Association: its Nature, Aims and Methods. Pp. 34. (London: British Astronomical Association.) 3*s*. [259

British Council. Report for 1943–1944. Pp. 138+12 plates. (London: British Council.) [279

Social Insurance. Part 1. (Cmd. 6550.) Pp. 64. (London: H.M. Stationery Office.) 6*d*. net. [279

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences). Vol. 62, Part 1, No. 12: Quantum Mechanics of Fields, 2, Statistics of Pure Fields. By Prof. Max Born and Dr. H. W. Peng. Pp. 92–102. 2*s*. Vol. 62, Part 1, No. 13: A Problem in the Random Distribution of Particles. By Dr. William Ogilvie Kermack. Pp. 103–115. 2*s*. 3*d*. (Edinburgh and London: Oliver and Boyd.) [289

Other Countries

University of Illinois: Engineering Experiment Station. Bulletin No. 350: Fatigue Strength of Fillet-Weld and Plug-Weld Connections in Steel Structural Members. By Wilbur M. Wilson, Walter H. Bruckner, John E. Duberg and Howard C. Beede. Pp. 94. 1 dollar. Bulletin No. 351: Temperature Drop in Ducts for Forced-Air Heating Systems. By Alonzo P. Kratz, Seichi Konzo and Richard B. Engdahl. Pp. 60. 65 cents. Reprint No. 28: Tenth Progress Report of the Joint Investigation of Fissures in Railroad Rails. By Ralph E. Cramer and Russell S. Jensen. Pp. 24. 15 cents. Reprint No. 29: Second Progress Report of the Investigation of Shelly Spots in Railroad Rails. By Ralph E. Cramer. Pp. 10. 15 cents. Reprint No. 30: Second Progress Report of the Investigation of Fatigue Failures in Rail Joint Bars. By Norville J. Alleman. Pp. 12. 15 cents. Reprint No. 31: Principles of Heat Treating Steel. By Prof. Harold L. Walker. Pp. 46. 15 cents. (Urbana, Ill.: University of Illinois Engineering Experiment Station.) [178

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 20, No. 11: An Improved Photographic Method for the Quantitative Study of the Reflexion of X-Rays by Crystals. By J. A. Wasastjerna. Pp. 26+17 plates. Serien 3, Band 20, No. 12: On the Apparent Distributions and Properties of Triple and Multiple Stars. By Åke Wallenquist. Pp. 33. Serien 3, Band 20, No. 13: Die Hydracarinenfauna Südbrasiliens und Paraguays. Von O. Lundblad. Teil 5. Pp. 182+10 plates. Serien 3, Band 21, No. 1: On the Morphology of the Lower Jaw of Stegocephalia with special reference to Eotriassic Stegocephalians from Spitsbergen. 2: General Part. By Tage Nilsson. Pp. 70. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [218

Proceedings of the American Philosophical Society. Vol. 88, No. 1 (June 16, 1944): Symposium on Taxation and the Social Structure. Papers read before the American Philosophical Society, Midwinter Meeting, February 18–19, 1944. Pp. iii+70. (Philadelphia: American Philosophical Society.) [228

Smithsonian Miscellaneous Collections. Vol. 104, No. 4: The Influence of Light and of Carbon Dioxide on the Respiration of Etiolated Barley Seedlings. By Robert L. Weintraub and Earl S. Johnston. (Publication 3769.) Pp. ii+16+2 plates. Vol. 104, No. 5: Weather Predetermined by Solar Variation. By C. G. Abbot. (Publication 3771.) Pp. ii+44. Vol. 104, No. 6: Smithsonian Pyrheliometry and the Andean Volcanic Eruptions of April 1932. By L. B. Aldrich. (Publication 3772.) Pp. ii+6. (Washington, D.C.: Smithsonian Institution.) [228

U.S. Department of Agriculture. Circular No. 697: Laboratory Studies on the Toxicity of Tartar Emetic to the Mexican Fruitfly. By C. C. Plummer. Pp. 14. (Washington, D.C.: Government Printing Office.) [258

Herbertia. Vol. 10, Tenth Anniversary edition. Edited by Hamilton P. Traub. Pp. 198. (Salinas, Calif.: American Amaryllis Society.) [298

Associação Portuguesa para o progresso das Ciências. O Contributo dos descobrimentos dos Espanhóis e Portugueses nos séculos XV e XVI para o conhecimento científico do Homem e das raças humanas. Por Prof. A. A. Mendes Corrêa. Pp. 19. (Pôrto: Imprensa Portuguesa.) [298

U.S. Department of Agriculture. Technical Bulletin No. 871: *Aspanteles diatraeae*, a Braconid Parasite of the Southwestern Corn Borer. By E. G. Davis. Pp. 20. (Washington, D.C.: Government Printing Office.) [298

Publications of the Observatory of the University of Michigan. Vol. 9, No. 1: Fifth List of New Southern Double Stars found at the Lamont-Hussey Observatory of the University of Michigan at Bloemfontein, South Africa. By Richard A. Rossiter. Pp. 6. (Ann Arbor, Mich.: University of Michigan.) [308

Papers of the Michigan Academy of Science, Art and Letters. Editors: Eugene S. McCartney and William C. Steere. Vol. 28 (1942). Pp. xiii+701+52 plates. (Ann Arbor, Mich.: University of Michigan Press; London: Oxford University Press.) 28*s*. net. [49

Ontario Research Foundation. Report for the Year 1943. Pp. 28. (Toronto: Ontario Research Foundation.) [49

Catalogues

Old Medicine: Art in Medicine, Renaissance Medicine—Instruments. (Catalogue 5.) Pp. 40. (London: E. Weil.)

The 'Pyrobit' Tester. Pp. 2. (Manchester: The Acru Electric Tool Manufacturing Co., Ltd.)

Light's Organic Chemicals. Pp. 14. (Wraysbury: L. Light and Co., Ltd.)

Additional German Publications being reproduced in America by the photo-offset process under authorization of the Alien Property Custodian in Washington. Pp. 8. (London: H. K. Lewis and Co., Ltd.)