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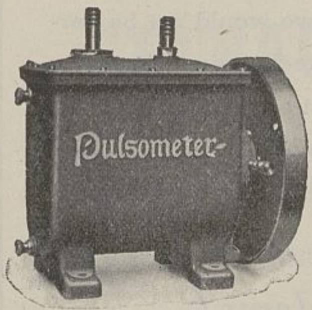

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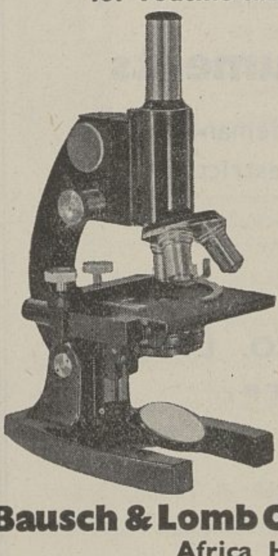

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THE STATE OF HEALTH IN EUROPE

THE smoke-clouds of war which shroud the war zones and the absence of health reports and of foreign medical journals make it difficult to form a scientific appreciation of health conditions on the Continent of Europe. At the same time, references in the Press of Germany as well as of occupied and neutral countries, and information supplied by neutrals who have visited Germany and the occupied countries, supply us to some extent with accounts which enable a general impression to be formed. As regards nutrition, the countries which are in a desperate plight are Poland, Jugo-Slavia, Greece and occupied Russia. The 'hungry countries' are Belgium, France and Norway. Czechoslovakia is considered to be a little better off.

The Poles receive a diet of 800 calories a day, which is about one fourth of the German ration; the Jews in Poland have 400 calories a day, that is, half the Polish ration; this is insufficient to maintain adequate nutrition. In the 'hungry countries', on paper the ration card is adequate; but in practice the inhabitants frequently cannot obtain their full ration. This is due not so much to shortage of food-stuffs as to inadequacy of transport, and the fact that the peasants, especially in France, distrust the war currency and keep their produce instead of taking it to market. In France, rationing was introduced much too late, and at a time when stocks of food-stuffs were largely exhausted.

In all the occupied countries deficiency diseases are now to be found—rickets, spontaneous fractures of bone, beriberi and pellagra. There is a deficiency of calcium shown by the lack of calcification of teeth. New diseases are said to occur; for example, epidemics of nephritis have been reported. Pregnant women are inadequately nourished, and it is alleged that a second pregnancy is tantamount to maternal suicide. There is a high increase in infantile mortality.

Germany, as she has already announced, will be the last country to starve. Here the ration card can be taken at its face value. The Army is very well fed; the diet is sometimes monotonous alike in quality and quantity. The workers are well looked after, and up to recently coupons have always been honoured. There is believed to be a 'black market', although the penalties are very heavy. Infant mortality has not increased. The children receive special nutritional care and are given supplies of vitamin C. The supply of milk to expectant mothers and children is regular and good. These mothers also receive a preparation of vitamin D through the district nurses. Margarine has been enriched with vitamins. The Germans' chief trouble is the so-called 'fat gap'. To cope with this they treat bones in an autoclave in order to extract the marrow. They also experiment in the synthesis of fats. One method is to oxidize paraffin and then to combine it with synthetic glycerin. Blood sausages are made on a large scale.

Before the War the Germans imported a large supply of soya beans from Manchuria. This has not been a great success, as the stocks became rancid.

Tuberculosis is a well-known index of a people's health and nutrition. At the end of 1941 the death-rate from tuberculosis was greatly raised in the occupied countries, and it has also risen in Germany, as in the War of 1914–18. Tuberculosis seems rife in Belgium. Generally, the increase noted in the disease is ascribed to various causes such as the breakdown of preventive measures, the return of war prisoners to France with 'open' tuberculosis, migration and under-nutrition. The number of primary infections seems to be increased and, owing to the lack of fuel, the restricted dietary is used by the body tissues of patients in sanatoria mainly for thermogenesis and energy production instead of combating tuberculous lesions.

Summer diarrhœa is again prevalent in the occupied countries.

Little accurate information can be obtained concerning epidemics, though from time to time reference is made to such outbreaks in the foreign Press. Recently it was stated that a severe epidemic of scarlet fever was raging in Denmark. In eastern Poland a virulent outbreak of tularæmia has been reported. This disease was previously unknown in Poland and seems to have been introduced from the U.S.S.R.

The chief epidemic bugbear is typhus. In Rumania there is little or no typhus, and the situation there appears to be well in hand. Polish prisoners of war, who might have conveyed the disease, were removed from the malarious area in the bend of the Danube to a healthier district, on public health grounds. Since the War, there has been much typhus in Poland, especially in the western region. In Warsaw and the Warsaw district there were some four thousand cases in 1940 as against thirty-three in 1938. There has been some typhus among German troops and in the front line. How much typhus has occurred in Germany it is impossible to say because the German figures do not include troops or residents in refugee camps. There has been no typhus in Hungary. Eighty-five cases are noted as occurring in a prison at Marseilles. The disease was imported from North Africa.

Every German soldier is inoculated with an omnibus vaccine in one administration. This contains an attenuated vaccine against typhus, an anti-typhoid vaccine (polyvalent) and a vaccine against dysentery. The inclusion of the latter vaccine seems of doubtful value. On the Continent a dead vaccine against typhus is chiefly used. The Germans are largely employing a brand prepared at the Pasteur Institute, Paris. There is a shortage of drugs, especially as regards anæsthetics, morphia and quinine.

The Allied Governments have announced that their first charge after the War will be to feed the inhabitants of the occupied countries, and they are making plans for this responsibility. If these countries are liberated gradually the task, obviously, will be much easier than if Germany collapses suddenly, as in 1918. A Continental expert considers that the chief demands will be for proteins, carbohydrates, yeast and ascorbic acid. The food should be supplied in as concentrated a form as possible in order to feed the greatest number. At first it will not be necessary to aim at an ideally balanced diet. Energy-providing foods will be the main requirement.

GEOLOGY, GEOLOGISTS AND THE WAR EFFORT

ON various occasions apprehension has been expressed by British geologists at the haphazard use of them and of their science in the prosecution of the War. For example, the general unawareness of the services which geologists are able to render was dealt with by Prof. P. G. H. Boswell in his presidential address to the Geological Society in 1941. Later, Prof. H. H. Read discussed the position in an article in NATURE of January 10, 1942, and he has recently returned to the same topic in a talk, referred to below, to the Parliamentary and Scientific Committee. Further, in NATURE of March 14, 1942, the role of geologists in war-time was considered in a leading article, the concluding sentence of which was: "There must be more enlightened direction from above, to ensure that wherever geology impinges on human activity, in war or in peace, the contribution it can make is recognized without delay and appropriate action taken".

This advice, wherever else it may have borne fruit, appears to have fallen on stony ground, if we are to believe a Press report, at a "northern school of military engineers", where it is stated that a squad of water-diviners has been formed in the Royal Engineers. The information has most likely aroused nothing but a little pleasurable excitement among the general public who, as Prof. Boswell and Prof. Read both emphasized, are deplorably ignorant of geological matters. Unfortunately, however, this interesting item of British news was reproduced in the *New York Times* under the caption "Dowser Squad in Army—British to use Water-Divine s in the Middle East". Certain of the Americans, like most of the Russians, are more aware of the part to be played by geological knowledge in war, and this small news item will not tend to increase their estimate of British military efficiency.

The present position was summed up in a revealing reply given by Sir J. Grigg in the House of Commons on January 19, in answer to a question by Capt. Studholme as to what extent the War Office relies upon dowsers for advice on water supply. The reply is worth quoting in full: "The War Office does not rely on dowsers for advice on water supply in the United Kingdom, and so far as I know the only place where they have been tried is the Middle East. A report of their performance there showed a very small percentage of successes, and orders were issued that scientific geological methods only were to be used."

Total war implies the use of any and every means to beat the enemy. There are circumstances in which the employment of a squad of dowsers would be justifiable and proper to this end. Those circumstances would arise when no geologists were available or no geological information obtainable. Then in that dire hour, water-divining, witchcraft, magic or necromancy of any hue might be called upon both 'to amuse the troops' and to lend a degree of colourful camouflage to plain 'wild-catting'.

But these circumstances justifying the use of dowsers do not exist, for both geologists and geological information are in plentiful supply. It is known that a number of geologists are serving in many branches of the army, but not as geologists; among the members of the Canadian forces in Great Britain are geologists of experience, resource and skill. The staff of H.M. Geological Survey of Great Britain includes geologists completely conversant with every aspect of underground water-supply; many academic and professional geologists are available with a skill in the investigation of groundwater problems acquired in many years of consulting practice. A galaxy of geological talent is thus ready and eager to apply the resources of their science. We have, however, to record the melancholy fact that, so far as we know, two geologists are employed as such in the British Army. During the War of 1914–18, the number of geologists employed as such in the Forces was, by slow and painful steps, raised to five; the recent formation of the 'Dowser Squad' appears to indicate that there is still little appreciation in military circles of the services geologists can perform.

It is probable that these remarks will incite the wrath of water-diviners. It must here be explained that this present protest is more concerned with the non-employment of geologists, who are demonstrably equipped for the investigation of underground water, than with the employment of water-diviners, who are not demonstrably equipped with any certain powers in this direction. In this latter connexion, it is worth while to recall the tests of dowsers made at Guildford some thirty years ago. These tests are recorded in the *Sanitary Record and Municipal Engineering* of May 2, 1913, and were conducted by a committee of scientific men with the late William Whitaker, F.R.S., as chairman. Whitaker had no rival in his knowledge of the groundwater of south-east England. Three sites were chosen which gave a variety of known underground water conditions. One site had 20 ft. of gravel on clay and was traversed by a large sewer, the second formed the top of a service reservoir from which water was rapidly being run off, and the third was known to contain a hidden spring with a yield of about 50,000 gallons an hour. These conditions afforded an ideal test for water-diviners. Seven diviners were conducted over the sites and their findings recorded and compared. The descriptions of these would require too much space, but the conclusions of the Committee may be given. They are as follow:

"The general conclusions of the Committee on comparing the state of facts known to exist with the indications given by the diviners, are that whatever sensitiveness to underground water may exist in certain persons, of which some evidence has been given, it is not sufficiently definite and trustworthy to be of much practical value. Moreover, the lack of agreement with each other shows that it is more a matter of personal mentality than any direct influence of the water. The diviners as a rule confine their attention to small streams of water, and as there are few places where these cannot be found they may well show a large percentage of successes."

On the most charitable judgment, therefore, the powers of water-diviners are 'not proven'; on an ordinary judgment, they are "not . . . of much practical value". The formation of the 'Dowser Squad' of the Royal Engineers is an event which cannot commend itself to the scientific public. It is an event, too, which becomes inexplicable when it is recalled that an account of the uses of geology during the last War was published by the Royal Engineers themselves in a volume entitled "The Work of the Royal Engineers in the European War of 1914–1919: Geological Work on the Western Front" (Chatham: Secretary, Institution of Royal Engineers, 1922).

In the talk* to the Parliamentary and Scientific Committee to which reference has been made, Prof. Read makes a number of representations, among which is one inviting that Committee to press upon the War Office and other Service Departments the importance of the contributions that geology can make to the war effort. Prof. Read quotes Sidney Paige, senior geologist in the North Atlantic Division, U.S. Engineers, as saying: "Let thought be directed toward methods of supplying all possible relevant technical data, geological and otherwise, to those who have a particular engineering job to perform in the Army or out of it".

One of the difficulties in carrying out this sound advice is that unfortunately geologists alone appear to be qualified to decide the type of work for which geology is required. This restriction results fundamentally from the neglect of geological studies in the schools and universities, a neglect which forms the subject of another of Prof. Read's representations.

This difficulty just mentioned—that geologists know best when they should be employed—is among the topics considered by F. L. Aurin in a "Memorandum to Members of the National Service Committee of the American Association of Petroleum Geologists"†. In this memorandum, it is pointed out that engineering skill cannot be substituted for the geologist's knowledge of rocks. Aurin maintains that this has been repeatedly demonstrated in the United States and cites the case of the present road between Los Angeles and the San Joaquin Valley; the present route was indicated as the most feasible one by geologists about fifteen years ago, but for many years competent engineers struggled with construction and maintenance problems on an alternative route. He asserts that geologists should have worked ahead of the construction parties on the Alaskan Highway, and that geologists should be on other critical military

* Geology and Geologists in the War and the Peace. By Prof. H. H. Read. (Parliamentary and Scientific Committee, Courtfield House, London, S.W.7.)

† *Bull. Amer. Assoc. Petroleum Geol.*, **26**, No. 7; July 1942.

roads such as any from India to China. Aurin's memorandum contains the following pertinent paragraphs :

"Since the type of work to which geological skill will contribute can be determined only by a geologist, it is essential that there should be an organization in the Army comparable to that used in industry. No industrialist of experience would dream of attempting to make the decision of whether or not geologic work is desirable on a given project. He, therefore, establishes a chief geologist with adequate staff to advise him when and where and what type of work should be done and to recruit the essential personnel and assign it to its tasks. There should, therefore, be such a staff geologist so located that he will automatically learn of contemplated construction projects and of the areas where knowledge of the geology will contribute to the effectiveness of attack or defense. These men will then be able to advise that a certain number of geologists with certain qualifications are needed at this, or the other point."

"Without some such mechanism as has been outlined, I see no hope that geology can be used as one of our special tools for winning the war. If such mechanism is provided, I have no doubt that it will contribute very substantially and that each geologist so employed will save men and materials for other effort and will, in special cases, contribute as only a highly trained specialist can contribute to our success."

"In this war, as in no preceding war, we depend on science, and geology is a specialized branch of science for which there is no substitute."

It appears from this memorandum that the United States, in spite of its much better geological record than that of Great Britain in the War of 1914–18 and of its considerable awareness of the importance of geology, still has not reached perfection in these matters.

The utilization of geology and other branches of scientific knowledge was the topic of the discussion which followed Prof. Read's talk, to which notes by various speakers are appended. There, for example, Mr. J. G. Bennett, of the British Coal Utilisation Research Association, considers that the technical information already available from the coal survey of Great Britain is not being exploited to the fullest possible extent. Dr. N. F. M. Henry regards geologists as themselves largely to blame since they have neglected to take active steps to ensure that geological knowledge is properly applied. More fundamentally, Mr. G. B. R. Pimm, of the Institution of Structural Engineers, considers the utilization of science and scientific workers by the Service Departments as part of a much larger question, namely, their proper use in the War, and the reconstruction and post-war periods. Mr. Pimm considers that this "can only be brought about by Regulations introduced by Organised Science, defining the place of Science in the service of the community, and the status, and rights and duties of all scientific bodies, particularly the Chartered Bodies already charged with the advancement of the various branches of Science".

These are broad and large matters following upon the consideration of the place of dowsers in the war effort, but the mobilization of the small 'Dowser Squad' is a symptom of a widespread disease.

J. J. THOMSON

The Life of Sir J. J. Thomson, O.M., sometime Master of Trinity College, Cambridge

By Lord Rayleigh. Pp. x+300+8 plates. (Cambridge : At the University Press, 1942.) 18*s*. net.

LORD RAYLEIGH has written a most excellent and satisfying account of the life of Sir Joseph Thomson. The book gives an adequate explanation of Thomson's epoch-making scientific work, and, in addition, a sympathetic and revealing description of his characteristics as a man.

Modern physical science is not an easy subject to expound to those who have no background of scientific knowledge. A choice has to be made between using elementary mathematics, and eschewing even the simplest equation in favour of a sometimes long circumlocution in words. In the preface, Lord Rayleigh makes it clear that he has chosen the latter course—"No formulæ have been used". Even so, eminent literary men have been heard to say they could not follow the scientific part of the book. Whether this is due to the difficulty of the author's task or to the deficiencies of a literary education must remain a matter of opinion.

Within the limits Lord Rayleigh lays down for himself, Thomson's work is well described, due emphasis being given to the more important results. The new physics may be said to have begun with Röntgen's discovery of the X-rays in 1895. The rays were found to make gases conductors of electricity, and Thomson and Rutherford carried out a joint investigation which showed that conducting particles are produced by the X-rays and that the particles can be made to carry a current if acted on by an electric force. By this process the charged particles are removed, as indeed they are if the conducting gas is left to itself. Thus there are likenesses and differences between conduction through gases and through liquids ; both are due to the motion of charged particles or ions, but in conducting liquids the ions are always present, while in gases they have to be formed continually by an ionizing agency. On these lines an explanation of the phenomena of conduction through gases was given.

Thomson then turned to a study of cathode rays—the straight rays which proceed from the negative electrode when a current is passed through a gas at low pressure. Two views of their nature were held : most English physicists, following an original suggestion of Varley, thought that they consisted of a flight of negatively electrified particles, while a theory of waves was supported in Germany. The rays are deflected by a magnetic field, and, at an early date, Thomson, chiefly for this reason, took the corpuscular view. He measured the deflexion caused by a known magnetic field, and the kinetic energy of the rays by a thermo-couple, and thus found that the velocity was 15,000 km. a second and the ratio of mass to charge was 2×10^{-8} gm. per coulomb, to compare with 10^{-5} for the hydrogen ions in liquids, about a thousand times greater ; thus in cathode rays either the charge must be larger or the mass smaller. In 1897 Thomson made the cautious statement : "these numbers seem to favour the hypothesis that the carriers of the charges are smaller than hydrogen atoms"—a momentous pronouncement which does not seem to have created much interest at the time ; the chemical atom was too firmly established. Then he attacked the problem in another way. If the cathode ray stream consists of negative particles, it should be deflected by an electric field. Thomson therefore passed it between two parallel metal plates connected with the opposite poles of a battery, and, when the residual gas was very highly exhausted, got the deflexion. From this, he found a ratio of mass to charge agreeing approximately with his former result.

Much evidence was available to show that electricity, like matter, is atomic, the unit being that carried by the hydrogen ion in electrolysis. It was therefore increasingly probable that in cathode rays the mass was small, not the charge large. To confirm this result it was necessary to measure the charge directly, and this was accomplished by Thomson using a method based on the rate of fall of cloud drops condensed on gaseous ions, a method developed from work of C. T. R. Wilson and used by J. S. E. Townsend, who confirmed thereby that the charges were the same as those on liquid hydrogen ions. On these results, combined with Rutherford's on ionic velocity, Thomson found the charge on a single particle to be 2×10^{-19} coulomb, which confirmed the conclusion that the mass was much smaller than the hydrogen atom. Again, in order to measure both quantities on the same particles, Thomson used those projected from a metal plate exposed to ultra-violet light in a gas at very low pressure. The same result followed.

These infra-atomic particles were at first called corpuscles by Thomson, but they were soon identified with the electric units named electrons by Johnstone Stoney, a name also used by Larmor, Lorentz and others. After some years, Thomson himself adopted what had become the general usage.

This amazing discovery was J. J. Thomson's greatest contribution to physical science ; others had been working towards the result, but the chief credit goes to Thomson. His investigations opened a new epoch and led to the enormous developments of the last forty years.

Rayleigh points out that, after a comparatively quiescent period during 1901–6, Thomson gradually reached another peak, culminating, about 1912, with his work on positive rays, a fitting counterpart to his investigation on cathode or negative rays. Positive rays are much less easily deflected than negative ones, and are clearly ordinary atoms or molecules carrying electric charges. If the electrostatic and magnetic deflexions are arranged to be at right angles to each other, since one is inversely as the velocity and the other inversely as its square, a parabola is traced on a photographic plate, and if other charged atoms or molecules are present, each one produces its own parabola. For this work high vacua are needed, and the success was largely due to Dewar's method of absorption in charcoal cooled in liquid air. Thomson's most striking result was the discovery of two curves for the gas neon, indicating atomic weights of 20 and 22. Thus ordinary neon is a mixture of two bodies, named by Soddy isotopes. This discovery pointed the way to the great work of F. W. Aston, whereby so many elements have been shown to consist of isotopes.

