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INTERNATIONAL COMMODITY CONTROL

THE second Inter-Allied meeting, held at St. James's Palace on September 24, fully justified the hope expressed by Mr. Eden at the conclusion of the first, held on June 12, that the meeting might represent the inauguration of a new phase by which peace will be maintained after victory. This second meeting indeed owes its chief significance, not to the accession of the Soviet Union to its counsels or to the adhesion of the Allied Governments to the common principles of policy set forth in the Atlantic Charter, affirmed at the meeting, important as these may be, but rather to the agreement on concerted action for reprovisioning Europe after defeat of the Nazi regime. That agreement, together with the support and interest of the United States indicated in the statement Mr. Eden was authorized to make on its behalf at the meeting, afford weighty evidence that this time the United States and the individual allies will collaborate in the peace after the war has been won. The importance of American collaboration was indeed confirmed very emphatically by Mr. Sumner Welles in a speech delivered on October 5, in which he discussed the urgent need for plans for reconstruction and condemned the policy of restricted trade followed by the United States during the period between 1918 and the outbreak of the War.

The resolution adopted by the meeting affirmed the common aim of the Governments represented to secure that supplies of food, raw materials and articles of prime necessity should be made available for the post-war needs of the countries liberated from Nazi oppression. It contemplates the co-ordination of the efforts of the individual Governments on behalf of their own peoples, and pledges the Allied Governments and authorities to prepare the requisite estimates of kinds and amounts, and to indicate the order of priority in which delivery of the supplies is desired. Plans for the most efficient use of individual and Allied shipping resources are also envisaged, and as a first step the resolution proposes the establishment in the United Kingdom of a bureau with which the Allied Governments and authorities would collaborate in framing estimates of their requirements, and which, after collating and co-ordinating these estimates, would present proposals to a committee of Allied representatives under the chairmanship of Sir Frederick Leith-Ross.

In proposing this resolution, which implements the policy set out in the fourth, fifth and sixth points of the Atlantic Charter, Mr. Eden referred to preliminary work which has already been carried out under the British Government. In addition to the Leith-Ross Committee, a Ministerial Committee

on Export Surpluses has been established, of which the Minister without Portfolio is chairman. While these Committees have been in the main concerned with the arrangement of purchases, mostly within the British Empire, of commodities which have become surplus to current demand, and primarily to stabilize the economics of the territories concerned, they have been mindful of the value of such purchases as a potential relief store for the European peoples at present being ruthlessly denuded by Germany, and have also started inquiries as to probable human needs.

The framing and co-ordination of estimates of probable requirements is the first task, and the proposal for the establishment of a central bureau is intended to co-ordinate such estimates and provide a practical working approach to a survey of all needs on a common basis. Mr. Eden stated further that the Ministry of War Transport has already been considering what shipping might be available, and the proposed declaration on shipping policy is evidence that the mistake made in 1918 in abandoning immediately after the Armistice the Inter-Allied Food Council and the Allied Maritime Transport Council is unlikely to be repeated.

These developments hold real promise of the establishment of the effective central authority which is essential, and that the international co-operation in the economic field during the crucial period when 'first aid' is required will be built so far as possible out of organizations existing before the armistice. Nevertheless, the more distant horizon is beset with greater difficulties, which even now must be faced if long-range planning to meet such needs is to be possible. A successful attempt to discover means to overcome such difficulties may well depend on an early discovery of the best path to follow.

These reasons give pertinence and urgency to the plans outlined by Mr. Eden, as well as to a number of discussions of various phases of the subject which have recently been opened. Some attention to these problems was given at the recent British Association Conference on "Science and World Order", notably in Sir John Russell's brilliant paper on restoring the scorched earth and in Mr. W. L. Kelly's exposition of the ideals developed in Australia on the disposal of gluts of food as a remedy for trade depression. They have also received attention in Mr. F. L. McDougall's paper on "Empire Primary Products in Relation to Post-War Reconstruction", read before the Royal Society of Arts, and they are analysed in some detail in a P E P broadsheet on commodity control schemes.

Mr. McDougall, after reviewing the failure to improve economic conditions which led to the consideration by the League of Nations of the relation of nutrition to health, agriculture and economic policy, emphasized once more the futility of the Dominions concentrating upon economic nationalism. Reliance upon their own local markets offers no solution, and he suggested that in the word 'welfare' we might find the right and possibly the only solution of post-war economic problems. The Empire primary producer is vitally concerned in the third freedom of President Roosevelt—freedom from want everywhere in the world. He is directly concerned with food and raw materials of clothing, and his own vital interests require accordingly an economic policy in all countries directed towards higher standards of nutrition, housing, clothing and other factors of social welfare.

If at the same time we succeed in translating into action President Roosevelt's fourth freedom—freedom from war—with what it involves in relief from expenditure on armaments, Mr. McDougall believes that the nations would be able to devote a larger proportion of their resources to social welfare. He suggested indeed that the industrial nations will find that they cannot afford not to put a rising standard of living in the forefront of economic policy; and he pointed out that in India and in most of the British Colonies the internal problem also demands the reorientation of agriculture designed to secure plentiful supplies of health-giving food to the producers themselves.

Mr. McDougall's paper was delivered a considerable time before the historic meeting of Mr. Churchill and President Roosevelt, and is of particular interest as indicating the way in which opinion in the Dominions already recognizes its vital interest in the vision and policy of a *Pax oceanica* opened up in the Atlantic Charter. The *Pax oceanica* can no longer be maintained by Great Britain alone, and not the least significant feature of the Atlantic Charter is the evidence it affords that the United States is completing her evolution from a continental into an oceanic power. The Dominions are vitally interested in maintaining the *Pax oceanica* as the basis of world order and freedom, and it is clear that they are ready to recognize not merely this obligation, but also that it can only be pursued in relation to Continental Europe. The economic expansion of the Dominions can only be achieved through the raising of standards of living, which is a world-wide problem.

A policy tending towards the creation or re-creation of world markets, whether by developing the welfare of the Colonial peoples or by European reconstruction, involves co-operation in the creation of markets. It means making the consumer and not the producer the starting-point of policy; the organization of consumption takes precedence over the organization of production. The old

programme of freedom of trade is transformed into a new programme of freedom from want.

The policy of direct attack upon economic stagnation and social backwardness in the Colonies, like the idea of minimum standards in nutrition, health, social services and education stressed by Dr. Julian Huxley in "Democracy Marches", involves a new approach to commodity control schemes. As the P E P broadsheet shows, the existing schemes all imply some degree of conscious planning and co-ordination of action, and their development has been in the hands of pioneers whose ability and honesty of purpose have both varied. Even during the War, great advances are being made in the technique of economic control, and education in the uses and limits of control is being widely diffused. Much is being learnt from the almost world-wide application of 'lease-lend' procedure and the working out of shipping programmes for essential supplies, while the significance of organized research and planning in this field under Sir Frederick Leith-Ross is far-reaching.

The P E P broadsheet gives a concise analysis of the commodity schemes already in existence, their characteristic features and actual results achieved during the last twenty years. This analysis is inevitably much slighter than that in the report of the League of Nations committee for the study of the problem of raw materials, or in the Royal Institute of International Affairs information paper on raw materials and colonies. The most valuable feature of the broadsheet is accordingly its discussion of the purpose of commodity control and of the methods of establishing it, based upon the conclusions drawn from experience already available.