Thomson was a great experimentalist, but he was not a skilful manipulator. He depended on others —especially his assistant, Everett—to handle his apparatus, though he was fertile in planning, and in suggestions when difficulties arose.

Science, moreover, owes to Thomson the creation of the Cavendish school of physics. When Cambridge in 1895 admitted as research students men from other universities, they flocked to the Cavendish Laboratory in ever-increasing numbers. Most of the prominent physicists in Great Britain and the Dominions, and many in the United States, received part or all of their training at Cambridge. Thomson's relations with the research students were most happy, and perhaps best seen at the annual Cavendish dinner, with songs composed for the occasion. Rayleigh singles out for special commendation one of which the chorus runs :

"Here's a health to Professor J. J. !
May he hunt ions for many a day,
And take observations,
And work out equations,
And find the relations
Which forces obey."

Lord Rayleigh justly praises also Thomson's moderately elementary lectures meant for undergraduates reading for Part I of the Natural Sciences Tripos. Rayleigh says, "I think I learnt more from these lectures than from any others I ever attended". Perhaps I may be allowed to echo those words.

From 1915 until 1920 Thomson was president of the Royal Society. For the first three years of the period the Society and many of its members were engaged on war work. Thomson himself served on the Board of Invention and Research under the chairmanship of Lord Fisher, for whom he acquired a great admiration.

In 1918 Thomson became Master of Trinity College. The appointment is in the gift of the Crown, and the Prime Minister (Mr. Lloyd George), after consulting Lord Balfour, recommended J. J. Thomson, knowing, he says in a letter to Lord Rayleigh, "his supereminence as a scientist". In his new post Thomson had to face duties and responsibilities unlike those to which he was accustomed. But his devotion to the welfare of the College, his interest in both its intellectual and its athletic achievements, were soon patent to all and won the appreciation of both fellows and undergraduates. As Lord Rayleigh says, he was readily accessible, never in a hurry, and always good-tempered, sometimes in rather trying situations.

Thomson died on August 30, 1940, and his ashes were laid in Westminster Abbey, near the graves of Newton, Darwin, Herschel, Kelvin and Rutherford.

Lord Rayleigh's book gives a worthy account of a great man of science. W. C. D. DAMPIER.

ATLANTIS REVISITED

An Unknown Land

By Viscount Samuel. Pp. 222. (London : George Allen and Unwin, Ltd., 1942.) 12*s*. 6*d*. net.

IT is no difficult task for a philosopher with some knowledge of science and some ideas for the regeneration of the human race to paint a picture of Utopia. What is difficult is to portray a Utopia in which the ordinary man or woman would care to live. Possibly W. S. Gilbert's gentle irony has all but achieved that feat, and suggestive as are many of the passages in this entertaining book, with one reservation, it is not the fascinating picture of scientific advance and social and intellectual development that remains most clearly in the memory after reading this book, but rather those passages in which, describing three of the States of the "Small Heads" who have separated in schism from the Utopia of the "Big Heads", Lord Samuel gently satirizes Russia, Germany and Great Britain. A competent journalist with real knowledge of science might have given as suggestive an account of the scientific advances of the Bensals, their achievements in agriculture, in industry, in fishery, in atomic energy, but in this long chapter on the Islands there is humour and humanity, and the philosophy which is the distinctive feature of Lord Samuel's essay in Utopia is warm as well as prescient.

Lord Samuel uses an old device to let his imagination and philosophic mind depict a people of reason and peace, detached from this disordered world, in the Southern Pacific where Bacon placed his "New Atlantis". Of Bacon's work this is indeed a continuation, though Salomon's House is no longer the one organization for scientific research as described by Bacon. It has been split up into several establishments in different places, though the Renfusa Institute at the capital town of that name is the lineal descendant of Salomon's House, and its central buildings on the same site are devoted to physics, astronomy and inorganic chemistry, with some of their applications in engineering and chemical industry. Biology has been transferred to an immense Institute elsewhere, and if neither biologists, physicists nor chemists can be expected to take Lord Samuel's account of Bensal achievements in research too seriously, that account should not be altogether rejected.

The chief defect of the book is indeed that Lord Samuel has poured too much detail into this receptacle of his full and inquiring mind. That may well obscure one of the dominant features of the book in contrast with Bacon's "New Atlantis". It is an essay on the reconciliation of philosophy, science and religion. With the new era which opened in Bensala with the introduction of suturization, the operation by which the Bensals delay the closing of the sutures of the skull and so give a longer period for the development of the brain, the inhabitants of Lord Samuel's Utopia turned from their concentration on material progress, with its achievements in mechanical invention, industrial chemistry and agricultural biology, to philosophy and religion. Here Lord Samuel develops not only a theory of education and a profound philosophy of "mental ambiency" but also the ideas of the 'sieve' into which the Bensals put all the ideas of the past and from which they extract the sensible "gist"—a kind of Napoleonic code of all knowledge and faith which assists the mind to discard its lumber.

Lord Samuel writes with his own charm and distinction, but does not disguise his debt to Butler and to Wells, no less than to Bacon. None the less, there is a certain unreality in this philosophical and ethical discussion. In banishing squalor and wretchedness and misfortune, the Bensals have banished also the human greatness of spirit which can triumph over tragedy and misfortune. The smug complacency of the Bensals is at times in almost revolting contrast with the heroism and fortitude with which thousands of men and women to-day are facing the tragedies and hardship of this War. It is difficult to believe that Lord Samuel anywhere in this volume touches the ultimate issues and values of human experience.

On a more practical plane, the pertinence of Lord Samuel's picture to present discussions on reconstruction is clear. By the device of inviting the Bensals to suggest the first steps to be taken if we were to accept as an ideal a system more or less like their own, he outlines a practical programme of reform. Also he delineates firmly and with prescience the problems that advancing mechanization and increasing leisure must set for us too, and on the road to reconstruction he sets the lights unmistakably at amber and green.

The contrast between the Bensal working week of nine hours, their custom of primary and secondary occupations, their elimination of purposeless occupations, may be in exaggerated contrast with conditions in Britain. That exaggeration, however, effectively points to the constructive thinking that must be done on the problem of leisure and on education for citizenship, before we can enjoy the advantages which mechanical advance has put in our hands without social disruption or disorganization in mass unemployment and mechanized amusement. This compressed mixture of science and philosophy, religion, politics and economics is not too indigestible to stimulate thought as to where mankind is going, and the moral values as well as the material standards which should be our guide. It may well have its place in provoking that new outlook and the receptive and creative minds through which alone there can emerge after this conflict a world order, warm with human life, safeguarded with humour, as well as enriched by the wise, ordered and co-operative use alike of the traditions and experience of the past and of the powers which science has put into our hands.

R. BRIGHTMAN.

BRITISH BIRDS

The Birds of Britain

By James Fisher. (Britain in Pictures Series.) Pp. 48+12 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1942.) 3*s*. 6*d*.

MR. FISHER'S "Birds of Britain" belongs to a series, Britain in Pictures, the distinctive features of which are (1) the beautiful illustrations, generally from work by leading artists; (2) the high standing of each author in the subject about which he writes. The book before us is no exception. Mr. Fisher is one of Britain's best young ornithologists. The illustrations in his new book have been chosen from the works of the best British artists and are represented by twelve coloured plates, beautifully reproduced, and twenty-six black and white drawings.

The author includes 424 different species of British birds, a list which is complete up to 1941. These are very usefully divided into nine sections: (1) residents (133); (2) residents now extinct (1); (3) summer visitors which breed in Britain (52); (4) summer visitors which have bred in the south (2); (5) winter visitors (26); (6) passage migrants (23); (7) scarce or irregular visitors, and vagrants (100); (8) birds which have been reliably recorded in Britain a dozen times or less, but more than once (61); (9) birds which have been reliably recorded only once in the British Isles (26). In his review, Mr. Fisher does not give a long list of the birds with descriptions useful only for reference purposes; most of his text makes fascinating reading. It is divided into sections: a bird's-eye view of Britain; peculiarity of British birds; historical changes; late changes; the observers; the future.

This book will prove to be a valuable acquisition to anyone interested in natural history.

THE NATIONAL GALLERY IN WAR-TIME

By F. IAN G. RAWLINS
Scientific Adviser to the Trustees

IT is one of the necessary sorrows of war that scientific workers are bound, for the most part, to apply their knowledge and skill for the time being to the work of destruction. It is also true, as is already obvious, that some good comes out of evil, but the primary aim is, and must be, to destroy. Naturally, there are heroic efforts to mend and to repair, perhaps even to restore; yet they are hard pressed to keep pace with the forces of obliteration. In this article, however, we are contemplating a happier theme, in which applied physics and kindred branches of technics have been harnessed deliberately and specifically to a project of conservation. Consideration of some such scheme is usually simplified a little by financial reasoning—the relative value of the things to be kept safe and the cost of doing so. But with the nation's heritage of pictures, in some respects the most precious and representative in the world, these terms become largely meaningless. It is the bare fact of irreplaceability which dominates thought. Loss or serious damage admits of no compensation. If science can help in this great quest for security, it will have shown that even in war its part is not wholly to undo. To save for posterity becomes an overwhelming urge.

Well before the outbreak of hostilities, the Board of Trustees of the National Gallery had approved plans for evacuation from the great building in Trafalgar Square, London. These were, in fact, implemented and the bulk of the collection was hundreds of miles away from London immediately before September 3, 1939. The programme of removal had been accomplished in ten days, in accordance with schedule. A tolerable exile had been arranged in various houses and halls. So far so good. Risks were reasonably spread. Administration and invigilation functioned duly. But was all this sufficient ? Indiscriminate bombing all over Great Britain set in. Nowhere above ground was safe in the special sense applicable to unique and irreplaceable objects. Even the fire-risk assumed new proportions in some respects. Thus, inevitably, the question was raised whether deep shelter could not be found, and if it could, what new hazards and imponderables it would introduce. Here indeed was a task for science, to shoulder its full measure of responsibility. In the sequel, some indication may be seen of the course of events. Meanwhile, all the refuges above ground had fulfilled their purpose, providing safe shelter unimpaired until their supersession.

A Deep Shelter Policy

In a matter of days, as it turned out, the Gallery was committed in principle to seek a subterranean home. The prime need was to find it. Mines, quarries, tunnels, caves, even deep defiles capable of being artificially roofed and reinforced were visited and discussed. Seldom must such a search have been started, and more rarely still could one have been more disappointing in its opening stages. Site after site was rejected on grounds such as those of possible flooding, presence of noxious vapours, insecure roofs, difficult access, probability of becoming a target later on for indirect reasons, and so forth. Up to the time of writing, two of these locations are definitely known to have experienced incidents which, had they happened when in use as repositories, would have constituted in one case a major disaster, and in the other a potential threat too grave to have been disregarded. These facts are mentioned to demonstrate that sanctuary was not to be had merely for the asking.

Six precious weeks went by with nothing to show for them but negation. Then, almost by chance, the outlook changed. A site offering sufficient space to house the whole collection, and possessing between 200 ft. and 300 ft. of rock cover, appeared. The access was not easy, and it was obvious at once that fairly heavy works would be needed to make it suitable for the purpose. Nevertheless, it was possible. The natural temperature within was 47° F. and the relative humidity 95–100 per cent. Tradition locally had it that the temperature was unchanged throughout the year. No data in support of this were extant, and there was no time to begin extended observations. Instruments were put in position for a week as a rough guide. The temperature remained at 47°–48° F. and the relative humidity at a point approaching saturation. There was no alternative but to accept these figures as characteristic. A good record for freedom from falls of roof was produced (for this particular type of workings), and the risk of flooding could be taken as negligible. There were no noxious vapours, and the material present in bulk was chemically inert. There were other features too, not shared by most places of the kind, of a favourable nature. Beyond these broad considerations, nothing could be said with certainty. In addition to the increasing danger to the pictures in their quarters above ground, it became necessary for special reasons to make an immediate decision to accept or reject this place. In any event, some six to twelve months would elapse before it could be ready for occupation.

Within a matter of days, the Trustees, the Treasury and the Office of Works (now the Ministry of Works and Planning) had agreed to accept and to go ahead. It amounted almost to a venture of faith. The National Gallery thus became possessed of a repository offering cover against aerial attack to a degree approaching impregnability. Nothing but an earthquake could harm the contents mechanically. At the same time, due to the high relative humidity, ruin within a month might be expected for the pictures if this was not dealt with, and restrained, during the whole period of occupation. Furthermore, access was physically impossible for a large percentage of the collection. Thus, to begin with, matters were not easy. But the decision was clear-cut. The protective cover was ample, and the capacity for storage adequate. All the other troubles must in consequence be overcome.

Reviewing the situation at the present time, with the great collection safely housed, it may be stated that no major disadvantage was overlooked in that rapid decision. It was thought to be feasible to accomplish the task, and so in the event it has proved. Naturally, this is far from implying that there is little more to do. Life there, in some respects, resembles that of the crew of a ship at sea. Constant watch and ward was never more essential. There is much machinery, and full provision for emergencies. The pictures themselves need thorough-going inspec-

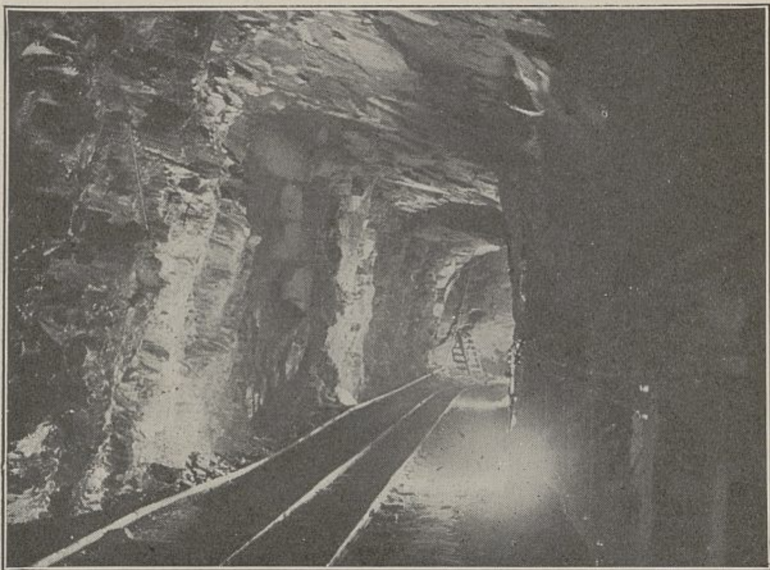

Fig. 1. THE MAIN UNDERGROUND APPROACH LEVEL. THIS WAS ORIGINALLY OF CROSS-SECTION 6 FT. × 6 FT. AND WAS ENLARGED TO 13 FT. 6 IN. HIGH AND 10 FT. WIDE.

tion at frequent intervals, if one is to be reasonably certain that all is well. Sometimes they need treatment, and this has been provided for. Temperatures, relative humidity, ventilation, electrical gear, the stability of the fabric, the workings themselves, all require ceaseless attention if accidents are to be avoided to within the limits of human fallibility. There is plenty of the unknown in this great bid for safety. From the beginning, the main responsibility for the safe-keeping and administration of the National Collection in exile has rested upon Mr. Martin Davies, to whom also is due much of the planning of its underground home.

In the next section, the arrangement of the repository and the apparatus installed will be described in some detail. Where information is lacking, the explanation is probably that data on that particular matter exist, but must be withheld at present for security reasons. When the time is appropriate more can doubtless be said.

The Underground Repository

The decision to place the great national collection below ground having been taken, the work of making the site suitable for the purpose devolved upon the (present) Ministry of Works and Planning. At this point a tribute of appreciation to the officers and staff of that department may be gratefully made, both for what has been done and for the way in which they have striven to meet the special requirements and ideas of the National Gallery. With a project so novel, it was only to be expected that some set-backs would occur ; the isolated position and the season of the year in which operations began both had their share in making progress exceptionally difficult and arduous. When the full story of this aspect can be told in detail, it will probably be admitted that the period of preparation, though somewhat longer than anticipated, was not excessive. The managing director of the company working the site did all in his power to help in every way. The site was first seen on September 17, 1940. Four days later the decision to accept it was taken. Blasting operations started a few weeks later, and most of the buildings were ready for drying-out (but not for occupation) in May, 1941. By August, 1941, all essential engineering services had been completed and the buildings were ready to receive the pictures. The move in began on August 12, 1941.

The nature of the underground workings was such that the only reasonable way of securing proper temperature and humidity conditions (as well as due invigilation) was to erect separate buildings underground, and to 'condition' them individually. (By 'condition' is not meant full air-conditioning, as technically understood, but bringing physical conditions within each building to a state satisfactory for the contents, by the comparatively simple means to be described later.)

These buildings were designed to have no mechanical strength ; they are simply 'envelopes' on a large scale. Of light brick construction and the inner walls and ceilings covered with wall-board, the floors are concrete, and the roofs are of fabricated material (treated with ruberoid) on top of which rests a wire-mesh mattress. The function of this is to distribute the weight, should any *small* fragments of rock fall from above. No provision is made against *heavy* falls of rock. This matter is one for constant expert vigilance on its own account, and upon it complete reliance

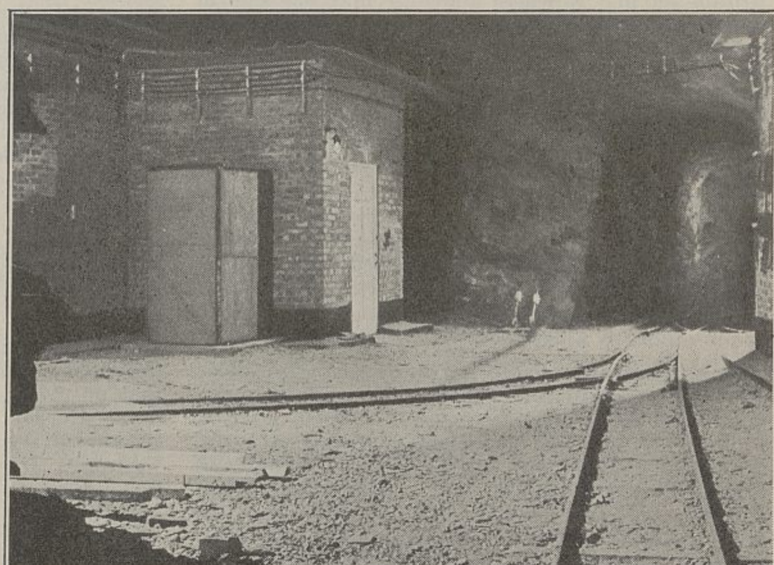

Fig. 2. A TYPICAL PLANT ROOM AND PART OF STORAGE BUILDING.

has always been placed. Steps have been taken to ensure that all aspects of this possible hazard are kept under close review.

A question to be decided at the outset, which had a direct bearing upon lay-out, was the amount of wall-space needed, regarded particularly as a function of height. The guiding principle was that, in general, stacking of pictures was to be avoided. All were to be accessible for ready inspection. In this way, the problem was one of two dimensions rather than of three. The demand for height was such that ten feet would suffice for the great bulk of the collection, with fifteen feet for a small percentage of the total. In fine, this meant six buildings, five giving a headroom of 10 ft. inside, and one with a 15 ft. clearance.

These needs made somewhat rigorous demands upon the placing of the buildings, if maximum accommodation was to be secured. Thus, they vary considerably in shape and size. All except one are on a common level; the exception is approached by an easy flight of steps, and is reserved for pictures capable of being safely carried up by hand. Fortunately, there are many of a size suitable for this. The question was discussed at the outset whether any real advantage would be gained by having two-story chambers, where the natural height available permitted. This was answered negatively, both on the score of time and expense of making such buildings, and of the difficulty and dangers of taking pictures to and from the upper floor by stairs, lifts or cranes.

It may be mentioned here that the 15-ft. chamber already alluded to was designed to serve a double purpose. Its first duty was to act as the receiving and unpacking station. The vehicles containing the pictures, when they arrived, drove down a tunnel some 200 yd. in length, into this building, which is large enough to allow of turning and is provided with a suitable unloading dock and ramp. In fact, this building was planned in close co-operation with the railway companies who undertook the task of transport. The second purpose of the building was to house the largest pictures, and to act in some measure as an inspection shop for all the larger works. Thus, all unpacking took place in 'conditioned' surroundings. The overall size is solely governed by the amount of space available, but the inside dimensions were most carefully considered in the light of general experience in moving, storing, and inspecting pictures. A fair amount of room is needed for carrying, turning and so forth: to cramp this unduly would be to risk accidents. Almost every building is provided with a small work-room where such operations as laying blisters can be carried out. By these means it is rare that a picture has to leave its conditioned surroundings for treatment.

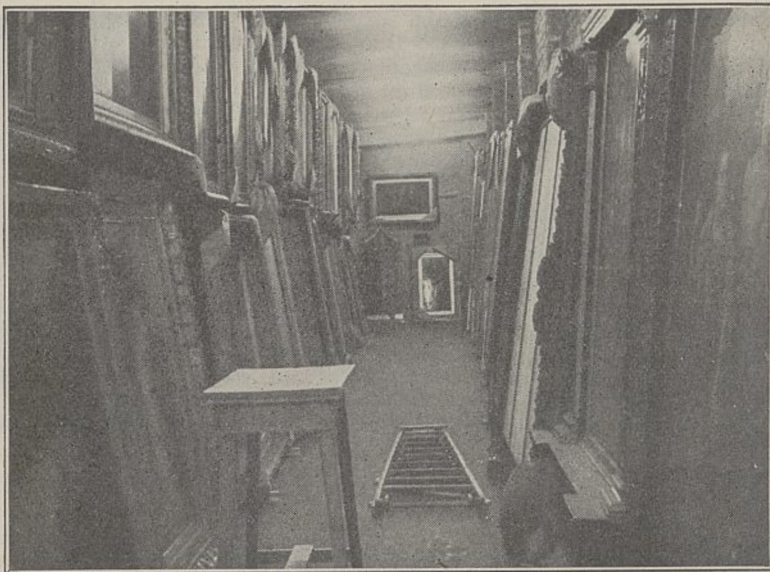

Fig. 4. INSIDE ONE OF THE STORAGE BUILDINGS, SHOWING PART OF AN AISLE, WITH PICTURES IN POSITION. THE HEIGHT IS 10 FT. FROM FLOOR TO CEILING.

The plant-room contains the heating and ventilating machinery required for each building. One such plant-room and equipment suffices for each, except in two instances where shape and capacity necessitated the provision of two such plant-rooms.

The guiding principle in regard to the major problem of 'conditioning'—in the limited sense already explained—has been to make each building a separate self-contained unit which can be controlled individually as desired, so far as temperature and relative humidity are concerned. The advantages of this were found in the early stages of occupation, when the storages were gradually filling up with pictures (after a suitable

Fig. 3. PART OF A STORAGE CHAMBER BEFORE OCCUPATION, SHOWING STACK OF SCREENS (LEFT), READY TO BE FIXED BETWEEN THE UPRIGHTS IN CENTRE.

period of thorough drying-out, expedited by the use of refrigerating plant). Due to the concentration of so much hygroscopic material (wood and canvas), it is easier to obtain stable conditions when a building is full than when it is empty. In addition, certain other categories of valuable material are present, which need a physical environment of a slightly different kind. Again, when material first arrives, it can be gradually acclimatized to its new surroundings by the appropriate regulation of temperature in a certain building.

When the site was first explored, it had three factors of value from the physical and engineering aspects. These were: (1) a constant temperature so low as 47° F. inside the workings, as already mentioned; (2) easy access to electric power; (3) water, sufficient for engine cooling. In view of (1), it was considered that a satisfactory relative humidity in the buildings could be obtained by temperature-control alone, that is, there would be no need for a permanent de-humidifying plant. This relative humidity was provisionally fixed at 55–60 per cent at 62° F. It should be maintained constant to within 3 per cent. This is a narrow tolerance. The point is that once a relative humidity between 55 and 60 per cent—say 58 per cent—has been set up within a building fully occupied with pictures, then it is undesirable that fluctuations should lead to higher values than 61 per cent or lower values than 55 per cent. Owing to the impossibility of forecasting exactly what would happen with such an indefinite 'population' as a combination of panels and canvases, it was agreed to proceed on this basis. To anticipate for the moment: experience of a full year's working has shown that the plant gives, as an example, a relative humidity of 57 per cent at 64° F., with a variation in the former of less than 2 per cent over a period of many months. In general, the temperatures in the various buildings are some 2°–3° F. higher than anticipated, if the correct relative humidity is to be obtained. Of the two factors, relative humidity is decidedly the more important. The reason for this slight temperature excess, and an indication of the methods to be adopted to reduce it, will be considered later. The question of the influence of temperature upon mould growth has also been taken into account.

As already mentioned, each building has its own plant room or rooms containing the necessary fans for air distribution, heating batteries, dampers and automatic controls, the plant varying in output according to the requirements of each building. The essential equipment consists, in each plant, of an

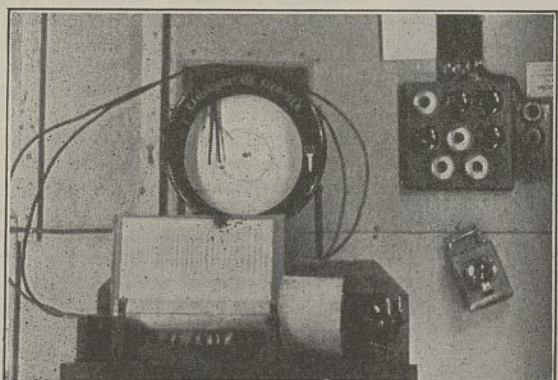

Fig. 5. HYGROMETER, CONSISTING OF DISC-TYPE TEMPERATURE RECORDER AND ASPIRATING SYSTEM.

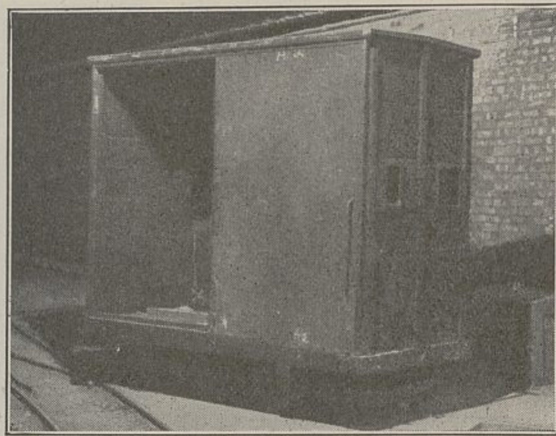

Fig. 6. CLOSED TROLLEY (ONE OF THE FOUR SIDE-DOORS REMOVED) FOR CONVEYANCE OF PICTURES BETWEEN VARIOUS STORAGE BUILDINGS.

electrically driven fan drawing air through a suitable filter, delivering it over a heater battery into a simple plenum in the chambers.

Warm air is distributed as evenly as possible through ductwork having low-velocity outlets, and is controlled by louvre and slide-type dampers. Provision is made for partial or total re-circulation of the warmed air, and the proportion of fresh air introduced can be controlled. The unusually stable temperature conditions outside the buildings make thermostatic control as ordinarily understood unnecessary. Overriding high-temperature protection is provided and remote warning of a rise or fall in temperature exceeding 2° F. is given.

The only variable is that of electricity supply voltage at the terminal of a long and heavily loaded rural system, and this is compensated by hand adjustment of the calibrated louvre dampers, and by switching off sections of the heater batteries. This maintains conditions well within the differential limits of commercial thermostats and without the need for heavy voltage control equipment.

Normally, the system works on almost full recirculation of air, with a change of about four per hour. The operating cycle begins at the plant room, where a very small amount of fresh air at 47° F. and 95 per cent relative humidity is 'bled' into the system through intake louvres. The air passes into the filters, mixing with the recirculated air drawn from the chambers. Then it passes through the fan, across the heating battery, through the duct system and is delivered to the rooms through a series of suitably placed orifices. Then the air is drawn back to the plant room through 'recirculation openings' normally kept open. Excess fresh air drawn in at the plant room displaces a part of the stale air through 'evacuation valves' provided for the purpose. When fresh air is being drawn in and filtered there is always a slight outward pressure from the rooms which assists in preventing introduction of any dust from outside.

On occasions, staff is required to work inside the rooms and then the air can be freshened by opening fully the fresh air intake louvres, and closing the 'recirculation louvres'. Air escapes through the evacuation valves. For a given heat input, the temperature then tends to fall, and if the blow through is of long duration, the heat input must be increased.

The advantages of almost complete recirculation are a reduced power consumption for heating, and less heat loss to parts of the workings outside the buildings where the natural ventilation is sluggish.

There has been experience of local temperature rise to 52°–53° F. from 47° F. with decrease in thermodynamic efficiency, and to overcome the consequent rise of relative humidity in the rooms while maintaining temperature, it has been necessary to use calcium chloride as a pre-drying agent for fresh air entering certain plant rooms, and to install powerful fans to draw on the vast volume of air at 47° F. in other parts of the workings. At the worst, in one part, a maximum temperature of 66° F. has been necessary to maintain 58 per cent relative humidity. Energetic measures are being taken to introduce cool air to this locality, and shortly it is expected that it will be reduced to uniformity with the rest of the system.

The flexibility of the whole system is important. Certain valuable material needs individual treatment, and conditions in a building or part of a building can be readily adjusted without any widespread disturbance of conditions.

Throughout, it must be remembered that fungus and moulds constitute a formidable danger to pictures. Research shows that at such a modest figure as 68 per cent relative humidity, especially at temperatures of above 70° F., trouble may occur. Free circulation of air is an effective counter weapon. This is amply provided for in each building. A number of trial canvases and panels have been placed in various parts of the workings—outside the storage chambers—to observe what happens to them in air at around 47° F. and approximately saturated. Moulds were observed well within a month and, in one case, in eighteen days. Constant vigil is kept, not only on the pictures, but also on all incidental woodwork and fabric. Routine inspection is undertaken at short intervals.

The recording instruments in use are simple but essential. In every building there is a hygrometer of the type shown in the illustration. These consist of a standard double-pen disc type mercury-in-steel temperature recorder, adapted to work with an aspirating system composed of a couple of asbestos fibre tubes through which air is drawn by a small fan and motor. In one tube is the wet bulb, and in the other the dry. From the former, a suitable wick dips into a trough of distilled water. (The air-flow is at approximately the same rate as that generated by a psychrometer or whirling hygrometer.) From standard tables, and from the reading of the wet- and dry-bulb temperatures, the relative humidity in the chamber is known at any moment. Calibration with a psychrometer, as a check, is carried out at frequent intervals. These composite hygrometers have been found most satisfactory: a little difficulty was experienced initially in getting the exceptionally large amount of wick to saturate evenly and continuously, but this has been overcome. If the plants are stopped down for a couple of minutes, a decided knick is observed on the charts, thus giving confidence in rapid reaction.

Thermometers are placed at every recirculation louvre throughout the buildings, so that engineering staff can read them from the plant rooms on their patrols. A series of 'standard temperatures' have been worked out empirically, corresponding to the desired conditions within.

Outside the chambers, at various points in the workings, temperatures are recorded daily, to make sure that the ventilation remains satisfactory.

The possibility of electric power breakdowns and failures has been most carefully considered. On this account a 140 h.p. low-speed Diesel-alternator, capable of taking the whole load of motors, fans, heaters, lights and accessories, has been installed. Due to the isolated situation and the severity of local conditions, calls upon the emergency plant are not uncommon. Before the pictures were moved in, a stringent test was made, the generating plant maintaining the whole load continuously for a week. This was thought necessary in view of the reliance placed upon electric power to keep the relative humidity in the buildings from rising (within a matter of a few hours) to dangerous limits. Fortunately, circumstances are such that a more rapid deterioration is not to be expected, but there is not a great deal of margin in this respect. Almost equally important is the need for prompt—almost immediate—restoration of lighting after a breakdown. Experience has shown that it is never more than 2–3 minutes before the stand-by plant is running and normal conditions return. The double calamity of a failure of both electricity supply and stand-by plant at the same time has been envisaged, and super-emergency measures designed to mitigate such a situation so far as possible. There is, of course, staff on duty day and night. As mentioned before, an adequate (but not limitless) supply of water, capable of being treated for use in engine cooling, is at hand.

Indications have already been given of the somewhat heavy engineering works involved in this whole project. To conclude this section, some details may be of interest. Initially, the site (for the purpose in view) was practically without access. A new road, entailing some considerable excavations and embankment, was therefore constructed. Within the workings themselves, enlargement of adits and levels necessitated the blasting and removal of some 3,000 tons of rock (including work now in hand for the improvement of ventilation). In addition, a further 2,000 tons were removed by hand-labour from the floors before it was feasible to begin the erection of the storage buildings. In this enterprise a special appreciation must be made of the work of the local company's manager, under whose direct supervision these operations were all carried out. He discharged this task rapidly, and thanks to his knowledge of the local strata, without accident of any kind.

For the necessary transport of pictures and stores (including engineering equipment), the National Gallery needs about a quarter of a mile of underground narrow-gauge railway. The maximum gradient encountered is 1 in 20 for a few yards. Special rolling stock was built for it by one of the main-line railway companies. An example is shown in the illustrations. These trolleys (propelled by hand) have proved invaluable. In fact, it would have been impossible to have 'moved in' without them. Day in, day out, they are in regular use.

Future Problems

Large-scale research is scarcely practicable in a repository such as has been described, especially as the prime motive is that of conservation of the nation's great collection. Nevertheless, the future is not being left wholly to itself. A sizable body of data relating to temperature, relative humidity, condition and reaction of materials is being assembled, and may well take its place in contributing towards the post-war design of museums and galleries, and to the choice of environment considered best for works of art. It is possible that full air-conditioning of such institutions in large cities and certain other places might be found to be financially desirable, when the sums spent annually in restoration and repair of paintings are critically reviewed. Careful inspection will always be needed, but the experience so far of housing a collection of pictures below ground under controlled conditions, scientifically planned, is decidedly encouraging. It would be a pity if some of this could not be translated into terms appropriate to times of peace. Many great pictures are probably now going through severe hardships and many vicissitudes. Those for which the Trustees of the National Gallery are responsible, however, are at present enjoying a climate of such salubrity that the greatest problem for the future is to foresee how they will react when they leave it.

WILD BIRDS AND HOME-GROWN FOOD IN BRITAIN

By DR. WALTER E. COLLINGE

WRITING in NATURE in July 1918, I stated: "It behoves us to awaken and to take heed where we stand, or for some years to come our land will groan with the cry of desolation, due to our apathy and the ignorance and neglect of the ways and habits of our insectivorous birds, and the wanton destruction of what has ever been Nature's means of adjusting the complications of animal life, which man in his ignorance is seeking to pervert". In the quarter of a century which has since passed, the nation has lost millions of pounds worth of home-grown food.

For very many years past, I have given warning of the vital importance of framing a sound and logical policy relating to the protection and destruction of wild birds. To a very large extent this warning has fallen on deaf ears. Little or nothing has been done, the *laisser-faire* policy has been pursued, and at the present moment it looks as if Nemesis were about to overtake us. No useful purpose would be served by re-opening here the whole question. It is a difficult one, touching various interests and prejudices; but we must no longer shut our eyes to the various extremely dangerous suggestions that are being so widely circulated, and, I fear, in some cases being put into practice.

At the moment, the whole of Great Britain is deeply concerned in the production of the maximum amount of home-grown food and in being able to harvest it. In so far as it lies in the range of human endeavour, there must be no mistakes made that will lessen the harvest of 1943. We now know that big, clean crops of all kinds can be raised and harvested, provided they are kept free from pests and disease. Such pests as wireworms, leather-jackets and other soil-inhabiting insect larvæ exact an enormous toll on root and cereal crops. In a like manner, the larvæ of various moths and flies, and also aphids, take their toll of the fruit and other crops. The soil may be treated with various chemicals and the fruit trees sprayed, but both are only partial remedies and both processes are expensive and demand man-power.

Two primary facts stand out, namely: (1) Wherever the insectivorous birds of a district or districts are destroyed, either purposely or through climatic or other causes, there is an accompanying insect oscillation which is not reduced until the balance of bird life is restored. (2) In the case of certain insects the numbers of which remain relatively constant, the controlling influence is largely, if not entirely, due to the uniformity of the bird life from year to year.

Nearly sixty years ago, John Curtis told us that if the depredations of injurious insects could be brought under control "the benefit would exceed everything of which at present we have any conception". The amount of insect food that insectivorous birds will eat is very large. I have given the following as an illustration and in an endeavour to bring the fact home to the public. Assuming that there are 32,000,000 acres of land under cultivation in Great Britain and that we have a pair of birds to every four acres, these 16,000,000 would consume annually 135,411,328,000 insects, and these would be destroyed just at the season of the greatest agricultural activity and would be accomplished without any outlay of men or money. Yet it now seems that ill-informed people are advocating the destruction of rooks, gulls, blackbirds, thrushes and other insect-eating birds.

Very briefly, let us examine the facts concerning the few species of useful birds mentioned above.

Rook. During the past fifty years, this species has received more attention as regards its food habits than any other British species, and the general consensus of opinion is that this bird is economically of the very greatest value. The nature of its food has been shown to consist of large quantities of injurious insects and their larvæ, some of which are most difficult to destroy and which annually exact a huge toll on the produce of the land.

Sea-gulls. No more short-sighted policy than that of the destruction of sea-gulls has ever been promulgated, and if carried out will have results of a most devastating nature. We have at last given up the foolish idea that sea-birds generally feed only on fishes and therefore are impoverishing the supply. Nay, we have still further advanced, for we now realize that, so far as sea-gulls are concerned, the percentage of fish eaten is comparatively small, very small in some cases, and much of it is obtained from the garbage of the shore.

The black-headed gull—the bird that follows the plough—for the greater part of the year feeds upon injurious insects. The total percentage (stomach contents) for the year is 24·70, whereas the fish content is 3·73 per cent. The highest fish content for any month in the year was in November, with 12·85 per cent, whereas the percentage of injurious insects during April to October was 33·01, with the following figures respectively 32·96; 28·0; 37·30; 31·38; 38·83; 26·62; and 26·0.

"Of 664 specimens examined only 143 contained fish remains and 267 contained no marine organisms whatever."[1] For the common gull the figures were, injurious insects 14·66 per cent, fishes 5·16 per cent, and for the herring gull 9·52 per cent and 17·55 per cent respectively.