Despite the inherent disadvantages of commodity schemes and the frequent abuse of monopoly power, there can be no doubt that control has come to stay. Without its continuance, problems involved in the handling of world commodities by international co-operation after the War cannot be solved. Functional, as distinct from geographical or national, organizations are likely to play an increasingly important part in economic life, and it is important to learn the utmost from mistakes in the past, so that such functional bodies can be made fully accountable to the community as a whole by a strengthening of political authority—national and international. The commodity control scheme of the future, international in its control of supply and of markets, should be subject to public supervision and allow for a substantial representation of consumers.

This development should remove the two main criticisms levelled against past restriction schemes —the maintenance of prices at an unreasonably high level, and the persistence of inefficient production under restriction schemes. The measures now being taken to deal with the problem of surpluses, however, involve further problems. The holding of stocks on a commodity control basis affects the financial issue. Some means must be found of bringing finance into line if commodity control schemes are to function satisfactorily in the post-war period.

Now that Governments have entered the market as large-scale buyers, they are likely to continue to do so after the War, both for unwanted surpluses and for key raw materials and foodstuffs. One centralized Government organization which controlled the marketing of such products would be in a stronger selling position than a number of individual producers and mechants, and would also be able to ensure fair distribution. In schemes established after the War for commodities in which there are shortages, consumer interest will undoubtedly play a much more important part. So, too, the barter arrangement between the United States and the British Government holds possibilities for development in the post-war period, the main economic task of which will be to build up a system which is not subject to the violent fluctuations characteristic of the period 1920–39, but which stimulates a steady expansion of economic activity and makes adjustments possible with the least dislocation of economic life.

This task is parallel with the political task of building up a stable world order which fosters co-operation between nations. Control of the production and marketing of raw materials, if organized on a comprehensive international basis, is of the first importance in both tasks. Moreover, commodity control in such an economic order involves not merely eliminating past defects so as to make a reformed pattern of commodity control an accepted part of the economic structure. It involves also market surveys and forecasting of a comprehensive type, which are scarcely possible save under a strongly organized international scheme. It requires, too, a concerted effort to avoid the existence of surpluses of foodstuffs and raw materials at one point and shortages at another, which under commodity schemes before the War were frequently found in neighbouring countries. It involves also control over the industrial potential of every nation and therefore over its power to pursue policies of aggression, and the steady and continuous enforcement of peaceful measures rather than occasional belated attempts to stop wars.

Recognition of the economic and political objects of post-war commodity control leads Political and Economic Planning to suggest the formation of an international raw materials union for all commodities, built up on the lines of the International

Postal Union and affiliating the international and national associations controlling particular commodities. This union could be set up in the first instance by the Governments of the Allies and of the United States as a non-political body, the chief concern of which would be to promote economic welfare. Only key raw materials would be brought in at the start, and the union would not concern itself with particular commodities but with the general structure to be adopted in particular commodity control schemes and the terms of supply and of purchase to be observed by bodies affiliated to it.

One important function of the suggested union would be the publication of regular reports analysing trends in price and consumption of controlled commodities, indicating successful innovations for adoption elsewhere and defects to be avoided in future schemes. Common services, such as technical and economic research or exchange of personnel, would be organized by the various commodity controls for their own commodities, and by the union in respect of wider interests. The union would also promote co-ordination between the various commodity schemes in neighbouring groups of territories, for example, by creating regional reserve stocks, developing storage capacity, encouraging diversification in areas too dependent on one or a few products, and assisting exchanges of surpluses.

On the further question of the function of such a union in enforcing economic sanctions, the broadsheet merely indicates the possibilities, with a pointed reference to the measures which the United States and the British Commonwealth are belatedly taking against Japanese aggression. The suggestion is indeed too tentative to be judged in detail, but it does indicate the value of establishing some such union during the War, and the way in which it could facilitate the work of the International Reconstruction Commission which will assuredly be required afterwards in place of the unco-ordinated effects of individual Governments which proved so ineffective twenty years ago. The same basic idea has been outlined by Dr. Julian Huxley in "Democracy Marches", and it is implicit in the fourth and fifth points of the Atlantic Charter. No reader of the P E P broadsheet can remain unaware of the difficulties with which this problem bristles, but that they should be stated clearly and thoroughly discussed is the first step, not merely towards meeting immediate needs, but also to the long-term planning and co-operation upon which the reconstruction of world trade and the development of a new and more stable world order depend.

ONTOLOGICAL EVIDENCE OF DEITY

Mind and Deity

Being the Second Series of a Course of Gifford Lectures on the General Subject of Metaphysics and Theism given in the University of Glasgow in 1940. By Dr. John Laird. Pp. 322. (London: George Allen and Unwin, Ltd., 1941.) 10*s*. 6*d*. net.

PROF. LAIRD gives us here the second half of his recent Gifford Lectures (the first half having already been published under the title "Theism and Cosmology"). "Theism and Cosmology" was exclusively concerned with the two types of theistic proof "which appeal more directly to the scientific mind", the "cosmological argument" for a "great first cause", and the argument from design. The centre of interest in the present volume is different; we are concerned with the "ontological proof", which if valid would show that God's existence cannot be denied without flagrant self-contradiction, and the various forms of the "moral argument". The consideration of the latter leads to much interesting discussion of the sense in which omnipotence, benevolence, personality can be ascribed to God, and of the possibility of "pantheism". The conclusion of the whole matter reached in the final paragraphs is that while none of the theistic "proofs" is convincing or even highly plausible, theism is a tenable, though not demonstrably true, metaphysical theory of the universe which is more plausible than most of the possible alternatives. The verdict is the Scots "not proven" (which, by the way, commonly means that the jury knows pretty well what to think of the case). This finding will not satisfy all philosophical theists, though it should not perturb those of them who are Christians, familiar with the thought of faith as a *venture*, an assent of the mind to what is not forced on it by demonstration.

Few readers of NATURE will be likely to quarrel with the contention that the "ontological proof", whether in Anselm's version or in Descartes', is a fallacy which has been once for all exposed by Kant, and that its pretended resuscitation by Hegel is really a substitution of assertion for proof. I am not equally convinced by the reasoning of the chapters on "Value and Existence" and "The Moral Proofs of Theism". Prof. Laird is always fair-minded,

acute and critical, but he has not, I think, allowed sufficient weight to the simple but impressive argument from the unconditional validity and imperativeness of the moral law to a divine moral law-giver. It is not easy for me to believe that any confusion between the moral law of right and wrong and the edicts of a political superior can account for this felt imperativeness of a law which there is no political superior to impose, and with which political superiors are only too apt to 'play ducks and drakes'. Here, I believe, Prof. Laird might have learned more from Kant than he is willing to do ; I believe more attention to Kant would have made him a little suspicious of the merits of what he calls (in his chapters on "Providence" and "Pantheism") an impersonal theism. It is argued that if as a fact existence is on the whole a boon, and virtue and success, on the large scale, go together, this adequately safeguards all that is essential in the doctrines of divine benevolence and providence ; that the "impersonalist" would ascribe this result to an unintentional *trend* in Nature is a negligible detail. But is it ? The love and gratitude which are the proper response to intentional benevolence can scarcely be evoked by a blind trend except through a romantic illusion, and it is hard to see how our destiny can be apportioned to our inward goodness of will, unless, as Kant said, by a "reader of hearts".

I would remark also that in the subtle and interesting discussion of "pantheism" Prof. Laird is probably over-hasty in inferring from the language of Christian theologians about God's omnipresence in all His creatures that these theologians are with half of their minds asserting a pantheism incompatible with the theism of other parts of their teaching. Most of the theologians in question—perhaps all—would accept the scholastic principle that no predicate (not even existence) can be asserted univocally of God and of any "creature". If the pantheistic propositions quoted by Prof. Laird are read with this qualification, their meaning may be seriously affected.

I much regret that considerations of space compel me to be content with so inadequate a notice of a scholarly, candid and most acute study which I heartily commend to all readers of NATURE.

A. E. TAYLOR.

RELATION OF ONTOGENY AND PHYLOGENY

Embryos and Ancestors

By Dr. G. R. de Beer. (Monographs on Animal Biology.) Pp. x+108+2 plates. (Oxford : Clarendon Press ; London : Oxford University Press, 1940.) 7*s*. 6*d*. net.

IN 1930 Dr. de Beer published a small and stimulating book under the title "Embryology and Evolution". In it he attempted to reorientate general views relating to 'recapitulation' in evolution. Beginning with a statement of Von Baer's laws, he described their modification at the hands of Haeckel, who in his biogenetic law abandoned Von Baer's principles of progressive deviation and instead implied, as Dr. de Beer puts it, that phylogeny is due to the "successive tacking on of new final stages to the existing adult stages of animals". Haeckel's biogenetic law had, of course, come under considerable fire before Dr. de Beer attempted to redefine the problem. Its main shortcoming was the fact that the order in which characters appear in phylogeny is frequently completely different from that in which they appear in ontogeny. The term heterochrony is applied to this alteration in the sequence of stages.

The main purpose of Dr. de Beer's original essay was to show that variation in the order and rate of appearance of structures in successive ontogenies can have considerable influence on phylogeny. Thus, if a structure which normally appeared in the young stage of an ancestral animal appears in the adult stage of the ontogeny of a descendant, large structural changes occur without loss of plasticity, a process to which Dr. de Beer refers by the name of pædomorphosis. On the other hand, characters which normally made their appearance in the adult stage of an ancestral animal might appear in the young stages of a descendant, when they would cause little structural change but considerable loss of plasticity. To this process Dr. de Beer refers by the term gerontomorphosis. Dr. de Beer's conclusion was that pædomorphosis and gerontomorphosis "act intermittently in the phylogeny of the race, the former producing racial juvenescence, the latter racial senescence".

Dr. de Beer has now republished his original book, which has been out of print for some time, under the new title of "Embryos and Ancestors". He states in his preface that much new evidence has become available in the intervening years but that nevertheless he sees "no reason to alter the plan" of his former book "in the slightest degree". The same chapters are there, but some have been extended with more recent examples. In its new form his book is just as stimulating to read as its

ancestor, and just as provocative. Some disappointment may be felt at Dr. de Beer's failure to consider some aspects of the problem in greater detail than he has done. The most striking instance of neotony which is usually emphasized is the view that man became differentiated from his fellow primates by a process of fœtilization, and it is this example of neotony which Dr. de Beer describes most fully. His arguments are the same as those which he presented in 1930, and are derived in the main from Bolk. Unfortunately Bolk's views on this subject scarcely stand up to close examination. It may be possible to recognize a process of neotony or fœtilization in human development if we are not too critical about the choice of the details of the developmental processes which form a basis of comparison between the development of man and that of non-human primates. It is, however, certainly impossible within the limits of the order of mammals to which man belongs to recognize an orderly process of increasing fœtilization.

While Dr. de Beer's lack of reference to such shortcomings of the general principles he discusses may be regretted, there can be no doubt that he has put the central issues of the general relation of ontogeny and phylogeny clearly and vigorously. His book will with little doubt influence a coming generation of biologists no less than did his earlier essay. S. ZUCKERMAN.

A NATURALIST IN NORTHERN IRELAND

Birds of the Grey Wind

By Edward A. Armstrong. Pp. xv+228+32 plates. (London, New York and Toronto: Oxford University Press, 1940.) 12*s*. 6*d*. net.

IT is said that no Nature book can be successful nowadays unless its illustrations are good. "Birds of the Grey Wind" has a number of really excellent photographs. That of the fulmar in flight is outstanding, but almost as good are those depicting peregrine and sparrow hawk, sandpiper and water ousel. Of special interest is the photograph of a chough feeding her young. This is the first close-up photograph I remember having seen of a chough—a rare bird, nesting in the twilight of caves—and it is perhaps because of under-exposure of the negative that it has been necessary to touch up the bills of the young choughs. There is an unusual illustration showing a mute swan chasing away a Bewick's swan on Lough Neagh.

The book describes mainly the birds of Northern Ireland. There are chapters on Rathlin, Strangford Lough and Lough Neagh; on the heron and cuckoo, red-breasted merganser, swan and cuckoo. Mr. Armstrong writes clearly and sympathetically on the birds of his Irish home. He has spent long days and nights studying them, has watched the herons' flight into their wood above Belfast Lough, mergansers displaying in the sea on a calm November day, tree-creepers roosting in the gnarled bark of some great Wellingtonia, whistling choughs soaring with wide-open primaries above Rathlin, and a young cuckoo (an excellent series of pictures illustrates this) ejecting a hedge sparrow's egg from the nest. He has a leaning for the tales of long ago: Columba awaiting the arrival of the weary crane from Eire upon his spray-drenched island of Iona; Saint Patrick landing to preach the faith at Strangford Lough—surely Lough Cuan, the old name of that lough, signifies Lough of the Sea, and not, as Mr. Armstrong says, Harbour Lake!—and the fate of the Children of Ler who were compelled to ride the stormy sea for centuries in the guise of swans.

The book contains many interesting notes on birds. We are told that Irish magpies are believed (p. 20) to be the descendants of a flock of some dozen birds from England which were blown out of their course by an easterly gale and arrived exhausted on the Wexford coast about the year 1676; that two thousand wagtails roost (p. 8) in a certain tree in a Dublin street; of the nesting of a merganser (p. 109) on a tall conifer in the old nest of a grey crow. The story (p. 34) of a kestrel bitten and killed by a stoat it was carrying off reminds me of the fate of a golden eagle not far from Cape Wrath, which rose with a stoat to a great height, then fell lifeless to earth with a great wound in its throat, the stoat, strangely enough, unharmed after its strange experience. Mr. Armstrong (p. 7) believes that the moorhen never loses its timidity even when living with other birds that are tame. But I recall that at Fallodon there was a moorhen which used to take bread from Lord Grey's hand, almost as readily as his tame ducks.

There is one small slip in Mr. Armstrong's chapter on the great auk. He describes (p. 217) Stack an Armin as being in the Orkneys: it is, as a matter of fact, a high rock rising from the Atlantic just off Boreray, one of the St. Kilda group of islands.

SETON GORDON.

CONSERVATION OF NATURAL RESOURCES*

By C. H. DESCH, F.R.S.

THE natural resources of the world fall into two main groups. The one, represented by the products of agriculture and forestry, may be renewed, either annually or at longer intervals, by cultivation, and may be consumed as income, while the other, including mineral wealth, must be regarded as capital, and once consumed is not renewed. Soils should perhaps form a third category, for while they may be maintained in fertility for thousands of years, as in China, they are only too easily ruined by careless or greedy exploitation, leading to exhaustion and erosion, or by mining operations, which may cause subsidence as in parts of England, or burial under debris through hydraulic mining as in California. This paper is mainly concerned with the conservation of those mineral resources on which modern industrial civilization increasingly depends.