Blackbird. In 1924, I pointed out[2] that we had too large a resident population of blackbirds. From numerous observations made by myself and many correspondents, there was no doubt that the population seriously decreased during the winters of 1938–39 and 1939–40 (December to March) and investigations made during 1938 and 1939, when compared with similar ones made in 1933–34[3], showed that there was an increase in the percentage of injurious insects eaten from 22·0 to 30·5 per cent, and a slight increase in the percentage of slugs and snails. There was a striking decrease in the percentage of cultivated fruits and fruit pulp, which dropped from 25·5 per cent to 15·2 per cent. Complaints respecting this bird have been very few during the past few years.

Thrushes. The missel-thrush and the song-thrush are the only ones that concern us. Of the total food consumed in a year by the former, 30·5 per cent consists of injurious insects and 16·5 per cent of cultivated fruits. The figures for the song-thrush are 32·0 per cent and 15·0 per cent respectively.

Tits. Who it was who first accused the tits of being injurious I do not know, but I fully agree with Yarrell that "none can be more mistaken than these men". The great tit consumes 66·5 per cent of injurious insects per year and 3·6 per cent of fruit, while the blue tit takes 78·0 per cent of injurious insects and 6·0 per cent of fruit.

The above figures need no comment; their significance is patent to every thinking man and woman.

There are certainly a few injurious birds, chief among which are the starling, the house-sparrow and the wood-pigeon. Repressive measures for dealing with these are long overdue.

In 1921 I summed up my investigation[4] on the starling by stating that, failing some action as there outlined, "the agriculturist and fruit-grower will be left faced with a growing enemy which is devastating their crops and inimical to their interests, and the country with a portentous factor which is adding to the scarcity of home-grown food. In short, the starling has become a plague in the land and a source of great national loss". Observations made during the past eleven years fully bear out this statement.

It has been estimated that the house-sparrow occasions a monetary loss of £50,000,000 a year. Whether this amount is correct or not is of little matter. What we do know is that they consume a large amount of home-grown food, and if they were reduced to half of their present number, it follows that half of the huge total would be saved.

Before it is too late, it is necessary that the beneficial species I have mentioned above should be scheduled and the destruction of them or their eggs be prohibited. I feel certain if this were done now, even if only as a temporary measure, it would demonstrate once and for all what a powerful factor they are in ensuring prosperous agriculture.

Writing some little time ago I stated[5], "The 'man in the street' and others in high places may not have realized this, but nevertheless it is true, and unless we do realise the facts and take action our agriculture, forestry and all kindred arts are doomed. These are strong words, but only uttered after a life-time's acquaintance with the subject. . . . The Government and the whole of agricultural Great Britain are evading a great and vital problem of paramount importance to the nation and charged with its future existence."

Long ago the prophet Joel wrote, "Tell ye your children of it, and let your children tell their children. . . . That which the palmerworm hath left hath the locust eaten; and that which the locust hath left hath the cankerworm eaten; and that which the cankerworm hath left hath the caterpillar eaten. . . . The field is wasted, the land mourneth; for the corn is wasted. Be ashamed, O ye husbandmen, howl O ye vine-dressers for the wheat and for the barley; for the harvest of the field is perished."

Let us hope that we shall not have to give voice to similar words at the end of 1943.

[1] "The Food of Some British Wild Birds" (1924-27), p. 254.

[2] *J. Min. Agric.*, **31**, 182–186 (1924).

[3] *Ibis*, 610–613 (1941).

[4] *J. Min. Agric.*, **27**, 1114–1121 (1921).

[5] *Nth. West. Nat.*, **15**, 216–218 (1940).

THE ACADEMY OF SCIENCES OF THE U.S.S.R.

PROGRAMME FOR 1943

By ALEXANDER BAIKOV

Vice-President of the Academy

MORE than in any previous year, the plan of work for 1943 of the Academy of Sciences of the U.S.S.R. is designed to aid the Russian armed forces and war industries in securing a victorious termination of the War. Our main work will be directly concerned with improving armaments and therefore cannot be divulged; but it may safely be said that, if in the past year Soviet physicists, chemists and engineers did much to improve and increase the supply of materials, instruments and tools for war industries, in the New Year they will do considerably more.

Although the scientific effort of the country is almost entirely devoted to war needs, this does not mean that pure scientific research has been suspended. Russian mathematicians and physicists, for example, are continuing their investigations into the theory of numbers, the dynamics of the atmosphere, etc. However, the main effort this year will be focused on mobilizing the material resources of the country and increasing the supply of raw material for war industries. This work is under the direction of the Commission for the Mobilization of the Resources of the Urals, west Siberia and Kazakhstan, under the chairmanship of Vladimir Komarov (of the Academy), the Commission for Mobilization of the Resources of the Middle Volga and Kama Regions, and similar commissions which will make an all-round study of the problems involved. The plan of work of the Academy's geological and geographical department is devoted to exploration and study of new natural resources which may contribute to the country's defensive might, chiefly to the discovery of new deposits of manganese needed for manufacturing various alloys, aluminium, nickel, wolfram and other ores, as well as non-metallic minerals such as fireproof materials, for which there are now great industrial demands. Much work is also planned in locating new oil deposits and increasing the recovery in functioning oilfields. Great hopes are placed in the Volga-Bashkir expedition. Oil will also be searched for in the Permian Kama coal deposits of the Tatar Republic. As before, considerable attention will be paid to the secondary recovery of oil. Adequate coal supply is just now decisive for industry in the U.S.S.R., and Soviet men of science will make every effort to discover new deposits and help to increase the output from those already being exploited. The production of motor fuel from coal and shale of the Urals, Karaganda and the Far East occupies an important place in the plan of work.

Among eminent Soviet men of science who are engaged on the problem of mobilizing the country's natural resources, under the direction of Vladimir Komarov, president of the Academy of Sciences, are Alexander Fersman, Vladimir Obruchev, Alexander Skochinsky, Pavel Stepanov, Lev Shevyakov and Alexander Zavaritsky.

No less important a place in the Academy's plan is held by the problem of increasing the yield of cereal and industrial crops, such as rubber-bearing plants, cotton, sugarbeet, and potato ; and also the manufacture of artificial fertilizers. The working out of new industrial processes and the intensification of existing processes constitute the central item in the plans of the Department of Technological Sciences of the Academy. Considerable attention will be devoted to the development of the power resources of the eastern regions of the country so as to ensure an adequate supply to the new industrial areas. Efforts will be made to improve industrial gas generating stations, and also to put the gasification of new forms of fuel on an industrial footing, utilizing sources available in various localities and thus obviating the necessity for long hauls of fuel. This will involve working out the principles of design of highly efficient gas-generating installations. The Department will also deal with problems connected with the economic restoration of the liberated regions.

In chemistry, work will be concentrated this year on industrial utilization of raw materials in the eastern regions, and the manufacture of synthetic rubber, plastics, pharmaceutical preparations, etc. The Institute of Chemical Physics will continue the study of the theory of combustion, which is of cardinal importance in the design of prime movers. Alexander Porai-Koshitz will direct researches into the utilization of the chemical products of coke in industrial plants of the eastern regions. Peter Kapitza will continue his work on the design of a powerful machine for making liquid oxygen.

The work of biologists will include investigations on the healing of wounds, and also on the prevention of infectious diseases. It is proposed to treat shock and tetanus on a wide scale by the method of Lina Stern, of the Academy of Sciences, which involves influencing nerve centres by spinal injections. Efforts will be made to discover more effective blood-clotting substances, stimulants, pain-relieving and fatigue-relieving substances.

Historians will engage on a number of interesting investigations, including the history of various nations—the Slavonic history of wars and international relations, the history of the second World War, the history of Russian culture and a chronicle of the present Soviet-German War will occupy chief place. The Department of Languages and Literature is compiling a work on language changes during the present War, a dictionary of modern Russian edited by Sergei Obnorsky, and a study of the mutual influence of Russian and English literature in the nineteenth and twentieth centuries.

The programme of work I have outlined was endorsed by the council of the Academy of Sciences at a meeting held in Moscow under the chairmanship of the president, Vladimir Komarov.

OBITUARIES

Prof. Arthur Willey, F.R.S.

DR. ARTHUR WILLEY, emeritus professor of zoology in McGill University, Montreal, died on December 26. He was the son of the Rev. William Willey, a leading minister of the west of England. After education at Kingswood School, Bath, he proceeded to University College, London, where in his second year he worked in Lankester's research laboratory. After taking his degree he was sent to the Stazione Zoologica, Naples, where he did research on Tunicates and Amphioxus, afterwards returning to the College as fellow.

Amphioxus was reinvestigated by Willey from every aspect, as it was a key animal in the controversies on the ancestry of vertebrates. In opposition to Cuvier's four types of structure, Saint-Hilaire sought a unity of plan homologizing insects and vertebrates, Leydig especially comparing their brains. Kowalevsky followed in 1866 with researches on Amphioxus, but in 1875 Semper and Dohrn independently maintained an annelid ancestry for vertebrates. In the early nineties most schools of zoology seriously discussed all these views, but in 1894 Willey's book, "Amphioxus and the Ancestry of the Vertebrates", caused almost a revolution. He had tried his matter out in a course of lectures at University College, when he had insisted on his practical work including every stage in the development and structure of Amphioxus in comparison with Ammocœtes.

At this time the leading zoologists of Great Britain became excited about the Pearly Nautilus. This "pre-tertiary creation" had been re-examined by Graham Kerr, following on work by Ihering and Ray Lankester, and a knowledge of its embryology was desired. To this end the managers of the Cambridge Balfour Fund elected Willey their student and continued him for five years. Nautilus had first been described by the great Dutch naturalist Rumphius, together with many Malayan 'plant animals'. Owen was excited by the anatomy of a later specimen, but Cuvier did not live to see it in the flesh. Its shell had been known from the time of Aristotle, but it was always compared with that of the argonaut, which floats on the sea-surface in connexion with the development of its eggs. It was supposed to be related to Spirula, the soft parts of which were equally scarce, although its shell is common on tropical beaches. This form, however, has a floating life with a shell that has been reduced to a minimal weight and size and has become almost internal, whereas Nautilus is a ground feeder in comparatively deep water with an immense shell, the animal being in a terminal chamber out of which its crawling and feeding tentacles protrude ; its flattened shell is held upright on the ground. Specimens which had floated to the surface, on which the early anatomy had been studied, were mostly moribund. Willey trapped specimens in relatively deep water ; the bait was mashed-up crayfish wrapped in coconut fibre so as to be invisible to the animal, which proved to be attracted by smell, its pinhole eye not being the efficient eye of most cuttle fish. The necessary breeding for the embryology did not succeed with the means at Willey's disposal, but the anatomical account published in the "Zoological Results" of his expedition is classical.

The scene of Willey's first labours was in Blanche Bay, New Britain, now known as Rabaul. It is a

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circular rocky bay open to the east; a camp was pitched on an island erupted in 1878. The floor at 50 fm. and deeper was ridged by lava lines with deep chasms between, the feeding ground of Nautilus. A coconut plantation covered the low ground and was an oasis of civilization due to Parkinson, almost a 'king'. The island had been partially subdued by that warlike missionary, George Brown, but conditions were primitive in the extreme, the natives still in the stone age, and Willey was in constant danger, but at all times quite imperturbable. Here in the primitive native canoes with a 'boy' or two, he went out day by day, laying his baskets, hand trawling and sweeping his surface nets, returning to an open shelter and cooking his taro, breadfruit or yam with an occasional fish, a tunicate flavour often added from his experimental colonies. New Guinea, to which he went next, was even worse, the natives being flesh rather than fish eaters. It was alleviated by the purchase of a small sailing cutter. The D'Entrecasteau and Conflict Groups were visited and Willey was anchored off Buna for some time.

When sailing, one of the boys jumped overboard to secure a floating cuttle bone and off this, when placed in a pan of water, were secured quite a number of organisms, including some which could both crawl and swim. These proved to be Ctenoplana, a single specimen of which had been described in 1886. As it crawls it is a flatworm, and as it swims a ctenophore, transparent and provided with swimming plates. This important intermediate form, later worked out in Haswell's laboratory at Sydney, made up for many disappointments. There was also a lancelet, Asymmetron, previously caught only in the Bahamas but now known to be cosmopolitan.

New Guinea proving unsuitable for Nautilus, a move was made via New Caledonia to the Loyalty Islands in the New Hebrides, even then governed by a condominium between France and England. Off Noumea, an enteropneust, Ptycodera, was found; this with later specimens was the subject of a long memoir, a comparison with West Indian forms and Amphioxus. A settlement was finally made at Sandal Bay, Lifu, and here for eight months Willey tried to make his Nautilus breed, but its heavily yoked eggs were always infertile. The island population (7,000) were enjoying the everlasting Catholic v. Protestant fights, and so far as the French authorities were concerned there was, as usual, little generosity. Land as well as marine animals were collected and on these more than thirty memoirs were published in the "Zoological Results". Willey's special contribution among these was on a primitive beast from Rabaul, *Peripatus novæ-britanniæ*; this gave him great pleasure as he had an unbounded admiration for F. M. Balfour, whose classical memoir on *Peripatus capensis* he greatly admired. A further visit to New Britain terminated two years of field research.

On his return, Willey became lecturer in biology at Guy's Hospital, London, and he was shortly after elected to the Royal Society. He did not like this soul-killing job, and social conditions in England were to him unpleasant, while the climate was anathema. He was hence glad to go to Colombo as director of its Museum, a post he held from 1902 until 1910. Here in Ceylon he found a fauna little known except for Kelaart's Prodromus, 1892. He supposed he would find many animals peculiar to the island and a fauna comparable to the flora as described by Tennant and Trimen. He set out to examine the mammals but found no important forms not already known from southern India. The phenomena of endemicity were best represented in the reptiles, now being monographed by Deraniyagala. The fauna is analogous with those of Great Britain and Tasmania in relation to their neighbouring continents, but there proved to be relationship to the East Indies. Educational requirements were the subject of several reports, as also the sea and freshwater fisheries and various molluscs. The Museum began to take a scientific shape, no longer merely a collection of curiosities. It was an uphill job at first, the attitude of the ruling authorities being deplorable, while collectors seldom appreciated the necessity of accurate data. The *Spolia Zeylanica* was founded as a quarterly journal, since when zoology in Ceylon has never looked back. Willey's own researches wandered into the marine worms connected with the pearl banks. As an amusement he was collecting data for a book, "Convergence in Evolution", which at the time created great interest among students, stimulating the closer study of the living forms.

In 1911 Willey commenced his courses at the McGill University, where he remained for the rest of his life. From here he always wrote happily of his teaching and life in the University—and as an adopted son of Canada. He had a research interest which wandered into every side of animal life, plankton, placentation in the beaver, Branchioderma and Branchiotrema, general marine conditions, Arctic Copepoda and even a research on "Reductions and Reversions in the Wing Venation of the Stoneflies". He was called upon to advise on many economic sides, and Macallum paid high tribute to the value of his opinion. The University Club especially interested him, and with age he became less sensitive and retiring, while preserving a pleasant liveliness in disposition. He acquired a solid popularity, for he was always dependable. J. S. GARDINER.

Prof. F. M. Cornford, F.B.A.

PROF. F. M. CORNFORD, who died at Cambridge on January 2, at the age of sixty-eight, was the first occupant of the chair of ancient philosophy established there in 1931. He became a fellow of Trinity in 1899, and was a lecturer in classics until his election to a readership in 1927.

His published work was abundant and falls naturally into two periods, divided by the War of 1914–18 during which he served in the Ministry of Munitions. The earlier period is especially marked by an interest in the origins of Greek philosophy, and in the religious conceptions from which it developed. Thus the leading principle in "From Religion to Philosophy" (1912) is a distinction between the 'mystical' school, represented by Heraclitus, Pythagoras, Empedocles and Plato, a school which seeks primarily to preserve what the religious consciousness values, and a scientific school, including Anaxagoras, the Atomists and others, which tends to discard religion for rationalism. In "The Origin of Attic Comedy" (1914) he sought to explain the structure of the extant plays by examining the ritual forms which lie behind them; here he was influenced by the work of Jane Harrison and Frazer. An earlier work, "Thucydides Mythistoricus" (1907), was a daring re-interpretation of the historian's mental background and of the religious framework which governed the selection and presentation of his material.

It is no disparagement of these earlier and more speculative works to say that Cornford's most permanent achievement is to be found in the post-war books, "Plato's Theory of Knowledge", "Plato's Cosmology" and "Plato and Parmenides", in which he translated and interpreted four important Platonic dialogues. Departing from the ordinary form of commentary, he skilfully interwove translation with running comment in such a way as to produce books which can be read as continuous wholes. To readers with scientific interests the edition of the "Timæus" called "Plato's Cosmology" will probably appeal most strongly: it reveals perhaps most fully its author's many-sided knowledge and power of argument; few classical scholars could have dealt so successfully with the problems of astronomy and physics, physiology and medical theory which the "Timæus" presents.

Jointly with P. H. Wicksteed he translated Aristotle's "Physics" in the Loeb series, and the notes and summaries marked by his initial show how competent he was to interpret Aristotle's discussion of such fundamental concepts of science as time, space, movement and infinity. About a year ago his last book appeared, a translation of the "Republic", of which it can only be said here that it is more than a translation, and makes an excellent introduction to Plato for the 'unprofessional' reader.

Much important work of Cornford's is contained in periodicals, especially in the *Classical Quarterly*: it includes an examination of the Pythagorean number-doctrine, a paper on "Innumerable Worlds", and a new interpretation of Anaxagoras's theory of matter. Finally, his chapters on philosophy down to Aristotle in the "Cambridge Ancient History" can be warmly recommended to anyone wishing to make a first acquaintance with ancient thought.

R. HACKFORTH.

Sir Henry Maybury, G.B.E., K.C.M.G., C.B.

SIR HENRY MAYBURY, who died on January 7 at the age of seventy-eight, was a wholesome-looking, thick-set man with a capable headpiece, a general friendly attitude towards his fellows and a tendency to come to decisions to which he adhered with what admirers called his determination and critics his obstinacy. His first fame came when he was surveyor to the County of Kent (1903). That was about the time when a friend and I were organizing the Gordon Bennet motor race in Ireland. Its description by a jarvey illustrates the position: "Those parts of Oireland that's not consailed wid dust is covered wid people".

In circumstances like these, Maybury made his successful efforts in Kent to abate the intolerable dust which cursed the early days of the motor era. He courageously used tar-bound instead of water-bound macadam, and soon found he had achieved the great advance of making roads waterproof. He pushed forward with it with insistence, was hailed as a saviour by the owners of riparian property, and made Kent roads a model for the rest of the country.

Somewhere on Salisbury Plain a number of consecutive lengths of road all bearing the same traffic (that is, with no side junctions) and suitable for considerable speeds were prepared, each according to a different formula. The run being substantially free from bends and the surface level, it called for no stops, starts, accelerations, swerves or brakings. As these are the chief causes of road wear, no perceptible deterioration or wear by vehicles revealed itself. What did transpire was that the waterproofing with tar, bitumen or the like minimized what is a substantial source of road costs, even in unused roads, namely, land creepage, vegetation, weeds and, above all, deterioration by sun, rain and frost. The waterproofing would pay for itself in upkeep economy. Before long, water-bound macadam, gravel, and slippery roads made with chalky marl began to disappear.