Mineral deposits have too often been regarded as inexhaustible, and it is only lately that the possibility of exhaustion in a measurable time has attracted attention. As industrialization becomes more intense in Western societies and continually extends to regions which were purely agricultural, the rate of consumption of mineral capital is accelerated to an extent which is not always appreciated. Sir Thomas Holland has shown that in the first twenty-five years of the present century the quantity of minerals extracted from the earth was greater than that raised in the whole previous history of the world, or, say, six thousand years since copper was first mined. A report to a committee of the League of Nations in 1937 by Prof. Högbom gave diagrams which showed that over a period of about sixty years the annual production of coal doubled itself in a little less than seventeen years, of pig iron at about the same rate, of oil in eight and a half years, of copper in twelve and a half years, and of tin in eighteen years, the general trend remaining remarkably constant in spite of temporary fluctuations. Coal, for reasons which have been given by Sir Harold Hartley, ceased to increase after 1913, but in most instances, after an initial rate of growth which may be irregular, as for aluminium to-day, a stable rate is reached which gives a straight line when plotted logarithmically.

This does not mean that the production in any one country follows this law. The older producing regions may show a slower rate of increase, but this is compensated for by the opening up of new sources as the demand grows. It may seem impossible that such a fantastic rate of growth could long be maintained, but the standard of living which calls for such a consumption of metals and power applies as yet only to the Western nations. China consumes little metal, its enormous population depending on the use of renewable natural wealth rather than on mineral capital, but it represents a vast potential consumption, and the same may be said of India and, perhaps in a more distant future, of Africa.

It is extremely difficult to form an estimate of the existing mineral reserves. The total quantity of each element in the earth's crust, down to a certain fixed depth, has been estimated with some accuracy, and the figures are surprising. Nickel proves to be ten times more abundant than lead and fifty to a hundred times more than tin. Vanadium is more abundant than copper. But it by no means follows that they can be recovered in those proportions. For the most part, metals are very finely disseminated in the rocks, and extraction is only possible where local concentration has occurred through geological causes. Nearly 90 per cent of the world's nickel comes at present from a single great deposit in Ontario, and there are few other important sources. The deposits of tin are also highly local. The concentration which is necessary for profitable working varies very widely; thus the ore of the Rand may be worked when it contains one part of gold in 150,000, while hydraulic mining has been used on deposits containing only one part of gold in three millions. On the other hand, an ore containing 20 per cent of iron is of low grade.

The estimates of world mineral reserves given by standard authorities fluctuate from year to year, but there is a certain complacency in the statement regarding some important minerals that the reserves will last for several decades. Where essential capital, which there is no possibility of replacing, is concerned, we have to consider a more distant future. It appears that coal and iron may last for several thousand years, but the known reserves of oil, gold, tin and perhaps copper suggest a life of less than a century. That life may be extended in two ways: by the discovery of new deposits, or by improvements in methods of mining and extraction. The first is always possible, and there are regions such as the mass of ancient rocks in Canada still covered by

* Paper read at the Conference on Science and World Order on September 27.

forest which may prove to be valuable, but the areas unsurveyed are constantly dwindling, and there are vast regions which are mineralogically barren. By far the greater part of the mineral production of the world comes from countries bordering the North Atlantic, and ore deposits of importance are limited in the main to the fringes of the great oceans and a few mountain ranges.

It is, however, possible to improve greatly the methods of mining and of concentration. To take the latter first, the enrichment of sands and crushed rocks by mechanical separation is as old as mining itself, but it has been greatly perfected in the last century, and the introduction of new physical methods, such as magnetic separation, froth flotation (depending on surface tension) and electrolysis have made possible the working of ores of low grade. Further inventions of this kind may revolutionize the extraction of minerals, and in that case the estimates of the life of deposits now accepted may be too pessimistic.

Improvements in mining may make it possible to extract a larger proportion of the useful material from a given deposit, and this seems particularly likely in the case of oil, but it must be remembered that mining operations are usually wasteful. The extraction of the rich ore from a mine frequently renders inaccessible a larger quantity of ore of lower grade which it does not pay to bring to the surface. Under the usual conditions of exploitation there is a natural tendency to 'skim the cream' from a deposit, extracting only that material which is immediately profitable, and this is most likely to occur where a concession is being worked, perhaps in a politically unstable country, by a foreign company. This is one of the factors to be taken into account in a scheme for an international control of raw materials.

Each new technological advance is apt to create a fresh demand for some material, which may be of scanty occurrence. The electrical industry is much dependent on the unique qualities of certain varieties of mica, and the engineering industries call for steels and other alloys containing the rarer elements, such as nickel, tungsten, molybdenum, cobalt and vanadium. The light alloy industry is of very recent origin and has opened up great new fields of usefulness, and this again will in future make greater use of some of the rare elements. Little is known as to the available reserves of these metals, but the deposits containing them are usually small and are highly local. Some of them must be within measurable distance of exhaustion.

One possible mineral source as yet but little explored may be mentioned in passing. Owing to the disintegration of rocks by weathering and the transport of the products by water, all the elements present in the rocks are found in the sea. It is true that they are in an extremely dilute state, but recovery is not impossible. The fiasco of 'gold from sea water' of some years ago may seem to make this unlikely, but modern physical chemistry suggests possible means of concentration. Already magnesia is recovered from sea water in quite large quantities, the great volume of water which has to be handled not proving an obstacle.

Most minerals, once extracted from the earth, find application in industry, and after a period of usefulness which may be long or short become waste. Some of them, but not all, return in part in the form of scrap. Steel is made from pig iron, and until 1914 the world's production of pig iron was greater than that of steel, the balance being used in the foundry. In 1914 the curves crossed, and since then the production of steel has been greater, and increasingly so, than that of pig iron, owing to the very large quantities of scrap which are returned to the steel furnace. Not all of it comes back, corrosion and waste accounting for a considerable proportion. The use of recovered or 'secondary' metal, as it is called, is also becoming important in other metal industries, such as that of aluminium. Unfortunately, the key elements used in small quantities in alloy steels are largely lost, and it is here that a shortage is soonest likely to be experienced. Research is needed to devise means of recovering these essential and irreplaceable materials when the objects which contain them become scrap.

Much is now heard of substitutes for materials which have become scarce, and in Germany especially great efforts have been made to reduce to a minimum the quantities of metals used, such as nickel and tin, which cannot be produced at home, but it cannot be said that any startling success has been obtained in this direction. The new field of plastics offers genuine substitutes for metals for a variety of purposes, and as some of them can be manufactured from agricultural products they represent a real contribution to the cause of conservation.

There is one instance of a mineral which has been almost entirely replaced by an artificial product. Chile nitrate, for long the only source of artificial nitrogenous fertilizers, and occurring only in certain rainless districts of South America, where it had been formed under quite exceptional geological conditions, was clearly limited in its reserves, and its exhaustion could be foreseen. In 1898 Sir William Crookes, in a famous address to the British Association, painted an alarming picture of a decline in the supply of wheat owing to the exhaustion of soil nitrogen. Nitrogen compounds synthesized from the air have now replaced Chile nitrate, and the supply of them is inexhaustible. Radium, the

ores of which are very rare, is being supplemented for medical and similar purposes by artificial radioactive elements, but substitutions of this kind are obviously very exceptional In the main, we can only look to a more economical use of metals and to more complete recovery as a means of conservation. Another fertilizer, phosphate, is mainly derived (apart from that which is a by-product of the basic steel industry) from a few sources of limited extent, and our present highly inefficient means of dealing with sewage leads to the greater part of the phosphates being discharged into the sea. This is a form of waste which is closely linked with the general question of the fertility of the soil, and the problem will call urgently for a scientific solution in the very near future.