Maybury was no researcher. His training as a railway engineer inclined him rather to the *ad hoc* experiment. Besides, the Harmondsworth Research Station for road materials to which so much of recent progress must be referred was not then in its stride. As chief engineer to the Road Board (1913) and later as chairman of the London and Home Counties Traffic Advisory Committee (from 1924) he accumulated much traffic experience. There came before him the noteworthy reports of the Metropolitan Police between 1920–27. They revealed year after year for seven years that high vehicle speeds occupied a far smaller place in the records of fatal accidents in town than did low speeds. Speeds not exceeding walking pace (less than 5 m.p.h.) were concerned in six times more deaths than were all speeds above 20 m.p.h. Moreover, a predominant majority (80 per cent) of fatal accidents occurred when the previous speed of the vehicles involved had been less than 15 m.p.h. On this Sir Henry Maybury's ripe experience led to the notable phrase often quoted from Report No. 61434–12: "A careful examination of these reports clearly indicates that there is an intimate connexion between the number of street accidents and traffic congestion". That was a new idea.

The moral is clear. Unfortunately for safe traffic flow afoot or awheel in Greater London, Sir Henry resigned in 1933, and now many of us sincerely deplore the final loss of his clear-sighted "obstinacy".

MERVYN O'GORMAN.

Prof. F. J. Allen

DR. FRANK JAMES ALLEN died on December 28 at Letchworth; he was born in Somerset in 1854. He went to Cambridge to study medicine and came under the influence of Michael Foster, and was one of the many physiologists who was inspired by that great teacher. He was awarded first-class honours in the Natural Sciences Tripos in 1878. He went to St. George's Hospital, London, where he studied clinical medicine, and later became an assistant medical registrar at that Hospital.

Sometime after qualifying in medicine, Allen returned to Cambridge as assistant demonstrator in physiology under Foster. He was elected a member of the Physiological Society in 1888, and later became a member of the Committee of that Society. He was appointed professor of physiology at Mason College, Birmingham, in 1888, and played a part in the negotiations which led to the formation of the University of Birmingham. He resigned his professorship in 1898 to enter general practice.

While in Birmingham, Prof. Allen gallantly captured a dog suffering from rabies and in doing so he was bitten by the animal. He went to the Pasteur Institute in Paris for treatment, and described his experiences as a patient at the Institute in the *Birmingham Medical Review* of 1898. The success of the treatment he received at the Institute is evident by the fact that he lived for a further forty-five years.

In his younger days, Allen made several contributions to physiological knowledge, and later devoted his spare time to a study of ecclesiastical architecture, publishing a book, "Great Church Towers of England", in 1932.

Allen was a widely read and cultured man, very modest and unaffected, and though many of his generation have passed away he is remembered by those who knew him with great affection.

H. P. GILDING.

WE regret to announce the following deaths :

Prof. A. K. Cajander, formerly professor of forestry in the University of Helsinki and director-general of the State Board of Forestry in Finland, who was Prime Minister of Finland during 1922–24 and 1938–39 and Minister of Defence during 1928–29, on January 21, aged sixty-three.

Capt. B. S. Cohen, formerly director of the Post Office Research Station at Dollis Hill, London, aged sixty-nine.

Prof. Edmund S. Conklin, formerly head of the Department of Psychology, University of Indiana, on October 6, aged fifty-eight.

Mr. A. H. Cornish-Bowden, for many years surveyor-general to the Government of the Union of South Africa, on December 5, aged seventy-one.

Prof. J. F. Craig, professor of veterinary pathology in the University of Liverpool.

Dr. Cyril Crossland, the first director of the Marine Biological Station at Ghardaqa, Gulf of Suez, on January 7, aged sixty-four.

Lord Hirst, honorary member of the Institution of Electrical Engineers, chairman of the General Electric Company, on January 23, aged seventy-nine.

Dr. A. L. Lowell, emeritus president of Harvard University, where his tenure of office, 1909–33, covered a critical period in university affairs, on January 6, aged eighty-six.

Dr. Alexander Russell, F.R.S., formerly principal of Faraday House, London, on January 14, aged eighty-one.

Prof. J. Strohl, professor of zoology and comparative anatomy in the University of Zurich.

NEWS and VIEWS

Science in the Service of Art

SIR KENNETH CLARK, director of the National Gallery, has sent the following notes referring to the article on "The National Gallery in War-time" by Mr. F. Ian G. Rawlins which appears on p. 123 of this issue. Mr. Rawlins has been scientific advisor to the National Gallery since 1934. To him the Gallery owes its admirable laboratory with X-ray, infra-red and ultra-violet ray apparatus, and equipment for microscope, tintometer and spectroscope work ; and when the War began he was conducting important researches into the structure of pigments and the physical condition of old paintings. A few of his experiments in radiology are contained in the publication "From the National Gallery Laboratory", which was reviewed in NATURE of February 8, 1941, p. 165. In the years before the War, he was also closely concerned with the methods by which the pictures might be safely evacuated, and when finally it became desirable to place the whole collection in entirely bomb-proof subterranean vaults, he was responsible both for the discovery of a suitable site and for planning the equipment described in the accompanying article.

In the construction of the shelters and installation of plant, Mr. Rawlins worked in collaboration with the Ministry of Works engineers, and thanks to his foresight and attention to detail all the difficulties of this ambitious undertaking have been completely overcome. From the point of view of physical conditions, there is no doubt that the National Gallery pictures are better off than they have ever been or will be in the future. Mr. Rawlins's work did not cease when all the plant was installed and in working order. Constant vigilance is necessary to keep the perfect balance of temperature and humidity. In this work Mr. Rawlins has been ably assisted by Mr. Martin Davies, the member of the Gallery staff in charge of the depot, who has brought efficiency and unsparing devotion to the task of conserving the nation's pictures.

Polish Homage to Newton

THE Association of Polish Technicians in Great Britain held a special tercentenary celebration of Isaac Newton, under the chairmanship of Prof. Max Born, in the Mathematical Institute of the University of Edinburgh, on January 17. Addresses were delivered by Prof. E. T. Whittaker and Dr. S. Neumark, formerly *dozent* in aeronautics in the University of Warsaw, and now a flight lieutenant in the Polish Air Force. He was introduced by Major Chodacki, formerly High Commissioner for Danzig. Prof. Whittaker remarked that as the celebration had occurred in 1943, it had fallen in the same year as the quadricentenary of the death of Copernicus. Dr. Neumark, in his lecture in Polish, demonstrated Newton's decisive contribution in the development of natural science by means of a chronological diagram. This represented Newton as the central figure receiving the inheritance of the previous preparatory period, and extending his creative influence all over the world and over numerous fundamental branches of science. Newton's principal discoveries in the fields of mathematics, mechanics, astronomy, optics, aerodynamics, theory of heat and general foundations of natural science were described and illustrated by simple mnemonic diagrams. A rough classification of the whole of Newton's work showed that he made the incredible number of thirty discoveries of the first importance, each of which would have sufficed to confer permanent glory upon the discoverer. Newton's direct practical contributions to industry and to the progress of Britain were illustrated by his work at the Royal Mint, his remarkable steps towards developing mass production and his influence as president of the Royal Society. Dr. Neumark ended his lecture with a brief discussion of the unique problem which Newton's scientific personality offers to students of human creative power and genius. The linking of the centenaries of Newton and Copernicus is a happy prospective for the future relations between science in Britain and Poland.

Engineer or Physicist ?

ALTHOUGH the importance of physics in industry is now almost universally recognized, and the fairly obvious deduction that the application of physics to industry calls for the presence of physicists in the industrial team is beginning to be appreciated, the exact function of the physicist in the team is by no means generally agreed. There are still employers who are under the impression that every physicist is a potential Newton or Rutherford, and others who regard him as a sort of super-engineer, capable of providing an immediate remedy for all the day-to-day difficulties which crop up in the factory. Both classes are likely to suffer severe disappointment. It would, of course, be admirable if every engineer could be his own physicist, or every physicist a master of engineering. Unfortunately, both fields of knowledge are now so vast that this is no longer possible. Progress in industry demands the services of both engineer and physicist, and close and cordial co-operation between them. Cordiality is most likely to be maintained if each has his recognized sphere, and sticks to it.

The matter has recently been discussed by Dr. Percy Dunsheath in an article in *Engineering* (Dec. 11, p. 474). Dr. Dunsheath, who has, as one might say, a foot in both camps, is very well qualified for making a functional analysis of the situation, and his article will repay close study by all responsible for the direction of industry. The article is too long, and too closely knit, for abstraction. Dr. Dunsheath's conclusion is that the physicist's principal function in industry is to provide a liaison between the "continuous spate of new knowledge of the physical universe" and the factory, and so "translating it for early application". "The engineers," he concludes, "must all be physicists up to a point, but the physicist, so long as he carries physics to the utmost boundary of existing knowledge, need not be an engineer. . . . By fundamental research to collect and establish physical laws and the application of this systematized knowledge, the physicist can do much to refine industrial science which ultimately must be the practical work of the engineer."

The 'New Deal' as a Social Philosophy

AN exceptionally interesting interpretation of the origin and nature of the programme known as the New Deal in the United States is contributed by Prof. D. Mitrany to *Agenda* of October 1942. Prof. Mitrany insists that the whole philosophy and policy of the New Deal derives from the fact that the era of the physical frontier has closed and that the United States stands at the threshold of the social frontier. The New Deal is not a programme or an ideology conceived and propagated as a theory before it could be practised. It was set in motion by social necessity; and a pragmatic attitude, a readiness to experiment, is characteristic of it as a whole, but was more marked during its first stage. The fact that the New Deal is a policy rather than a theory, and an improvised policy, makes it difficult to distil out of its action the social philosophy which inspires it. America's present social forces and trends have developed with the New Deal, and the crystallization of the new outlook has largely been stimulated by realization that the means for a full life were there, but that the old system had failed to make them available.

The measures of the New Deal fall in three broad but well-defined groups: in their effect on the mass of the people; in their effect on the use of the nation's material resources; and lastly, in their effect on government. For the mass of the people the New Deal has set out to provide security first, including protection against arbitrariness of economic wealth and power and gradual and continuous improvement afterwards. The activity of the New Deal for the salvage of the nation's material heritage makes an impressive programme, of which the Tennessee Valley Authority provides the outstanding example, as it does also of the changes which the New Deal is bringing about in the government of the United States. In establishing public control of the public use of those resources, the New Deal has broken sharply away from the old system, and the history of the Tennessee Valley Authority provides an illuminating epitome of the passage of public attitude from the 'old deal' to the New Deal and of the struggles that mark its progress. A great constitutional transformation has occurred without any formal changes in the constitution. The New Deal may be said to have brought about three essential changes in American outlook and policy: solicitude for the 'forgotten man'; solicitude for the country's natural resources and technical equipment; and a centralized public action for these two social purposes. The United States are passing from a social ideal of individual effort for individual reward to an ideal of mutual effort for common advancement, and Prof. Mitrany points out that the change involves a new outlook, a new method and a new purpose. The New Deal is still in its formative stage, but it is in essence a philosophy of social action. If its ends cannot be reached through international action, it may be thrown back during its next phase, as it was during the first phase, upon action of a national and socialistic kind.

Problems of Communal Feeding

MR. F. LE GROS CLARK has issued a broadsheet on "Soviet Forms in Communal Feeding". Coming as it does at a time when we are witnessing a rapid development of communal feeding in Great Britain, it is of very great interest and importance. Catering for people in large groups is not only economical in food, fuel and man-power, but also provides a good opportunity of improving the nutritional status of those fed. It is obvious from this study that the Soviet peoples are fully alive to both these aspects, and it is interesting to find that they came up against just those difficulties which are being encountered now in Great Britain. Needless to say, they dealt with them in their usual thorough manner. Our own tribulations might have been less had we taken advantage of their experiences. Thus, while we search for some means of preserving the palatability and the ascorbic acid content of meals cooked in kitchen depots and distributed in insulated containers, we read here that: "In 1931 the decision was taken to abandon completely the method of conveying cooked food in insulated containers and to utilise the depots almost entirely for the output of uncooked but partly prepared food of all kinds". In the same year, the wages of the kitchen staff were brought into line with those in other branches of industry. Mr. Bevin is struggling with this point now. Details are given of development, control, training of personnel, official standards to be achieved, 'special diets' sections, school canteens, rural canteens, etc. A study of them is heartily recommended.

Sylvicultural Research in Bengal

MOST of the provinces in India draw up a quinquennial programme of sylvicultural research work and prepare an annual report on the work undertaken in accordance with the programme. For this purpose a sylvicultural research officer is selected from the ranks of the Forest Department. The annual report on sylvicultural research in the Presidency of Bengal for 1940–41 (Government Press, Darjeeling, 1941) is by Mr. D. A. G. Davidson. In connexion with research in such an important branch of his work as sylviculture, which is its foundation, it appears that at a Divisional Forest Officers' Conference held in Darjeeling in 1940 a resolution was passed which reads, "the practice of allowing divisional officers to undertake research independently of the Sylvicultural Branch should be discontinued and no funds should be provided in future for divisional experiments". It is difficult to understand the meaning of, and the purpose underlying, this attempt at granting a monopoly to a research branch. In forestry, the opportunities for observation by the divisional officer, that is, the man who spends much of his time out in the forests in a definite locality which he can thus get to know with some intimacy—and in India this means large areas—are exceptionally advantageous. The officer may be every bit as observant as the research officer and has better, because more numerous, opportunities for carrying out a piece of research work up to a certain point.

The attempt to introduce exotic, faster-growing species in connexion with forestry has become a common habit in many parts of the world. Experiments in this connexion were commenced at Darjeeling and neighbourhood seventy and more years ago. The research officer is still engaged on these experiments. Attempts have also been made to induce seed production by ringing the trees, after the method practised for fruit trees. But most of the trees ringed in Bengal died. In experimental plots in the Chittagong Hill tracts, although the second story species, *Dichopsis polyantha*, *Artocarpus chaplasha* and other evergreen species regenerated profusely, the regeneration of the top species, Garjan (Dipterocarpus), has proved unsuccessful. It may be suggested that the Garjan might be added to the mixture by planting it in lines at 30–40 ft. apart and at such distance in the lines as may be decided, and that big plants should be used. This method has been found successful under somewhat similar conditions in West Africa.

Floatless Pump Control System

LONDEX, LTD., 207 Anerley Road, London, S.E.20, have introduced a patented system ("Lectralevel") of floatless liquid level control, designed for automatically pumping out, filling or maintaining the liquid level in a container and employing a single mercury switch for controlling the pump motor starter. The pump suction pipe may be earthed and used as one side of the control circuit, the pressure of which (25 v.) is derived from a small double-wound transformer supplied from the power or lighting mains. The control circuit is completed through the liquid to be pumped, and only light insulation is required for the electrodes, which may be of ordinary galvanized wrought iron tubing. A shorter electrode terminating at the highest level of the liquid is connected direct to the relay, and when the level rises to this electrode the relay is energized and the pump motor started. A longer electrode is immersed in the liquid to the lowest required level and is connected to the relay by the same lead through a resistance of a few ohms, its function being to pass sufficient current through the relay to hold the latter closed after the level has fallen below the short electrode. When the liquid level falls beyond the longer (lower) electrode, the relay circuit is interrupted and the pump motor automatically stops. The motor is not restarted until the level reaches the shorter (upper) electrode, when the aforementioned resistance becomes short-circuited and sufficient current flows to actuate the relay. The relay employed is the Londex *LQA*, the mercury switch of which carries up to 20 amp. at 440 v. Where the liquid is under pressure or insulated electrodes cannot be employed conveniently, a patented automatic liquid level control device of the induction type is available wherein a float is employed to alter the magnetic conditions in two coils which respectively operate the relays at high- and low-liquid levels.

Medical Services in Argentina

IN a recent paper (*Bol. Of. San. Panamer.*, **21**, 955; 1942) on this subject, Dr. Hugo J. D'Amato, general secretary of the National Department of Hygiene, Buenos Aires, states that malaria exists in endemic form in northern Argentina and sporadically in the coastal zone. There was a considerable reduction in the number of cases in the endemic area in 1941 when the number of consultations was 193,000 as compared with 231,000 in 1940. More cases of goitre received attention in dispensaries in 1941 than in 1940, there being a high proportion of cases among school-children in the north. The campaign against venereal disease is being actively carried on, as is shown by the fact that the Public Health Department has secured supervision of 717 dispensaries, and serological analysis was being carried out in six cities in 1941. The law for prematrimonial examination is rigorously enforced with excellent results. During 1941, 389 new cases of leprosy were reported, making a total of 4,727, of whom 46 died. In November a colony of 700 beds was added to the existing four institutions under the supervision of the Public Health Department. The number of plague cases (52) in 1941 was a quarter of that for 1940. The following new health agencies have recently been established: a department of specific prophylaxis against diphtheria; a national committee of tuberculosis; a department of hydatidosis, and departments of plague and cancer control. Lastly, strict supervision of drugs has been established.

Public Health in Chile

No epidemics have occurred in Chile since 1939 apart from some cases of typhus which were immediately controlled (*J. Amer. Med. Assoc.*, October 17). Good results have followed the control of malaria in the northern parts of the country. Although the mortality in early childhood is exceedingly high, much attention has lately been given to the feeding of mothers and infants, whose condition, it is expected, will soon improve. According to a new plan, 3,600 persons will have the right to ask for medical care under insurance as well as 200,000 or more children. Since 1940 the health of the people has been improved by providing rations in public restaurants to poor families free of charge.

Scientific Journal of the Royal College of Science

THE students of the Royal College of Science are to be congratulated on their success in maintaining the publication of their *Scientific Journal*, printing some of the papers read during the session 1941–2 before the Chemical, Natural History and Mathematical and Physical Societies. This volume, the third to be issued in war-time and the twelfth of the series, maintains the high standard and variety of scientific interest of the previous volumes. The range of subjects covers electron diffraction and the electron microscope, graphical and mechanical methods of calculation, the chemistry of hashish and of acetylene alcohols, methane as an engine fuel, the nature of viruses, and luminescence in Crustacea, as well as a historical paper on Arrhenius, Ostwald and van't Hoff. Copies may be bought from the Sales Manager, *Scientific Journal*, Imperial College Union, London, S.W.7 (paper cover 4*s*., bound 5*s*. 6*d*. per copy).

Introduction of Chinese Plants to Great Britain

FEW botanical explorers have surpassed the genius of Ernest Henry Wilson, who introduced the flora of China to Great Britain and North America. A short paper by E. H. M. Cox (*J. Roy. Hort. Soc.*, 67, Pt. 11, November 1942) describes Wilson's expeditions to China, in the early years of this century, for the firm of James Veitch and Sons and later for the Arnold Arboretum. He visited the provinces of Hupeh and Zechwan, from which he introduced *Davidia involucrata*, *Meconopsis integrifolia* and a very large number of other species. Such well-known garden plants as *Buddleia variabilis magnifica*, *Clematis Armandii*, *Berberis Wilsonæ*, *Thalictrum dipterocarpum* and *Viburnum Davidii*, with several species of Rhododendron, Lilium and Abies, all owe their horticultural introduction to Wilson.

Earthquakes Registered in India during 1940

ACCORDING to seismological bulletins just received, numerous earthquakes were registered at the observatories of Agra, Bombay, Calcutta, Colombo, Dehra Dun, Hyderabad and Kodaikanal during the period July–December 1940 (*Seism. Bull.*, July–Sept. 1940 and Oct.–Dec. 1940. Delhi: Government of India Meteorological Dept.). At Agra, 66 were registered during the period July–September and 75 during the remainder of the year. Again, non-instrumental reports of earthquakes sensible to human beings are an important feature of the reports. During the first quarter under discussion, 16 were reported to J. M. Sil, meteorologist at Poona, the shocks of greatest intensity being of scale 8 (Rossi-Forel) and occurring on August 3 at Gulmarg, on August 8 at Gulmarg, on September 21 at the same place and also at Srinagar. During the second quarter, 11 earthquakes were reported as having been felt, the greatest intensity being 7 on the Rossi-Forel scale on two occasions. The first was at Bhuj on October 31, and the second at Srinagar on December 25.