The case for a planned conservation of mineral resources may not seem so strong as that for energetic action to conserve soils and forests. Even minerals of which the known reserves are small may last for several generations. The future of the rarer and increasingly important elements is more difficult to foresee because of the imperfect survey so far made of their scattered deposits, but it is likely that the demand for them will increase more rapidly than that for the more common minerals. However, many of the errors of the past have come from lack of foresight, and a planned world economy must take account of conditions a century or more hence, when our descendants may find themselves hampered by the wasteful exploitation of natural resources in our own day.

That an international control of raw materials will be needed after the War is a natural consequence of such a promise as that of equal access contained in the fourth aim of the Atlantic Charter. A recent issue of *Planning* (P E P) has suggested a means by which such a control could be introduced, tentatively at first by application to a small number of commodities, the international raw materials union of producers including representatives of Governments in their capacity of consumers as well as producers. Such an authority would have many functions outside the scope of this paper, but as it would be in possession of the fullest information as to production, consumption and reserves it would be able to consider, in the light of that knowledge, the question of the possible exhaustion of reserves, and to recommend, or if its constitution should permit, to enforce, greater economy in use or a restriction of exploitation.

ECONOMIC ASPECTS OF THE BLOCKADE AND COUNTER-BLOCKADE

By Paul Einzig

THE relative importance of the economic factor among the factors determining the outcome of the War has increased considerably as a result of the progress in the mechanization of the armed Forces. Requirements of weapons and equipments of raw materials necessary for their manufacture and of motor fuel are now incomparably larger and more diversified than they were during the War of 1914–18. The striking power of the armed Forces is now dependent on the industrial capacity and the importing capacity of the belligerent countries to a much higher degree than in previous wars. The belligerent countries are now incomparably less self-sufficient than they were in the past. For this reason the duration and outcome of the present War depends to a very large extent on the results of blockade and counter-blockade.

It is essential to avoid exaggerating the relative importance of economic warfare ; but it is equally important to avoid going to the other extreme. The exaggeration of the relative importance of the blockade during the early months of this War was largely responsible for the slackness of Great Britain's war effort in other directions during that period. After the disillusionment that followed the German victories in Western Europe, the pendulum swung in the opposite direction, and for some time it was all but generally believed that economic warfare in general and blockade in particular was incapable of producing any noteworthy results. The truth lies somewhere half-way between the two extremes. In order to defeat Germany it is indispensable to win a decisive military victory. Such a victory is inconceivable, however, unless and until Germany's vital economic resources have been materially reduced as a result of offensive economic warfare. It is an equally essential condition of victory that offensive economic warfare waged by Germany in the form of counter-blockade and air bombing should be prevented from reducing Great Britain's economic resources.

The argument of those who underrate the importance of offensive economic warfare among our weapons against Germany runs broadly as follows :

The relative extent to which Germany's economic resources can possibly be affected either by air

bombing or blockade is moderate. Germany's industrial capacity is so vast, her plants and stocks are so widely dispersed over the territory of the Reich and of the occupied countries, that the R.A.F. would be incapable of destroying more than a relatively small fraction of these resources. As for the blockade, its significance has become materially reduced as a result of the acquisition of new sources of raw material through the conquest of the greater part of Europe, and as a result of the development of the production of synthetic materials. There is a great deal of truth in this contention. It seems an altogether hopeless task to try to reduce Germany's economic war potential in general by means of an economic offensive. On the other hand, it is by no means beyond the realms of possibility to reduce certain key resources of Germany.

During the earlier phases of the War it was hoped that the German war machine could be paralysed by concentrating upon the reduction of German stocks of oil, rubber, textiles and rare metals such as tungsten, molybdenum, wolfram, etc., required for hardening steel. In the meantime, this list became shorter, partly because Germany succeeded in seizing large stocks of special metals and partly because the necessity for concentrating on a small number of materials had become obvious. Indeed, in my own view, maximum results could be achieved by simply concentrating on oil. Assuming that Germany will be unable to seize the Russian oilfields—or at any rate that even if she should seize them they would be in a hopelessly damaged condition—there is every reason to hope that the British economic offensive would be able to paralyse the German war machine and economic system by bringing about a reduction of Germany's oil supplies. While in most other respects the blockade does not inflict upon Germany an intolerable burden, in respect of oil it is capable of preventing almost completely the arrival of consignments from outside Europe. Moreover, if the air offensive is concentrated upon the oilfields under German control in Poland, Rumania, etc., and on synthetic oil plants, refineries, storage tanks and pipelines, then Germany's producing capacity and stocks could be materially reduced. By pursuing such a policy, economic warfare would be made to play a decisive part in preparing the ground for military victory.

Hitherto we have confined ourselves to examining the possibilities of Allied offensive economic warfare against Germany. Let us now consider the problem of the defence against German offensive economic warfare. The British economic system has no Achilles' heel comparable to the German oil position, for the simple reason that so long as mastery of the sea is retained, deficiencies in particular materials can be made good by importing from overseas. For this reason, while German air bombing is capable of inflicting considerable losses upon life and property, it is in itself incapable of paralysing the British war machine and economic system in the same way as British air bombing is capable of paralysing the German war machine and economic system if concentrated upon oil production and supplies. The only way in which German economic warfare against this country could play a decisive role would be through cutting off Great Britain's lifeline. This is exactly the object of the German counter-blockade.

While Germany largely relies upon the production of food and raw materials of conquered Europe, Great Britain depends to an even larger extent on economic assistance from the United States and from the British Dominions. Neither of the belligerents is able to prevent the other from making use of these vast auxiliary resources outside their own territory. Judging by the progress to date of the Battle of the Atlantic, the German counter-blockade has so far failed to achieve this end. Judging by the expenditure of vast quantities of oil by Germany in the offensive against Russia, the results of the British economic offensive in the restricted sphere of oil have also been far from complete. These facts do not, however, prove that the economic weapon is of relatively small importance. After all, during the War of 1914–18, it took four years for the British blockade to produce its full effect upon Germany. It would be unduly optimistic to assume that the Battle of the Atlantic has been won and that Germany is entirely incapable of preventing Great Britain from benefiting by American and other overseas economic assistance; and the mere fact that certain statements concerning the effect of the British blockade on the German oil position have since proved to be at least premature does not mean that sooner or later the British economic offensive will not deprive Germany of her vital oil supplies.

Blockade and counter-blockade tend to produce a profound effect upon the economic structure. The result of the British blockade is an intensification of the German self-sufficiency drive, and its extension over German-controlled Europe. Under the necessity of war requirements many new branches of production are established and existing ones are expanded. The German counter-blockade affects the British economic system in a different way. It is true that in some respects self-sufficiency is aimed at in order to economize in shipping space. For example, in Great Britain food production tends to increase, largely as a result of the German counter-blockade. The same factor also works, however, in the opposite sense. It requires less

shipping space to import the finished products than to import raw materials required for their production. Partly for this reason many new plants have been established in the British Dominions in preference to their being built at home. In order to reduce the dependence of the British Forces in the Middle East and the Far East upon the lifelines from Great Britain, exposed as they are to German attacks, munition industries have sprung up in India, Australia and New Zealand. These Dominions are unable to depend on imports from Great Britain, and tend to become much more self-sufficient through the development of industries of their own.

The same is true concerning neutral countries. Lack of shipping space, among other reasons, prevents Great Britain from supplying her Latin-American markets to the same extent as before. The British blockade prevents these countries from buying manufactures from Germany, Italy, or other German-controlled industrial countries. Nor are the United States or Japan in a position to fill the gap. Consequently, blockade and counter-blockade leads to the industrialization of Latin-America. In any event, since the blockade and counter-blockade have made it more difficult for the Argentine, Brazil, etc., to sell their products either in German-controlled Europe or in Great Britain, they could ill afford to keep up their imports at pre-war level.