The Night Sky in February

NEW moon occurs on February 4d. 23h. 29m. U.T. and full moon on February 20d. 05h. 45m. Conjunctions with the moon are as follows: Feb. 2d. 07h., Mars 5° S.; Feb. 3d. 15h., Mercury 0·4° N.; Feb. 6d. 10h., Venus 0·5° S.; Feb. 13d. 01h., Saturn 4° N.; Feb. 16d. 03h., Jupiter 4° N. Occultations of stars brighter than magnitude 6 are as follows: Feb. 12d. 19h. 24·7m., 179 B. Tauri (*D*); Feb. 13d. 19h. 05·6m., 318 B. Tauri (*D*); Feb. 24d. 05h. 00·3m., 65 Virginis (*R*). The times are given for Greenwich, and *D* and *R* refer to disappearance and reappearance, respectively.

There will be a total eclipse of the sun on February 4–5, invisible at Greenwich. The eclipse is visible in Japan, Alaska and the eastern parts of North America. There will be a partial eclipse of the moon on February 20, partly visible at Greenwich. The magnitude of the eclipse is 0·767. The circumstances of the eclipse are as follows:

Moon enters penumbra	.... Feb.	20d.	02h.	43·1m.
„ „ umbra	....	20	04	03·0
Middle of eclipse	....	20	05	38·0
Moon leaves umbra	....	20	07	13·0
Moon leaves penumbra	....	20	08	32·4

Jupiter and Saturn are well placed for observation during the month. Mercury attains its greatest elongation west on Feb. 18, when it rises at 6h. 15m. in the latitude of Greenwich, about an hour before sunrise. Venus rises about an hour after the sun in the middle of the month and sets at 19h. Mars, in the constellation of Saggitarius, rises at 5h. 30m. about the middle of the month and is not well placed for observation. Comet Whipple is a naked-eye object and can be seen in the night or morning hours up to the time of sunrise. An ephemeris appeared in NATURE of Jan. 23, p. 106.

Announcements

ON the joint recommendation of the presidents of the Royal Society and the Institution of Civil Engineers, the James Alfred Ewing Medal for 1942 has been awarded to Dr. R. E. Stradling. The Ewing Medal is awarded annually for specially meritorious contributions to the science of engineering in the field of research.

THE Council of the Institute of Metals has awarded the Institute's Medal to Dr. Harold Moore, for "outstanding services to non-ferrous metallurgy". Dr. Moore has been director of the British Non-Ferrous Metals Research Association since 1932. Following his training under Dr. J. E. Stead, he held metallurgical posts with industrial firms before joining, as chief metallurgist, the Research Department, Woolwich, of which he was director of metallurgical research during 1919–32. The Institute's Medal, which is offered to the Council of the Institute by the Mond Nickel Company, Ltd., for award annually, is of platinum; previous recipients have been Sir William Bragg, Sir Harold Carpenter, Dr. Paul Merica, Dr. C. H. Desch and Sir W. Murray Morrison. It will be presented to Dr. H. Moore at the annual general meeting to be held in London on March 3.

To commemorate the birth, on March 3, 1843, of the distinguished metallurgist, Sir William Chandler Roberts-Austen, the Institution of Mechanical Engineers, the Iron and Steel Institute and the Institute of Metals have arranged a lecture on his life and work, to be given by Dr. S. W. Smith, on Wednesday, March 3, at 5.30 p.m. at the Institution of Mechanical Engineers, Storey's Gate, S.W.1. Sir W. C. Roberts-Austen was an honorary member of the Institution of Mechanical Engineers and he conducted a notable series of researches for the Alloys Research Committee of that Institution; he was a past-president of the Iron and Steel Institute, and his name is perpetuated in the literature of ferrous metallurgy by the word 'austenite'. Dr. Smith, who in 1914 wrote a book "Roberts Austen; a Record of his Work", acted as Sir William's private assistant at the Royal Mint. No tickets are required for the lecture.

LETTERS TO THE EDITORS

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

X-Ray Evidence of the Nature of Cold Work in Metals

IT is well known that the cold working of a ductile metal produces a broadening of its X-ray reflexions, but the physical nature of the changes that produce this broadening does not so far seem to have been satisfactorily established. The broadening may be due to small crystallite size or to the non-uniformity of the lattice parameter, and it is possible that both factors are present in actual practice. Different views, however, are expressed as to which is mainly responsible, and moreover there is a great deal of uncertainty about the real meaning of 'small crystallite size'.

It should be possible to distinguish between the two effects by means of X-rays, for they produce different variations of line-breadth with angle; if β is the breadth of a reflexion with Bragg angle θ, $\beta\cot\theta$ should be constant for (isotropic) lattice-parameter variations, and $\beta\cos\theta$ should be constant for small (spherical) crystallite size. Dehlinger and Kochendörfer[1] have attempted to find which of these relations is obeyed in the case of rolled copper strip, and concluded that both effects were present; their methods of estimating broadenings are, however, open to suspicion and their results cannot therefore be accepted unreservedly. Brindley[2] has used filings of various metals, and though he has not corrected his breadths for the broadening due to experimental conditions, he concluded that the non-uniformity of the lattice parameter is the more important effect. According to Wood[3], on the other hand, the main cause of the broadening is the small size of the fragments into which he considers the crystals to be broken by cold work; but since his results are based mainly on one reflexion they afford no test.

Although filings are not the most suitable subject for experiment, since the stresses in them cannot be known and must certainly be heterogeneous, they form the most suitable kind of specimen for accurate X-ray work. We have therefore attempted to obtain complete evidence of the variation of line-breadth with angle by the methods devised by Jones[4]. Instead, however, of using a standard specimen of 'infinite' particle size, we have taken the photographs in a high-temperature camera of 19 cm. diameter[5], and the standard lines were assumed to be those from the specimen annealed *in situ* and recorded on a separate film. The method is unfortunately least accurate at the low angles, where the distinction between $\cot\theta$ and $\cos\theta$ is greatest; errors of the order of 30 per cent are possible in the lowest reflexion, 111.

$h\ k\ l$	β uncorrected (mm.)	β corrected (mm.)	θ	$\beta\cos\theta$	$\beta\cot\theta$	E_{hkl} $\left(10^{12}\cdot\frac{\text{dynes}}{\text{cm.}^2}\right)$	$E\beta\cot\theta$
1 1 1	0·64	0·18	21·7°	0·17	0·45	1·59	0·72
2 0 0	0·77	0·42	25·2°	0·38	0·89	0·78	0·69
2 2 0	0·84	0·44	37·1°	0·35	0·58	1·26	0·73
3 1 1	1·21	0·76	45·0°	0·54	0·76	1·02	0·78
2 2 2	1·01	0·47	47·6°	0·32	0·43	1·59	0·68
4 0 0	1·65	1·04	58·5°	0·54	0·63	0·78	0·49
3 3 1	2·18	1·24	68·2°	0·46	0·50	1·34	0·67
4 2 0	2·98	1·89	72·3°	0·57	0·60	1·03	0·62

The results for a specimen of copper filings are shown in the accompanying table. The specimen was annealed at 400° C. for 30 minutes to give the standard lines. It will be seen that, although there is a large scatter, $\beta\cot\theta$ has much less systematic variation than $\beta\cos\theta$, which indicates that the broadening is due mainly to lattice parameter variation and not to small particle size. It appears that broadening due to the latter effect, if it exists, is masked by the former.

Whatever the nature of the distortion produced by cold work, it is to be expected that local internal strains will be produced varying between zero and the maximum possible. The maximum possible lattice strain can be calculated from the yield stress Y and the Young's modulus E, and, as shown by van Arkel[6], it agrees well with that observed. From the breadths of the lines in the present case, $Y = \frac{E\beta\cot\theta}{4R} \sim 2 \times 10^9$ dynes/cm.^{2} (where R is the radius of the camera), and the generally accepted value for copper is $1 - 2 \times 10^9$ dynes/cm.^{2}.

Since E varies with direction, we might expect that the breadths of the X-ray reflexions would also vary with direction. The product $E\beta\cot\theta$ should be constant if the maximum stress is independent of direction, and it will be seen that in this quantity, shown in the last column of the table, the scatter of values is much less than for $\beta\cot\theta$ alone. Only one line, (400), is in bad agreement, but this is the weakest line on the film.

Further experiments are in progress. It seems that X-ray methods throw a great deal of light on the mechanism of cold work, but it must be emphasized that the observation of *all* the spectra is necessary if the utmost information is to be obtained.

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Ionization in Hydrogen by Fast Hydrogen Neutrals

RECENT work by Varney and his collaborators[1,2,3], also earlier work by Beeck[4], have shown that gases can be ionized by their own accelerated neutral molecules or atoms. A classical theoretical treatment of the problem was given by Zwicky[5], who showed that the effect is most likely to occur when both reacting particles are of equal mass. It was first noticed with the inert gases, particularly argon, for which the effect is relatively large. Berry[3] has very recently published results obtained with hydrogen in the type of apparatus developed by Varney's school, in which a velocity selector is used for the positive ions. The latter are neutralized in a separate chamber and then pass into the space-charge detector[6,7], where they are detected after causing ionization. The strength of the remaining neutral beam was assessed by measuring the secondary electron emission from a target by which it was struck. The voltage range for the neutral particles was approximately 900–6,400, and the cross-sections ($N_1\sigma$) per cm.³ of gas at 1 mm. mercury pressure were approximately 2(A), 0·05 (He), 0·15 (H_2) and 0·9 (N_2).

I carried out some experiments with a canal-ray positive ion source in 1939[8], using hydrogen (99·3–99·7 per cent, with about 0·7–0·3 per cent oxygen), and which seem to be of interest in view of the above work. The canal ray beam (several hundred micro-amperes of 20 kV. H_2^+ and H_1^+ ions in approximately equal proportions) passed from the source (about 0·1 mm. mercury pressure), through a canal 2·1 mm. long and 1·5 mm. in diameter, into a region where the pressure was about 5×10^{-4} mm. mercury. The positive ion beam was deflected electrostatically and it was found, as expected from previous work, that a large proportion (about 75 per cent) of the beam, judged by the luminosity in the gas, was composed of neutral particles. The effective strength of the neutral beam was probably several hundred micro-amperes, and may have reached about 1 milliamp., because, in other experiments, secondary electron currents from various electrodes indicating the possibility of such a beam strength had been measured[9]. A double Faraday cylinder placed to measure the undeflected positive ion beam showed that when the voltage was applied to the deflexion plates, a positive current of about 4 microamp. was indicated. When the source was switched off, leaving the gas flow unaltered, the current always fell to zero, showing the absence of spurious discharges in the deflexion chamber. The main beam was about 18 microamp. in this particular experiment, measured with a small receiving aperture at 50 cm. from the canal, where the strongly divergent beam had, as stated above, a strength of several hundred micro-amperes. The deflecting field was more than ten times greater than that required to deflect the beam off the collector aperture. On one occasion, 50 kV. was applied to the deflector plates, whereas about 800 volts was sufficient to give adequate deflexion from the collector. Indeed, it is likely that such strong deflecting fields reduce the current of ions to the collector.

It was considered that the residual current might be due either (*a*) to liberation of electrons from the collecting cylinder, or (*b*) to the collection of positive ions produced in the gas by the action of the fast neutrals, if it is reasonable to suppose that such positive ions would tend to be 'knocked-on'. The reaction is:

$$X^{\text{fast}} + X \rightarrow X^{+\text{fast}} + X^{\text{slow}} + e^-.$$

Hence the effect was considered comparable in some respects to the well-known *Umladung* reaction

$$X^{+\text{ slow}} + X^{\text{fast}} \rightarrow X^{+\text{ fast}} + X^{\text{ slow}}.$$

Excitation was also present in the gas, because the neutral beam luminesced (hydrogen red). Case (*a*) was considered unlikely, as the Faraday cylinder was always used in such a way as to eliminate secondary emission effects so far as possible. It was also considered that such emission from the collector could be caused either by reception of fast neutrals or by photons in the gas, although the canal ray spectrum was stated[10] to consist largely of the lines at 4,340, 4,863 and 6,563 A. Further evidence for the absence of secondary emission from the collector was available in that wide variations (1–20 kV.) in the voltage applied to the live (positive) deflector plate had no effect on the magnitude of the residual current. The latter would have been expected to rise with increasing positive deflector plate voltage if the secondary emission from the collector had been taking place. The live plate was made positive to eliminate the effect of secondary emission from it to the earthed vacuum chamber and Faraday cylinder, which was nearly at earth potential. The deflector plates were struck by large stray currents from the canal ray beam.

Thus it seems almost certain, although I wish to emphasize the approximate nature of the results and the fact that no further attempts were made to elucidate the phenomena, that the residual current was due to ionization by fast neutrals, as photo-ionization in the gas did not seem likely to account for it. Such effects, if present, may also occur in Varney's work. My experiments, described briefly above, were incidental to the main purpose of the work, which was to produce an intense canal-ray beam. However, with the approximate values of pressure, initial neutral beam strength (1 milliamp.) and collected current, the calculated cross-section is of the order given by Berry[3].

In conclusion, it is possible that the copious beams of fast neutrals formed by canal ray sources may be of interest in experimental work of the kind conducted by Varney, who used accelerated electrons from a hot filament to produce the primary positive ions.

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Nature of Entropy

To the student of thermodynamics, the conception of entropy usually presents some difficulty. It seems to have no precise physical significance, but is often regarded as no more than a mathematical convention. This can only be due to inadequacy of our thermodynamic theory, since a quantity which fits so completely into the mathematics of the subject must surely have some relation to the physical facts.

The definition of entropy according to the equation $d\varphi = \frac{dQ}{T}$ suggests that it may be regarded as occupying in thermodynamics theory a position somewhat analogous to that of momentum in mechanics, or of coulombs in electrical theory, temperature being analogous to velocity or to electrical potential difference. There ought, in fact, to be such an analogy because, according to the kinetic theory of gases, temperature is proportional to the mean kinetic energy of the molecules; but the analogy fails because of the square law relationship between kinetic energy and velocity, between electrical energy and electrical potential.

Although this, by itself, may seem a flimsy pretext, the suggestion arises that our scale of temperature might with advantage be re-designed so that heat energy should become proportional to the square of temperature. The selection of a scale of temperature based upon equal increments of energy and incidentally equal divisions of a thermometer scale appears to have been rather arbitrary, and is no doubt due to the limited variety of manifestations of heat that can be measured in preconceived terms. In fact, all heat measurements come back to temperature, and that cannot be measured absolutely. It is conceivable that, had we lacked means of measuring velocity directly, we might have evolved a scale of velocity based upon equal increments of kinetic energy.

If, for greater mathematical convenience, we remade our scale of temperature so that temperature became proportional to the square root of heat energy, and, in the kinetic theory, to the mean molecular velocity, then subject to adjustments in the definition of specific heat, the position of entropy would be more clear. Entropy would, in a simple heat transfer, bear a straight-line relationship to temperature, mean molecular velocity would be proportional to temperature, and equal increments of temperature would represent a greater increment of energy at high temperatures than at low. In this and other respects, the theory of thermodynamics would conform more closely to the kinetic theory of gases and would acquire a helpful similarity with mechanical and electrical theories with their basic and, to all intents and purposes, identical energy expressions : $\frac{1}{2} mv^2$ and $\frac{1}{2} CV^2$.

I am not a physicist and do not know the full extent or effect of this tentative suggestion. Einstein said in 1921, "I am convinced that philosophers have had a harmful effect upon the progress of scientific thinking in removing certain fundamental concepts from the domain of empiricism . . . to the intangible heights of the *a priori*".

Is it possible that this is a case in point ?

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Reclamation of Bracken-land

IN the course of work on the improvement of rough pasture and moorland, to be published shortly, some attention had to be given to the reclamation of bracken-land. The site (a hillside of the Vardre near the ruins of Deganwy Castle, North Wales) was thickly covered with bracken about 2 ft. in height, free from undergrowth, the soil being sandy to light loam. The following treatment led to satisfactory results.

Late in autumn, the bracken was cut and left spread out on the ground, and a dressing of calcium cyanamide (10 lb. per rod) and manganous sulphate (4 oz. per rod) was applied. Within a few days the vegetation turned blue and gradually withered. In the following March the plot appeared bare, the disintegrated bracken having been embodied in the turfy soil and forming a spongy surface, which readily retained moisture. A mixture of grass seeds, including red and white clover, trefoil, timothy, rye grasses, cocksfoot, tall oat, meadow fescue, crested dogstail, and smooth meadow grass (4 oz. per rod), soil from a pea cultivation (1 lb. per rod) and sand was scattered on to the slimy surface. By the end of June the plot was covered with a fine crop of meadow grass including legumes, the vigorous growth continuing late into autumn. During the next summer the grasses were found well established and free from bracken. Although rational husbandry, such as the addition of phosphorus and potassium, the introduction of grazing cattle and the elimination of bracken in the neighbourhood would have in all probability ensured further improvement and permanency, the plot left unattended amidst an area of bracken gradually receded, and within six years gave all indications of reverting to its original condition.

Here we have calcium cyanamide and its degradation products functioning as an all-embracing parasiticide (cyanogen, urea), humifying agent (ammonia), long- and short-term fertilizer (lime, nitrates), growth promoter (urea)[1], and pH regulator (calcium, dicyanodiamide). The humification of all available organic matter, including the bracken rhizomes, is in reality a reproduction of the compost process *in situ*, differing, however, from the Indore method by the preponderance of chemical over biological reactions. The seasonal separation of the destructive from the nutrient phases of calcium cyanamide was attained by increasing its quantity[2] and regulating the time of its application. The manganous sulphate catalyses the oxidation of ammonia to nitrate independently or in conjunction with the nitrifying bacteria[3], reactivated after a lapse of four months. The addition of soil from a pea cultivation, as an inoculation, introduces nitrogen-fixing bacteria essential to the legumes.

This treatment may, therefore, be regarded as an alternative to the methods already in use or suggested in the past. Among such approaches to this problem we have : (1) *burning*, a procedure often impracticable and always wasteful ; (2) systematic exhaustive *cutting* handicapped by the labour and time factor ; (3) *tillage* (disc or plough), frequently obstructed by steep gradient or rocky subsoil of the area ; (4) *injection* of sodium chlorate into bracken stumps, a process catalysed by the addition of vanadium pentoxide[4] ; and possibly (5) tillage accompanied by *spraying* with calcium thiocyanate, which gave favourable results in the eradication of nut grass[5] ; and (6) the introduction of a suitable *fungus* into the bracken stumps.

There is evidence to show that both during its growth and decay bracken exerts an eliminating effect upon other weeds. Should this be substantiated, it could be made to serve as an intermediate stage in the removal of more resistant and pernicious types, such as bindweeds, etc. This may be correlated with the comparative experiments at Wythenshawe Park, Cheshire, and Holcombe Hill, Lancashire, which have established the discriminating action of calcium cyanamide in so far as its efficiency is dependent upon the type of soil, turf and vegetation.

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[1] Copisarow, *Chem. and Ind.*, **61**, 67 (1942).

[2] Recently Henderson (Agr. News letter, Pub. Relations Dept. E.I. du Pont de Nemours and Co., **9**, 72 ; 1941) obtained satisfactory results with even higher concentration of calcium cyanamide in the case of tobacco plants.