It seems probable that to a very large degree these effects of blockade and counter-blockade will be of a lasting nature. This was the case with the economic effects of the Continental system and the British retaliatory measures adopted during the Napoleonic wars, and also with the effects of blockade and counter-blockade during the War of 1914–18. It is true, there is a great deal of idealistic agitation in favour of free trade after the War. The fact, however, that by the termination of hostilities the degree of international division of labour will be much smaller than it was in 1939 will have to be borne in mind. Overseas countries will be reluctant to de-industrialize themselves. Most countries will be anxious to retain and develop industries required for national defence. As for Great Britain, the permanent loss of many of its overseas markets and the decline of its income from overseas investments will make it necessary to continue to produce at home more food than it did before the War. The task of 'unscrambling the eggs' by demobilizing new industries abroad and by letting the millions of newly sown acreage in Great Britain go once more out of cultivation will be more difficult than is generally realized.

The lessons learnt from experience in economic warfare during this War are likely to influence the peace terms. The victors will want to disarm their vanquished opponent not only in a military sense but also in an economic sense. The reversal of Germany's trend towards self-sufficiency would provide some safeguards against another war ; a compulsory demobilization of some of her industries producing synthetic key materials would go a long way towards discouraging a repetition of 1914 and 1939, simply by rendering Germany more vulnerable to blockade.

SEISMOLOGY AND EARTHQUAKE-PROOF DESIGN

By Ernest Tillotson

ON May 7, 1940, Mr. D. Laugharne Thornton read a paper on "Earthquakes and Structures" to the Royal Society of Arts[1], in which he stressed the need for the co-operation of engineers and seismologists for the purpose of mitigating the effects of earthquakes on buildings. Mr. Thornton's paper showed that engineers are fully alive to the situation, while the work seismologists have been doing to this end is perhaps not generally realized. Most of the work has been done with actual earthquakes, though much useful information has been obtained by the use of shaking tables and artificial earthquakes caused by dynamite explosions. (The results might be of immediate use in 'bomb-proof' design.) As Great Britain is an island in which strong earthquakes are rare, adequate results would not repay the setting up of strong-motion instruments, and most results have, therefore, been obtained in the United States and Japan. Mr. Thornton stated in his paper that "the first great earthquake in which scientists were ready with a wide distribution of instruments including some capable of recording strong motion, occurred so recently as September 1, 1923, at Kwanto, Japan". It may well be that the first adequate and reliable results for certain purposes were obtained then, though ever since the time when Milne and Knott were in Japan valuable information has been accumulating. Certain institutions and individuals have also long been obtaining noteworthy results in the United States, though it was late in 1932 when the U.S. Coast and Geodetic Survey inaugurated a programme of recording strong ground movements in seismically

active regions of the country to obtain data needed in the design of earthquake-resisting structures. The Survey has published much of the work, and the latest publication has recently been received[2].

Several types of strong-motion seismographs are used, but only the accelerographs and displacement meters give results of wide scientific value. These instruments do not operate continuously on account of the paper cost and the necessarily large speed of the record during the earthquake, but are automatically started through a pendulum-starting device by any earthquake which attains a certain strength. After a time the photographic record is automatically stopped. It is then removed and developed.

Seismographs are themselves pendulums especially devised for the purpose they have to serve. The accelerographs are so called because their period of 0·1 sec. is relatively short compared with that of the principal earthquake waves which cause damage, and therefore their acceleration is measured. The displacement meters have a period of 10 sec., and, since this is relatively long compared with the period of the principal waves in which we are interested, they record approximately the displacements. There are now thirty-five accelerographs in California, four in Arizona, four in Montana, one in Utah and one in the Panama Canal Zone. There are six displacement meters in operation, all in California, but each is installed near an accelerograph.

The positions of the instruments are important, since it is necessary to distinguish between ground movement and building movement. The accelerograph mostly used is more compact and satisfactory in operation than the displacement meter, and the chance of obtaining acceleration records is so much greater than that of obtaining displacement records that the former is often installed and the approximate displacements calculated. To do this the acceleration records are first enlarged and then, on the assumption of simple harmonic motion, these are integrated to obtain velocity curves which are in turn themselves integrated to give displacement curves. The mathematical principle is simple, but owing to the irregularities of earthquake motion there are many complications in the actual operations. These problems have all been solved, and in a private letter Dr. L. O. Colbert informs me that it is now the regular practice in his department to integrate the more important records, the others having to be omitted only because of necessity. Engineers are interested in all three sets of curves, namely acceleration, velocity and displacement.

In addition to the accelerographs and displacement meters several strong-motion seismographs of a type invented by Mr. Arthur J. Weed of the University of Virginia are in operation. This is an inverted pendulum device of period 0·2 sec. with oil-damping, and registers on smoked glass in three dimensions. The pendulum is always working, and when the vibrations become sufficiently intense a trigger action starts the clockwork which drives the smoked plates. Calibration is necessary. Since in the United States the various instruments are well distributed over the regions subject to earthquakes, a considerable number of records have been obtained, and all the principal earthquakes since and including the Long Beach earthquake in California of March 10, 1933, have produced records. The most informative records have been the three records of the Long Beach earthquake (one obtained in the business centre of Los Angeles), the records of the Imperial Valley, California, shock of 1934, those obtained for the shock at Helena, Montana, in 1935, and especially those of the earthquake of May 18, 1940, also in the Imperial Valley. The latter was of special interest as the instrument was only seven miles from the epicentre and a slightly greater distance from where there was slipping of 12 ft. along the fault.

Earthquake work in Japan is largely organized by the Earthquake Research Institute of the Tokyo Imperial University. Since the early part of 1939 economic depression has cut down the work of this Institute. Transport difficulties have also decreased the amount of information received from Japan so that the present state of Japanese seismology is somewhat unknown. Undoubtedly important work is proceeding there, as prior to 1939 great strides had been made. Early in 1931, Prof. Mishio Ishimoto perfected his acceleration seismograph, since which time it has taken various forms, all recording on smoked paper. The pendulum period is 0·15 sec. and the static magnification is about 200. An acceleration of 1 cm./sec.^{2} gives an amplitude on the record of 1 mm. There is a considerable number of these instruments in operation, but their present whereabouts are not known exactly since they are sometimes moved to get a better distribution.

The acceleration and displacement have in general proved to be greater than anticipated. For the northern California earthquake of September 11, 1938, the Ferndale accelerograph south-west–north-east component registered an earth wave period of 0·18 sec. with a maximum acceleration of 93 cm./sec.^{2} and a maximum displacement of 0·075 cm. This was not one of the great earthquakes of California, though the acceleration stated is above the average for 1938. Investigations at the University of California, California Institute of Technology and the Massachusetts Institute of Technology, have been made to deter-

mine the relation between actual damage and the measured motions.

One interesting utilization of the displacement curves is for the control of shaking platforms on which working models of buildings can be tested. This has been done at all the institutions mentioned, and photo-electric cell controls have been devised so that the motions can be closely reproduced. At the Massachusetts Institute of Technology the interesting experiment has been made of placing the accelerograph which recorded the Long Beach earthquake at Los Angeles on the shaking platform, subjecting it to the deduced displacement of that earthquake, and then reproducing the accelerogram. The reproduction, though not perfect, was quite satisfactory.