[3] Rotini, *Chim. e l'Ind.*, **22**, 7 (1940) ; Schmalfuss, *Bodenkunde und Pflanzenernahr.*, **20**, 362 (1940).

[4] Bates, Brit. Rubber Publicity Assoc. Rubber and Agr. Ser. Bull. No. 14 (1940) ; NATURE, **148**, 753 (1941).

[5] Fromm, *Science*, **96**, 337 (1942).

Water Content of Medusæ; Sexuality in a Planarian

In recent numbers of NATURE there have appeared two communications which seem to call for comment. In the issue of August 22, Lowndes[1] discusses the question of the water content of medusæ, determining that of *Aurelia aurita* to be 96·56 per cent in sea water of 3·3 per cent salinity. A few years ago I became interested in the same question and also determined the water content of *Aurelia aurita*, finding 96 per cent water in specimens from sea water of 3·2 per cent salinity[2]. Later, I determined the water content of four other species of medusæ, all hydromedusæ, finding 96·5–97 per cent water in specimens taken from sea water of 3·0 per cent salinity[3]. In the first of these papers I reviewed the available data on the subject[4]; these show that in sea water of more than 3 per cent salinity, the water content of medusæ ranges from 94 to 96·5 per cent but that in brackish water of less than 2 per cent salinity, the water content of *Aurelia aurita* may rise to 98 per cent. From these facts it may be inferred that the water content of freshwater medusæ must be very high, and this has recently been found to be the case by Dunham[5], who reports 99–99·3 per cent water in Craspedacusta, thus confirming an old statement by Cremer[6].

In NATURE of September 19, Goldsmith[7] comments on sexuality in the planarian *Dugesia tigrina* (Girard) 1850 (old name, *Planaria maculata* Leidy). This is the most common freshwater planarian in the United States, occurring throughout the country in ponds, lakes, and streams, and presenting many local and geographic variations. It also occurs, as first noted by Curtis[8], in sexual and asexual strains. In 1937 Kenk attempted to induce sexuality in the sexual forms by various environmental factors, but was unsuccessful[9]. From field data I had noticed that the sexual strain is commonly found in running water or along shores subject to wave action, whereas the asexual strain appears to be confined to ponds and still waters. I therefore suggested[10] that possibly moving water is a factor in the sexual development of this planarian, but shortly after I had published this suggestion I found (unpublished) that this explanation is untenable as regards the sexual strain, and soon Kenk[11] published to the same effect, showing that members of the sexual strain reared throughout life in dishes in the laboratory may become sexual and lay viable capsules. The point raised by Goldsmith had, therefore, already been settled by Kenk. The possibility still remains that there is some relation between permanent asexuality and still water, but this now seems to be unlikely.

The theory of Kenk, which appears to be accepted by Goldsmith, that this planarian has an inherent sexual rhythm is, however, erroneous. In Nature, these worms become sexually mature in early spring and lay cocoons for about three months thereafter. The reproductive system then retrogresses, the copulatory apparatus disappears, and ordinarily there is no further sexual reproduction until the following spring. This cycle is not, however, inherent but is controlled by temperature, as I have shown[12]. The development of the reproductive system, especially of the copulatory apparatus, follows in a few days when the worms are put at room temperature after a sojourn (of two weeks or even less) at a cold temperature (15° C. or below). Stocks brought in from Nature at any time after temperatures have fallen in the autumn and set at room temperature begin to develop sexually in one or two days and start to lay cocoons within a week; although if left outdoors they would not have reached sexual maturity until the following April. Only worms of mature size can be induced to mature sexually by temperature change, and some time must elapse (about three or four months) before sexuality can again be induced in the same individual by manipulation of the temperature.

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[1] Lowndes, A. G., NATURE, 150, 234 (1942).

[2] Hyman, L. H., *Science*, 87, 166 (1938).

[3] Hyman, L. H., *Biol. Bull.*, 79, 282 (1940).

[4] The important paper of Koizumi, T., and Hosai, K., *Science Rep. Tohoku Imper. Univ.*, Ser. 4 (Biol.), 10, 709 (1936) was unfortunately omitted from this bibliography. They found the water content of Aequorea, Cyanea, and Dactylometra to be 96·4 per cent in water of 3·42 per cent salinity.

[5] Dunham, D. W., *Amer. Midland Natural.*, 28, 526 (1942).

[6] Cremer, Max, *Sitzungsber. Gesell. Morph. Physiol. München*, 22, 41 (1906). The statement of Cremer is as follows: "Wenn man bedenkt dass die grösseren Exemplare dieser Tiere kaum einen Durchmesser von 1 cm. besitzen und dass ca. 99 per cent des Körpers dieser Quallen überhaupt aus Wasser bestehen. . ." No grounds for the statement are given.

[7] Goldsmith, E. D., NATURE, 150, 351 (1942).

[8] Curtis, W. C., *Proc. Boston Soc. Nat. Hist.*, 30, 515 (1902).

[9] Kenk, R., *Biol. Bull.*, 73, 280 (1937).

[10] Hyman, L. H., *Trans. Amer. Micro. Soc.*, 58, 271 (1939).

[11] Kenk, R., *Amer. Natural.*, 74, 470 (1940).

[12] Hymen, L. H., *Anat. Rec.*, 81 (Suppl.), 108 (1941).

Seed Dispersal by Human Activity

In a recent paper[1] dealing with weed problems, Prof. E. J. Salisbury has directed attention to accidental carriage and distribution of seeds by human activity, and instances that clothes can be one of a number of means of distribution.

In recent research work on tussock grassland in North Canterbury, New Zealand, with particular reference to the distribution of the nassella tussock (*Nassella trichotoma* (Nees) Hack.), it was demonstrated that clothing can be an important means of seed distribution. The 'cuffs' of a pair of trousers yielded some 17 gm. of seeds and fruits (after five days' field work), the mixture being composed of the seeds and fruits of 33 species of plants, 19 species of grasses, and the remainder of other weeds. Several pairs of socks yielded, among other germinules, more than three hundred 'seeds' of nassella tussock, a troublesome plant rapidly becoming locally dominant in North Canterbury.

The relatively large amount of seeds and fruits present, the number of species and genera represented and the quantity of each, indicated the potentialities of this little-considered means in the distribution of plants, both noxious and beneficial.

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[1] Salisbury, E. J., NATURE, 149, 594 (1942).

RESEARCH ITEMS

Insects of Norfolk Island

IN the December issue of the *Annals and Magazine of Natural History* (9, No. 60, 865 ; 1942) the insect fauna of Norfolk Island is discussed by C. N. Hawkins. The account also includes a preliminary report on a recent collection of insects from that same area. The author considers that, generally speaking, the insects of this somewhat remote island would repay much more intensive collecting and investigation. The truly endemic species have been extensively supplemented by introductions from other lands through human agencies. It appears, therefore, necessary to be very careful in drawing inferences from the present fauna and to exclude all species which could have been artificially introduced at a time when little attention was given to such matters. Allowing, therefore, for such immigrants, it does appear that in the main the insect fauna of this island shows more affinity with that of North-Eastern and Eastern Australia than with the New Zealand fauna, although there is undoubtedly some connexion with the latter also. In discussing a recent collection of insects from Norfolk Island the author states that it comprises thirty-three species of Lepidoptera, of which only eleven are mentioned in earlier lists by various writers. The Coleoptera are distributed among eighteen families and number thirty-eight or more species. The Hymenoptera include a number of species of ants and parasitic forms. No Apoidea are mentioned and only two species of Vespoidea and one of Sphecoidea are recorded. Of the Hemiptera, excluding the Coccidæ, Aphidæ and Aleurodidæ, only thirteen species are listed. The Diptera have not, so far, been worked out. A special feature of the collection, as a whole, is the considerable number of species of wide distribution and general economic importance that it contains.

Unique Freshwater Crustacea

THE rivers of temperate South America are inhabited by a unique genus and family of fresh-water crustaceans found nowhere else in the world. When Latreille in 1818 described a new species as *Galathea lævis* he was unaware that it was a freshwater form and placed it in an exclusively marine genus. Two years later Leach noticed that it was a representative of a new species but was also worthy of being placed in a new genus which he termed Aegla. Since that time it has been recorded from a number of different localities and is indeed widespread, and several different specific names have been given. The general usage, however, has been to regard all the records as relating to one species, which has been termed *Aeglea lævis*, after an incorrect spelling of the generic name introduced by Demarest in 1825. Waldo L. Schmidt (*Proc. U.S. Nat. Mus.*, **91** ; 1942) has, after the examination of practically all the material available (now quite considerable), provided a detailed and well illustrated review of the genus. He recognizes eighteen distinct species and of two of them a marked variety. The distribution of the various species is dealt with, and it is noted that a number of them appear to be confined to the individual watersheds of large tributaries in somewhat the same manner as the limitation of certain molluscan species to different valleys. The Æglidæ appear to be most closely related to the Galatheidæ, and so furnish an example of another crustacean family invading fresh water.

Proliferation-promoting Substances from Injured Cells

OBSERVATIONS which suggest that factors, active in promoting proliferation of cells, appear in the intercellular fluids when yeast or animal tissue cells are injured, without rupture of cell membranes, by such agents as ultra-violet rays are : (1) slow injury to cells leads to higher potencies of intercellular fluids than rapid killing ; (2) the potency of the fluids increases rapidly before appreciable mortality is noted ; (3) the potency is greater when cells are injured in a physiologically favourable suspension medium ; (4) active factors appear in suspensions of cells subjected to anærobiosis without killing the cells ; and (5) cells killed quickly by grinding and boiling and then subjected to injurious rays yield less potent preparations than cells injured slowly by irradiation prior to quick killing by grinding or boiling. J. R. Loofbourow (*Biochem. J.*, 36, 631 ; 1942), continuing these studies, suspended *S. cerevisiæ* in distilled water and subjected the cells to injury by ultra-violet irradiation. He found no appreciable change in cell number throughout the irradiation period, which, together with the absence of cytolysis, indicated that the proliferation-promoting factors in the intercellular fluids were released through the membranes of grossly intact cells. Preliminary studies with radioactive phosphorus indicated an increase in membrane permeability during irradiation. Re-synthesis of growth-stimulating materials occurred in the living, damaged cells at a rate comparable with the loss of such materials to the intercellular fluids. Of monochromatic wave-bands, that at 2650 A. was the most effective in bringing about the release of proliferation-promoting factors, cell death, loss of cell volume and increase in 2600 A. absorption of the intercellular fluids. There is indicated a correlation between the lethal effectiveness of various wave-bands and their ability to bring about the release of these factors.

Anatomy of Leguminous Root Nodules

MISS HELEN L. FRAZER's observations upon this subject (*Proc. Roy. Soc., Edin.*, 61, B, Part III (No. 24), 1942) give more precision to our knowledge of the distribution and structure of the endodermal boundaries to be found within these nodular tissues from an early stage in development. They were studied in various common leguminous plants and in all cases (except in some large specimens from lupin) were characterized by the presence of a common endodermis in the outer tissue, in addition to individual endodermal sheaths around each vascular strand. The cells of the common endodermis had a complete suberized lamella from an early stage, and experiments with dyes confirm the natural conclusion that the nodular contents must thus be retained within the nodule even if soluble and free to diffuse from the infected tissues. On the other hand, in the elongate form of the nodules, suberization progressed slowly towards the distal end of the endodermal sheaths around each vascular strand, so that movement of solutes to or from the vascular strand should remain possible in this region and possibly also through the occasional unsuberized (? passage) cells found in the bundle endodermis in the spherical type of nodule. The impermeability of the common endodermis may lead to a reduced air supply in the inner tissues, a condition that has been assumed by some other workers as an inference from the study of nodule respiration.

Eye-Spot of Wheat and Barley

Two recent papers by Miss Mary D. Glynne describe the disease eye-spot, caused by the fungus *Cercosporella herpotrichoides* (*Agriculture*, 49, 2; Sept. 1942). It causes a rather destructive type of lodging in wheat crops, and is aggravated by too great a frequency of wheat and barley in the rotation. Oval, brown-bordered spots, shaped rather like an eye, appear on young plants, and black dots later form in the middle of the eye-spots. The disease penetrates successive leaf sheaths, and bad infections weaken the straw. A useful survey of the incidence of the malady (*Ann. Appl. Biol.*, **29**, 3, 254; Aug. 1942) shows that the disease is more prevalent in eastern England than in North Wales, and reinforces the conclusion that the greater the time after the previous cereal crop, the lower the chance of severe infection.

Californian Sequoias

A STUDY by Looby and Doyle (*Sci. Proc. Roy. Dublin Soc.*, **23**, 35–54; 1942) of the origin of the gynospore and development of the female gametophyte in *Sequoia gigantea* and *S. sempervirens* shows that marked differences obtain in the number of gynospore mother-cells produced, the form of the spore tetrads, the origin and duration of the tapetum, the growth of the nucellus, the segmentation of the young gametophyte and in alveolar formation. These differences strongly support the recent suggestion of Buchholz, based on post-fertilization and other studies, that the two Californian Redwoods are generically distinct. The name *Sequoia sempervirens* is retained for the redwood while the 'Big Tree' or Sierra redwood reverts to its former title of *Wellingtonia gigantea*.

Recording Plastometer for Organic Plastics

AN article (*Bell Lab. Rec.*, **21**, No. 1; September 1942) by F. J. Biondi describes an improved parallel-plate plastometer, used to measure the flow properties of plastics, which has recently been developed by the Laboratories to plot automatically the relation between the variables measured. A specimen of the material is deformed by a known force at a specified temperature and the decrease in its height with time is magnified and recorded. The plastometer has two horizontal plates which press between them a small cylindrical pellet of the plastic material. An electrically heated and thermostatically controlled steel block surrounds the specimen, while the frame which supports this block also carries bearings for a shaft connected to the upper plate. A weight, supported by the upper end of the shaft, which is also connected by a universal link to the multiplying and recording apparatus, deforms the specimen. A series of levers and pulleys multiplies the movement between the plates approximately thirty times. This multiplying mechanism and that which drives the paper on which the record is made are housed in a cabinet at the top of the machine. Below the plastometer are the temperature regulating equipment, voltage control and auxiliary switches. An electronic regulator controls the temperature of the steel block within narrow limits from room temperature up to 300° C. Flow curves show that flow occurs more rapidly as the moisture content of the pellets increases, and that in a particular material the average rate of flow can be nearly doubled by changing the moisture content of the pellet two per cent. Moisture is one of the variables which must be measured and controlled if powder of constant flow characteristics is to be supplied to moulding machines. The recording plastometer has also been used by the Laboratories to measure the individual and combined effects of the other variables which affect the flow of plastics.

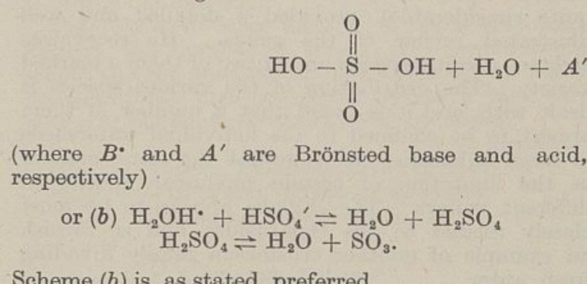
The System Ethanol-Methanol at 40°

THE system $C_2H_5OH-CH_3OH$ has been studied, from the point of view of vapour pressure, by A. C. Morris, L. T. Munn and G. Anderson (*Canad. J. Res.*, **20**, 207; 1942). The total-pressure curve plotted against mols per cent is linear, and the partial-pressure curves agree with Raoult's law within the experimental error. This is an interesting result, as both alcohols are generally regarded as 'associated' liquids, and still the system closely approaches an 'ideal' one. Attention is directed to the difficulty of purifying the alcohols, particularly from water, and it is clear that the density is not a sufficient criterion of purity, although in general use for this purpose.

Heavy Oxygen

USING heavy oxygen (^{18}O) water having an excess density of 150–210 γd, E. R. S. Winter and H. V. A. Briscoe (*J. Chem. Soc.*, 631; 1942) have studied the exchange of oxygen between water and oxyacid radicals, with special reference to the sulphate and bisulphate ion. Contrary to previous findings, $KHSO_4$ and KH_2PO_4 interchange, though slowly, at 100°. In certain cases the effect of addition of other salts and free acid was examined. The rate of interchange in bisulphate solutions increases with concentration and temperature; the cation has a marked influence, the interchange being substantially greater with the sodium than with the potassium salt; and the addition of other (inert) salts or of free acid also increases the rate. The rate is substantially lower for KH_2PO_4 as compared with $KHSO_4$. Although no simple mechanism will satisfactorily explain the experimental figures, it is concluded that the most probable explanation is that interchange occurs through anhydride formation, and this applies to KH_2PO_4 at 100° and K_2CrO_4 at 20°. The mechanism for $KHSO_4$, for example, is either

$$(a)\quad H_2OH^{\cdot} + HSO_4' \rightleftharpoons H_2O + H_2SO_4$$



(where $B^{\cdot}$ and A' are Brönsted base and acid, respectively)

$$\text{or } (b)\quad H_2OH^{\cdot} + HSO_4' \rightleftharpoons H_2O + H_2SO_4$$
$$H_2SO_4 \rightleftharpoons H_2O + SO_3.$$

Scheme (*b*) is, as stated, preferred.

AGRICULTURAL EDUCATION IN GREAT BRITAIN

AGRICULTURAL education in rural areas of Great Britain was the first subject for discussion at the recent conference of the Agricultural Education Association held at the Midland Agricultural College during January 4–6.

Mr. F. H. Garner prefaced his remarks by saying that the inhabitants of the countryside who are of necessity interested in agriculture are the landowner, the farmer, the farm worker and the parents of children living in the country. Little special effort has been made to educate landowners, but to a very large extent they have received information on all phases of agriculture. The older type of landlord is being replaced by a new type, such as the universities, colleges and insurance companies; the agents who manage such estates have had good training in agriculture and the results are good from the farmer's point of view.

As regards the farmers, the county councils, through the agricultural organizers and their staffs, are in the first instance primarily responsible for their education. A certain amount of work has been done by the National Farmers' Union, agricultural societies and clubs, and so on. A certain percentage of farmers have taken courses in agriculture at the universities, agricultural colleges and institutes. About two years after the outbreak of war, the War Agricultural Executive Committees took over much of the educational work in agriculture through their technical development sub-committees, and in many cases the work was carried out on a much wider scale than had been possible hitherto. These sub-committees could be very active because money was made available for educational work; they were helped by the fact that farmers were getting better prices and consequently could try out recommendations. They have done more to push forward the education of backward farmers than has ever been accomplished before, and it seems most important that such work should be maintained in peace-time. During the last few years, an agricultural bias has been introduced into the teaching at many rural schools, and the Young Farmers' Club movement is extending rapidly; it can be stated that in various ways farmers are receiving an agricultural education.

On the other hand, there has been very little attempt to provide agricultural education or instruction for farm workers. There have been a few short courses at agricultural institutes, but generally farm workers have received very little education in rural matters. More recently, but only to a limited extent, some of the demonstrations run by the War Agricultural Committees have been staged to attract the agricultural worker. Sometimes the workers show no inclination to attend the demonstrations, and there is the added difficulty that these workers, having to earn their livings on the land, are unable to attend if loss of wages results, except perhaps on Saturday afternoons. Demonstrations must be specially planned for the workers, and farmers must be approached in order that they may encourage their men to attend. Also, the farm institute courses for the young farm worker must be reintroduced, and this despite the danger that after these young people have attended their courses they may try to leave the land and obtain more remunerative posts.

With regard to the parents of the country school children: these parents may have various interests, for they may not all be agricultural workers. In the past, this section of the community has received no agricultural education of any kind, and it is quite evident that parents can undo all the good work done by schools, Young Farmers' Clubs, county councils, etc., in maintaining interest in rural activities. Before parents will encourage their children to work on farms they must first be satisfied that housing in rural areas is as good as it is in towns, and that their children can find adequate recreation, both indoors and outdoors, in the villages; that their children will earn as much money on the land as in the town; and that agricultural work is not degrading. Something must also be done to appeal to wives and prospective wives of the farm worker. The courses given in rural schools on domestic science, dressmaking and hygiene are very valuable, but if the girls find that housing conditions in rural areas make it difficult, and sometimes impossible, for them to do as they have been taught, they may be forced, through education, to find houses in the towns.

The ensuing discussion had a very wide range, for several speakers felt that in the matter of agriculture it is not possible to separate rural from urban education. Mr. S. J. Travers, of Kent, believes that urban and rural children should be educated together: they would be on the right lines if they could be made to understand that the land is a national asset and not to be abused as it had been in the past. It was pointed out by Mr. R. H. Smith, Hampshire, that whereas the rural child, through scholarships, etc., has the beginning of a ladder, the urban child has no means at all of obtaining the first steps in agricultural education. Town boys who are eager to take up agriculture may have their enthusiasm killed by being placed in unsuitable work on unsuitable farms. Other speakers also mentioned this question of a 'ladder'. Principal Robinson, Midland Agricultural College, referred to the need for an agricultural education which would give encouragement to the man with ability but lacking the capital to advance up the ladder. He thought a rural bias could well be introduced into education, not so that plenty of skilled labour would be available for the farmer, but to enable even the town boy or girl to appreciate and understand countryside problems. The cry in the past has been cheap food and hang the farmer: unless we educate the rural with the non-rural community, we shall not achieve this appreciation.

The opinion that teachers generally should be educated to the importance of agriculture as an industry was voiced by Mr. W. R. Heaton, Burford Grammar School, who complained that very little financial support is forthcoming for any scheme in agricultural education. He stressed that vocational agriculture should not be taught in schools, but instruction should be given in the underlying fundamentals of biology, chemistry of soils, and some book-keeping and mathematics done from mensuration of farm buildings, etc.

After several members had contributed to the discussion, Mr. John Davies, Glamorgan, remarked that the scope was for ever widening as each speaker seemed anxious to educate yet another class of people. He then asked: Whom do we wish to educate? He believed that the farmer and the farming community are entitled to first consideration, and this opinion was warmly supported by Mr. A. McVicar, Shropshire, and Mr. E. Rea. Mr. McVicar and others said that there is no recognized plan or scheme for a system of agricultural education in Great Britain, and this is urgently needed. It was suggested by Mr. F. R. Horne, of Devon, that not enough attention has been paid to following up the careers of the more promising trainees to see that they become established in agriculture.

The technical development sub-committees referred to in Mr. Garner's paper were both criticized and praised. They were spoken of as an implied criticism of pre-war policy in agricultural education, because if this had not been neglected in pre-war years, there would not now be the necessity for forming these committees. The work of these committees was also stated not to be fundamental education but rather 'tip-giving'. On the other hand, the expansion of agricultural education through the committees *as a national charge* was welcomed, and it was urged that if they are to continue after the War they must be moulded on the right lines now.

A statement by Mr. R. C. Andrew on the Danish system of education for older people caused Mr. R. C. Wood to urge his hearers to familiarize themselves with the writings of Sir Richard Livingstone on the Danish folk high schools. More attention must be paid to adult education and a more cultural atmosphere should be introduced into agricultural institutions in Great Britain.

NORTH SYRIA AS A CULTURAL LINK IN THE ANCIENT WORLD

THE subject chosen by Sir Leonard Woolley for his Huxley Memorial Lecture delivered on November 24 before the Royal Anthropological Institute was the role played by north-west Syria in the first and second millennia B.C. as a connecting link between the civilizations of the Near and Middle East. The region is defined as the area stretching from Lattakia on the present north Syrian coast northwards to the Anti-Taurus Range, and from the Mediterranean Sea to Aleppo. To the south and south-east lay "the commercial kingdoms of Syria and the Phœnician harbours", with Egypt still farther to the south; eastwards lay the homes of the Amorites and the Khurri, leading on to Nineveh. The Euphrates leads direct to Babylon or north-eastwards to the region of Lake Van and the Uratu kingdom; northwards beyond the mountain barriers lay Cappadocia and the Konia plain, leading to the Bosphorus or the Ionian coast; westwards were Crete and Greece, with Cyprus—actually visible from the top of Mount Casius—as a stepping-stone. The nodal position of the region thus chosen is obvious.

Before the War, three main excavations of special interest from Sir Leonard's point of view were in progress: Ras Shamra, just north of Lattakia, the ancient royal city of Ugarit; Al Mina, at the mouth of the Orontes, and the Atchana mound, up the Orontes on the edge of the great Amk plain; and Tal Tayanat, where the Oriental Institute of Chicago has excavated the Syro-Hittite palace. Other recent excavations there have of course been in the Amk plain, and also farther north-westwards as at Mersin on the Cilician coast, but Sir Leonard in the limited time available confined himself principally to the results of his own work at Atchana where, too, the chronological framework devised by Prof. Sidney Smith in his monograph "Alalakh and Chronology" provided him with a gratefully accepted method of correlation with better known cultures in neighbouring lands.

At Alalakh (the Atchana mound) there were unearthed seven archæological levels of buildings, pottery, etc., and a trial pit has shown at least three more underneath and as yet unexcavated. Layer 7 has yielded an imposing city gate and a great palace built by Yarim Lim, king of Aleppo and overlord of Alalakh—according to Sidney Smith *c.* 1780–1730 B.C. It is contemporary, therefore, with the end of the Egyptian Twelfth Dynasty and the Middle Minoan period of Crete. Near the coast at Ras Shamra, Middle Minoan II sherds have been discovered in presumably contemporary levels but, of course, this does not itself prove *direct* contacts. No Cretan ware occurred at Alalakh; all was Asiatic (Khabur ware), and the types persisted down to level 5, *c.* 1483 B.C. During 1800–1500 B.C. Alalakh was thus predominantly Amorite. There is evidence (seal-impressions) that Egyptian political claims were recognized, but culturally the town looked eastwards. But while the influence of the West on Alalakh seems at this time to have been slight, Sir Leonard feels that the astonishing resemblance of the palace itself in its plan and construction to that of Knossos, not to mention the style of the frescoes found, suggests, even as Sir Arthur Evans hinted ("Palace of Minos", 2, 269) that migration of Asiatic people to Crete played a part in the rise of the culture there. He adds that the frescoes at Alalakh are at least a century older than their parallels at Knossos, so that "there can be little doubt as to the originating centre", and argues that North Syria was helping to build up in Crete that remarkable Minoan civilization which was later to have its repercussions in Asia. In the same way and on the same grounds of architectural resemblances, he suggests that Amorite influence affected the regions to the north, inspiring not only the late Syro-Hittite buildings of North Syria such as Sakje-Geuzi and Carchemish, but even the more distant Boghaz Keui in the Halys basin.

In levels 6 and 5 there are fewer remains. It would seem that the influence of Egypt disappeared—this was the period of the Hyksos domination there—but the Hittites to the north were becoming an organized power. It was a Hittite invasion of North Syria, conducted by Mursil I in 1595, that terminated the local phase represented by level 6. However, culturally Alalakh continued much as before until Thutmose III conquered the town in 1483. But the weakness of Egypt permitted the folk of the 6th level to be in closer relationship with southern Syria and Palestine, as is reflected in the types of pottery found.

Level 4, starting from the Egyptian campaign of 1483, comprises, in so far as its principal building is concerned, three phases, including the enlarged palace of Niqme-Pa, *c.* 1450, which take us down to 1370, when the Hittite king Suppiluliuma invaded North Syria and, after destroying the Mitanni kingdom, installed his son as king of Aleppo. The main feature of the pottery of level 4 is the prevalence of the Cypriote Bronze Age type. Gone is the old Khabur ware. The better local wares are now either plain burnished red, or have simple bands of colour. All have a distinctly Cypriote flavour. As the typical Cypriote 'milk bowl' actually occurs at Alalakh so early as level 6 (seventeenth century B.C.) and sherds resembling the Cypriote white slip ware have been unearthed from below level 7, once again Sir Leonard concludes that, throughout, the main influences flowed from the mainland to Cyprus and not vice versa. To this level, too, must be ascribed certain sculptures of Hittite type which were actually found, re-used, in level 1. Sir Leonard sees in these the direct forerunners of the lions of early type at Carchemish and of the watergate reliefs of the same city. His argument is further supported by the finding of a bronze lion dagger, almost an exact parallel to the 'dagger god' represented in the Yasilikaya rock carvings. Niqme-Pa's palace has supplied one example of Lower Minoan II pottery, and another contemporary one with the familiar octopus pattern found in a private house. Ivory carvings, which are clearly copies of Egyptian prototypes of the time of Thutmose IV, occur, and contact with Egypt at this time seems to have been close.

The buildings of level 3 are few and poor. The period begins with Suppiluliuma's conquest of North Syria and lasts until 1285 B.C. Throughout this time Alalakh was ruled by the Anatolian Hittites, which fact explains the difference at this period between it and Ugarit (Ras Shamra), which was only fifty miles away, for the latter did not fall under Hittite control. The influx of Ægean settlers and others made of the Syrian coast town an outpost of Late Minoan II civilization, but only a very little Ægean influence can be noted at Alalakh.

Level 2 is dated from about 1275 to 1220 B.C. The main interest here is the occurrence of a local Syrian (Mitanni) ware, the decoration of which is ornate with bold rosettes in white on a dark ground and animal and bird forms introduced. A development of this, apparently peculiar to Alalakh, has all-over designs in which the motifs are running water, elaborate stylized lotus plants, and the double axe. The connexion with the Cretan Middle Minoan III is indisputable, though no doubt an example of deferred inspiration.

With the fall of the Hittite power in 1220 B.C., Alalakh was more open to Ægean influences. Nearly every grave in Level 1 contains a Mycenæan vase, and doubtless Ugarit was the connecting link. Then came the great movement of the 'Peoples of the Sea' who swept down, about 1190 B.C., through Anatolia and Syria and were only stopped by Ramses III on the borders of Egypt itself. Ugarit was destroyed, as was Alalakh, and neither site was ever again re-occupied.

To sum up, Sir Leonard Woolley considers that there is evidence for:

(1) "Direct contact with the Asiatic mainland influencing in or before the 18th century the development of the Cretan civilization."

(2) The existence in the Anatolian Hittite confederacy of an important element culturally if not racially akin to the Amorite population of northern Syria.

(3) A possible Asiatic origin of the Cyprus Bronze Age culture.

(4) Egyptian control of northern Syria in the Twelfth Dynasty with, later, a relation between the Hyksos culture and that of the Amk plain.

(5) Direct Late Minoan II and III influences on northern Syria.

(6) The development of Syro-Hittite art in northern Syria long before the beginning of the Syro-Hittite political period and of its kinship with the Hittite art of Anatolia.

ASSOCIATION OF SCIENTIFIC WORKERS

MEDICAL SCIENCES COMMITTEE

AT a conference for workers in the medical sciences arranged by the Association of Scientific Workers, held on January 9 at the London School of Hygiene and Tropical Medicine, Dr. D. McClean (chairman) recalled that the Medical Sciences Committee of the Association was elected in May, 1942, in an attempt to put into operation the policy of the Association in the medical sciences. That policy was the application of science for the benefit of the community and the raising of the status of the scientific worker. The responsibility for the application of medical science to public needs lies with medical scientists (not medical men alone) themselves; means should therefore be provided whereby all medical scientists could consult on methods of improving their work and collaborate in the most effective way in pressing for its application in practice.

Mr. Ben Smith, industrial organizer of the Association of Scientific Workers, emphasized the necessity for organization of workers in the medical sciences if they wish to get their policies implemented. Any activity the object of which is to alter existing conditions is necessarily political in nature, and for political activity organization is essential.

Dr. J. H. Humphrey, speaking for the Industrial Health Sub-committee of the Association, said that owing to the increasing numbers of persons working in factories and the extreme specialization in the work, industrial hazards are becoming more complex and important, while the medical personnel available for their prevention and the treatment of their effects are inadequate. Work on industrial hazards was carried out before the War by the Industrial Health Research Board; during the War, the activities of this body have practically ceased, but partly owing to the efforts of the Association it has recently been resuscitated. The Physiological Society has circularized its members to discover whether physiologists are available for full-time or part-time work on industrial health problems. None were available for full-time work, few for part-time. Liaison with shop stewards has also proved very profitable, as workmen themselves have suggested problems for medical research which might otherwise have passed unnoticed. The main difficulty is less to obtain new knowledge than to get what is already well-known applied.

Dr. Yudkin directed attention to the unorganized nature of nutritional research and gave an account of the efforts of the Nutrition Sub-committee of the Association to obtain co-ordination of nutritional research by pressing for the formation of a Nutrition Council.

Dr. C. L. Oakley spoke on the difficulties experienced by research workers in discovering who are working in their own and closely related fields; ignorance of current and unpublished research leads to much duplication of work and waste of time and energy. The specialization of modern research work frequently requires collaboration between experts in various different techniques. Those who wished to collaborate should be encouraged, and for this purpose he suggested the formation of a central bureau at which research work could be registered in title, and from which information could be sent out to workers in the same or closely related fields. The most natural body to undertake this work might appear to be the Central Register, since it already possesses the names of all active research workers. Nevertheless, it was pointed out that departmental demarcation within the Civil Service might produce obstacles. He emphasized that the Bureau would exist only for collaboration, not for the staking out of claims in special fields of research. Interested bodies are being circularized to obtain support for this scheme.

Mr. Griffin suggested that the present lack of status of laboratory technicians should be remedied by the introduction of a full course of training for them, followed by a qualifying examination; successful candidates to be enrolled in a State register. To effect this it would be essential to have large numbers of technicians in an organization such as the Association of Scientific Workers, which can undertake trade union activity.

Mr. A. L. Bacharach said that for much biological experimental work animals are as essential as pure chemicals are to the chemist. Of the many thousands of animals of many different species so used, a small percentage only are bred for the purpose; the rest are obtained from dealers. Since the suitability of animals for experimental purposes depends almost entirely on their genetic make-up, their freedom from disease and their diet—subjects on which almost all dealers are lamentably deficient—it is not surprising that a large proportion of dealers' animals are unsatisfactory. Besides this, the demand for animals far exceeds the supply. Adequate supplies of pure-bred, healthy, well-fed laboratory animals could be obtained only by tackling the problem on a national scale, by the development of Government-controlled breeding centres. A scheme for the development of such centres circulated to learned societies and users has received sufficient support to justify asking the Medical and Agricultural Research Councils and Ministry of Supply to receive a joint deputation of interested parties.

Two resolutions were adopted by the meeting: the first urged the Ministry of Health to secure the compulsory pasteurization of all milk for human consumption, and to take necessary steps to secure the requisite equipment and to reserve adequate skilled personnel; and the second welcomed the setting up of the Allies' Post-War Requirements Bureau, promised full co-operation of the Association on scientific matters, and expressed the hope that the work of the Bureau includes the preparation of relief immediately following Allied intervention on the European continent.

FORTHCOMING EVENTS

(Meetings marked with an asterisk are open to the public)

Saturday, January 30—Sunday, January 31

ASSOCIATION OF SCIENTIFIC WORKERS (at Caxton Hall, Westminster, London, S.W.1). Conference on "Planning of Science in War and in Peace" (to be opened by Sir Robert Watson-Watt, F.R.S.).*

Saturday

At 2.30 p.m.: "The Central Direction of Science".

Sunday

At 10 a.m.: "Local Organisation".
At 2.30 p.m.: "Determining the Future".

Saturday, January 30

SOCIETY OF CHEMICAL INDUSTRY (in the Chemistry Lecture Theatre of the University of Sheffield, Western Bank, Sheffield), at 2.30 p.m.—Dr. W. H. J. Vernon: "The Corrosion of Metals in Air" (Jubilee Memorial Lecture).

Monday, February 1

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. P. Dunsheath: "Industrial Research in Great Britain, a Policy for the Future" (Llewelyn B. Atkinson Memorial Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 7 p.m.—Prof. C. L. Fortescue: "The Relation between Subsequent Career and the Form of Preliminary Training".

Tuesday, February 2

INSTITUTION OF CIVIL ENGINEERS (STRUCTURAL AND BUILDING ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 2 p.m.—The Rt. Hon. Viscount Falmouth: "Recent Developments in Fire Research and Fire Protection Problems".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 3 p.m.—Sir Lawrence Bragg, F.R.S.: "The Solid State", (ii) "Plus-minus Compounds".*

Wednesday, February 3

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. G. H. Bates: "Agriculture To-day and To-morrow", 4: "Maintaining the Ploughed-up Area after the War".

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (in the Lecture Theatre of the Royal Institution, 21 Albemarle Street, London, W.1), at 5.30 p.m.—Discussion on "Dielectric Breakdown and other Electronic Processes in Solids" (to be opened by Dr. H. Fröhlich).

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Prof. Willis Jackson: "The University Education and Industrial Training of Telecommunication Engineers".

INSTITUTE OF WELDING (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 6 p.m.—A series of papers on "Developments in Arc Welding Technique".

Thursday, February 4

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, Westminster, London, S.W.1), at 2.30 p.m.—Fifth (final) Discussion Meeting: "Civil Engineers and the Building Industry—Management and Organization; the Future of the Building Industry" (to be opened by Lord Reith).

Friday, February 5

ROYAL SOCIETY OF ARTS (INDIA AND BURMA SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Colonel Sir Samuel Christophers, Bart., F.R.S.: "Measures for the Control of Malaria in India".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Prof. J. C. Drummond: "History and Knowledge of Scurvy and its Treatment".

Saturday, February 6

NUTRITION SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 11 a.m.—Conference on "Nutrition in Pregnancy".

BRITISH RHEOLOGISTS' CLUB (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 2.15 p.m.—Dr. R. N. Haward: "The Extension and Impact Resistance of some Plastic Materials".

GEOLOGISTS' ASSOCIATION (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. F. A. Bannister: "The Determination of Minerals by X-Ray Methods".

APPOINTMENTS VACANT

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

GAS EXAMINER (PART-TIME) for tests at Uxbridge and Hampton Court Gas Works—Mr. C. W. Radcliffe, "R.2", Clerk of the County Council, Middlesex Guildhall, Westminster, London, S.W.1 (endorsed 'Gas Examiner') (February 3).

LECTURER IN MATHEMATICS—The Principal, Dudley and Staffordshire Technical College, Dudley (February 4).

DIRECTOR OF THE GAS RESEARCH BOARD OF THE GAS INDUSTRY—The Secretary, Gas Research Board, Gas Industry House, 1 Grosvenor Place, London, S.W.1 (February 22).

MASTER FOR ENGINEERING—The Headmaster, The Gateway School, Leicester.

LECTURER IN ENGINEERING (MECHANICAL)—The Principal, North Staffordshire Technical College, Victoria Road, Stoke-on-Trent.

MASTER OR MISTRESS TO TEACH PHYSICS—The Headmaster, Dover College, Poltimore, Exeter.

LECTURER IN BIOLOGY, MAINLY FOR BOTANY—The Registrar, Municipal College, Portsmouth.

AIR MINISTRY, ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS for the Provinces—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Section D.315, Sardinia Street, Kingsway, London, W.C.2.

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