Since the destructive elements of motion are not fully known and are ascribed variously to acceleration, velocity, and period (because of resonance induced by the earthquake wave having the same period as the natural period of the structure) other observations are needed. The periods of thousands of buildings in various cities of California have been measured and are being analysed in regard to the type of building. It is proposed to re-measure the periods in selected types of buildings after a major earthquake. To measure the period the buildings are shaken by an eccentric fly-wheel device which is of variable speed, so that one of its periods corresponds to the natural period of the building. From the records, the period or periods of the building are readily obtained. The recording is done by a vibration meter, generally constructed on the principle of the Wood-Anderson torsion seismometer, or on a Neumann–Labarre vibration meter. Dominant ground periods have been reported from Göttingen, Germany, and Tokyo, Japan. In the United States a large-scale ground shaker has been built, but the high sensitivity Neumann–Labarre horizontal vibration meter and the Patterson vertical vibration meter show several distinct periods in California, none of which is dominant. It is recognized that a large earthquake might shake a thicker layer or layers of the earth's crust and thus produce a different period or periods. The general purpose of the work is to see whether a more logical method can be developed than that of providing in the buildings for a horizontal force equal to some percentage of gravity. Ten per cent is effective in Japan where the structures are simple and low, but it does not serve for the multitudinous array of buildings in California, or for all the other types of buildings in other parts of the world which are frequented by earthquakes.

Experiments have been made, mostly in Japan, in connexion with the vibration of various parts of a building. Records were obtained with a vibration meter orientated in various directions and placed successively on various floors of the steel-framed eight-storied tower and four-storied wings of the Imperial Diet building in Tokyo at various stages of construction, by Prof. Akitune Imamura. These showed that when the ground period was near 0·4 sec. the vibration was like that of a frame fixed at each end, whereas with a ground period approaching one second it was like a frame fixed only at one end. The former experiment suggested that the frames were too slender for their massive top load. The designers thereupon reinforced the weak parts of the building and thus increased the seismic stability of the structure. Prof. Katsutada Sezawa and Dr. Kiyoshi Kanai have subjected ideal cases to mathematical investigation and have found formulæ to represent the dissipation of vibrational energy. Fitting one of these formulæ to special boundary conditions, the greatest damage was found to occur in buildings at places where there was maximum bending moment as deduced from the formula. One building in their work is considered to be a circular cylinder constructed on a frame and having several stories. The columns in which the greatest bending moment is induced differ with difference in the value of $Ej^2\varepsilon/\mu l^3$ where E is Young's modulus of the structure, j is radius of gyration of the section, ε is radius of the structure, l is length of structure, and μ is elastic constant for earth. When $(Ej^2\varepsilon)/(\mu l^3)$ is 0 the columns in which the greatest bending moment is induced are those below the first floor. The larger the value of $(Ej^2\varepsilon)/(\mu l^3)$ the more the columns of floors still farther up partake of the greatest bending moment. In the limiting case where $(Ej^2\varepsilon)/(\mu l^3) = \infty$, the floor under consideration is that which is immediately below the roof or that a few floors below the roof. Friction in buildings may also damp down earthquake stresses.

Another distinct line of research has been pursued by the U.S. Bureau of Mines and other investigators, including Prof. L. Don Leet. When dynamite is used to shatter and remove rock, a by-product of the operation is the dissipation of a small fraction of the energy of explosion in the form of elastic vibrations which travel away from the blast through the ground. The types of waves have been studied in connexion with the geological formations through which they pass, and the dissipation of energy investigated. High frequencies (25–50) and short duration (about 0·5 sec.) are typical of records on rock. Lower frequencies (3–5) and longer duration (maximum observed in one set of experiments 23 sec.) are recorded on unconsolidated deposits particularly if the deposit exceeds twenty feet or so in thickness. The range of amplitudes for various distances and sizes of charge can now be predicted within limits which are narrow

enough to be of practical engineering value in estimating probable effects on structures.

In Great Britain very few earth tremors and no large earthquakes are experienced, but earthquake regions do exist in the British Dominions and Colonies, and British insurance companies often have interest in regions subject to earthquakes. It is well to point out that a body of information on strong-motion seismology does exist and that methods are available to those interested for the study of problems relating to the construction of earthquake-proof buildings. In various parts of the world building codes are in operation, and in such of these areas as are subject to earthquakes, buildings, bridges, dams and other structures financed in part or wholly from public funds, together with such structures as are built under the control of the authority, are designed in some measure to withstand earthquake stresses. It cannot be too strongly emphasized that this part of seismic science is progressing rapidly and that a study of observations obtained either from natural phenomena or from experiments, in addition to providing us with useful information, enables us to ask more intelligent questions in the future.

[1] NATURE, 146, 437 (1940).

[2] United States Earthquakes, 1938. U.S. Dept. Commerce, Coast and Geodetic Survey, Washington, Serial Number, 629, by Frank Neumann (1940).

PRESERVATION OF THE BRITISH FLORA*

By Dr. J. Ramsbottom, O.B.E.

MANY societies, leagues, associations and other bodies have concerned themselves in the past with the preservation of native British plants. The appeal is often made on æsthetic grounds. This is a sound policy, but occasionally it has seemed to get a little out of hand, and even sometimes to have defeated its object.

It is probable that far more damage is done by trampling down the plants than by picking the flowers. Many plants, as for example the common heather or ling, cannot endure trampling, whereas the effect of picking the flower of a bulbous plant is seen with daffodils and tulips every year in our gardens. Reasonable and careful picking of the commoner wild plants does little harm, and the joy that comes from flowers is one that it seems senseless to chide. It is really at bottom the spirit that prompts crowds to flock to Kew, Hyde Park, Bushey Park, Hampton Court, etc. This spirit should be encouraged in other directions.

Most of our attractive wild flowers are so abundant that little harm follows a reasonable amount of picking. The digging up of plants is a totally different matter. Plants with a successful method of reproduction such as bulbs, or corms, and perennial plants, do not disappear if only the flowers are removed: other plants suffer only in so far as there is a loss of seed production. But it is obvious that if plants are dug up there will be a gradual disappearance, no matter whether they are as prolific as are primroses and ferns in the south-western parts of England. Practically every civilized country has recognized the danger; in most there are societies which have laws prohibiting activities subversive to the welfare of the native flora.

In 1931 many societies, councils and institutes which are interested in various aspects of plant preservation elected representatives to the Wild Plant Conservation Board, which works under the auspices of the Council for the Preservation of Rural England. In 1914 the Selborne Society, through its Plant Protection Section, had prepared a Bill for presentation to Parliament, but legislative action was prevented by the outbreak of war. However, there is a good deal of scope provided by the Local Government Act of 1888, which empowers county councils to adopt by-laws for the preservation of wild plants.

Botanists and ornithologists have viewed with concern the effects of cutting verges and lopping hedges in country lanes. Here we meet with difficulties. The lanes must be kept tidy if on no other grounds but those of safety to users. There are various weeds which the Corn Production Acts say the farmer must destroy, and it is unreasonable to expect him, or roadmen, to carry out this obligation if botanical discrimination is added to the task. There are signs, however, that some county councils realize that there is no necessity for ruthless and indiscriminate cutting, or that spring or early summer is necessarily the period for the tidying process.

With rarer plants the problem is different. Some of these are unattractive to the non-botanist and are not likely to suffer except through excessive collecting. One or two are reputed to have vanished on this account, and the evidence from herbarium sheets gives support to some of the accusations that have been made.

* From the presidential address to the Botanical Section of the South-Eastern Union of Scientific Societies, delivered at Kingston-on-Thames on July 26.

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W. THOMPSON,
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Education Offices,
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King's College,
Newcastle-upon-Tyne, 2.

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On the other hand, some of the rarer plants are showy. An attractive plant may be protected because of surviving in more or less inaccessible places, such as the Cheddar pink. It seems to me that the only way to ensure the safety of others is to arouse a local interest in their protection. Local pride would do a good deal to preserve such rarities, especially if the habitats were known and the danger of extinction appreciated.

But there is also a wider problem which is not concerned with thoughtless or witless destruction. At the time of Cæsar's invasion of Britain we know that it was largely forest. During the Roman occupation much of the land was cleared and roads were built. With the cutting down of forests there is a difference in rainfall and always soil erosion, sometimes, as is more clearly understood in those countries which are paying the price, to the extent of causing deserts. When roads are made there is always an alteration to the drainage. With the building of towns cattle were put to pasture rather than driven from place to place. From all these processes at work there must have resulted an enormous influence on vegetation. I am not suggesting that any species were lost, though there might well have been. On the whole the number of species in the British flora is small; this is explained by the fact that more were not able to advance into Great Britain after the last retreat of the ice. The Channel has acted as a barrier to the invasion of plants from the Continent. If, therefore, any plant species were wiped out, that finished the matter; they did not come again.

The settlement by the Romans started changes which have continued to the present day. The old highways with their droves of cattle and wide expanse must have had an enormous influence on vegetation and consequently upon individual species. Later the spread of towns and the effect of smoke and other pollution consequent upon this have all had their destructive effect. The drainage of the Fens which began in the Middle Ages enormously affected the vegetation of the areas concerned. Neither must we forget the effects of farming, forestry and other forms of cultivation.

What we get as a gradual effect of civilization is an alteration in or a destruction of primitive vegetation. The change has taken place and most of it could not have been prevented even if this had been desirable.

As London extended, known localities of rarities were built over. Some of the habitats mentioned in the herbals now make strange reading. The one probably most quoted is that of the small bugloss given in Johnson's edition of Gerard's "Herbal", 1633, *Buglossa sylvestris minor* (*Lycopsis arvensis*)—"On the drie ditch-bankes about Pickadilla".

The lost habitats best known to London botanists are those of Battersea Fields, Chelsea Fields and Brompton Marshes, which disappeared as the Thames Embankment was built. A number of interesting species remain between Putney and Kew. Clusius, in his "Historia Plantarum Rariorum" (1601), records that the daffodil was "in such abundance in the meadows close to London, that in that celebrated village of Ceapside the country women offer the flowers in profusion for sale in March, when all the taverns may be seen decked out with these blossoms"; L'Obel (1605) also says, that in February and March the London flower-market is full of it.

Such losses are inevitable. As towns spread, especially in the old haphazard way, places famous as collecting-grounds from the time of the herbalists become just building sites to be developed. London has been fortunate in having royal parks and commons which are sterilized against such development; and a far-sighted policy reserved such forests as Epping and Burnham Beeches and is now organizing a green belt.

It is possible by sensible town planning not only to arrange proper means for fresh air and recreation for everyone, but also to prevent the sprawling ribbon development which has made some by-pass roads by-words. There are certain other consequences which it would be out of place here to mention. The point that can be legitimately made is that the countryside around such roads is ruined.

We are faced, however, with a much more serious problem at the present time as a direct result of the War. Aerodromes and military camps have multiplied over the countryside, and the carrying out of various exercises and other preparations for defensive or offensive war have made a sorry mess of some areas. I simply state the fact about our flora just as I would about the destruction of many famous buildings: it would be absurd to do more considering all that is at stake. Before the outbreak of war the Air Ministry paid due attention to the representation of those interested in different ways in the areas in which it was proposed to build aerodromes, and I understand that, even under the strain and stress of war, regard has been paid so far as is expedient to what is now popularly styled the amenities of the countryside. This enlightened policy is one of the most hopeful signs that we may look forward to the after-war period as one of 'reconstruction' in every sense of the word. It is obvious to everyone with eyes to see that there are a great many new blots on the landscape. After the War it may be that some of these will have to remain, but it should be a definite policy to remove, so far as possible, those which are no longer serving the purpose of national defence. Moreover, it may not be amiss to suggest that when an area is in occupation by H.M. Forces,

vegetation should not be wantonly or carelessly damaged. Trees which are knocked about, for example, do not invariably survive—and trees do not grow in a night.

Let us see to it that when salvaging our material possessions after the War we take care that our countryside is looked after.

When the time comes local bodies should make it their aim to get rid of all objectionable signs of war activity in their areas and they should be pressed to do so by local natural history societies. A derelict camp still with obvious signs of previous occupation is a sad sight, and does not improve with the years. Heaps of bully beef tins and other refuse left by our troops in the South African War are still to be seen in some parts of the Karroo. Organic material is soon dealt with by fungi and bacteria, but bricks, petrol tins and barbed wire are beyond their efforts.

In recent years there has been a strong movement on the part of several societies and associations for the establishment of national parks: roughly the objects they have in view may be classed as landscape preservation, public access and protection of wild life.

The idea of national parks seems to have been put forward first in 1832 by George Catlin, who suggested that the country around the geysers near the head of the Yellowstone River should be reserved as a public park.

The Yellowstone Park, sixty-five miles long by fifty-five miles broad, was reserved in 1872. The Oxford Dictionary defines a national park as "an extensive area of land of defined limits set apart as national property to be kept in its natural state for the public benefit and enjoyment". The definition is excellent so far as it goes, but there may be differences of opinion about the interpretation of the words "public benefit and enjoyment". The national park movement has spread rapidly in those countries where there are great stretches of unaltered vegetation. In Great Britain it is obvious that we cannot emulate Yellowstone Park, Jaspar Park, Kruger Park, that of Belgian Congo or those of Angola and the islands of the Gulf of Guinea now under consideration by the Portuguese Government.

What it is possible to do should be carefully considered—and then done Probably nowhere in southern England—though possibly in the north, in Wales and in Scotland—could we fix on an area sufficiently extensive to fulfil all the objects in view. But this does not mean that no attempt can be made to preserve tracts of countryside representative of our scenery. These tracts may be called national parks, or what you will; they should be sufficiently extensive and isolated not to suffer from suburban suffocation.

Recreation is a vital necessity for the public if there is to be real health of body and mind, but there is no reason why this should not proceed hand in hand with preservation. Sanctuaries could be set aside in the larger areas for preserving any species which need protection, in addition to smaller areas scattered about the country as nature reserves. If the public are educated up to it they will demand that such species be protected; education is more effective than *Verboten*—just as "Reserved for the protection of . . ." is than that wooden lie "Trespassers will be prosecuted". The way in which the general public obey some very annoying present-day restrictions gives ample proof of the fact that a law or regulation is the more powerful the more the reason for it is comprehended.

Strange as it may seem, it is often overlooked that it is the vegetation which is the key to the position. If plants are preserved then the scenery remains pleasant, and birds, animals and insects are for the most part safe. Perhaps the best way to appeal to the public is to make a point about the scenery: "Preserve the country's scenery"—and the rest follows. The general aim could then be stated as the desirability of preserving the various types of representative British scenery in sufficient numbers as to be reasonably accessible.

It is obviously impossible to sterilize a sufficiently large area in the British Isles to include all types of scenery or vegetation. The type of vegetation depends in the first instance upon the character of the soil, the altitude and the amount of rainfall, and as any large park or parks would need to be in a mountainous district we obviously cannot envisage such a park as providing an epitome of the country's vegetation. For that we must have several areas and, for special protection, areas set aside in these. No plan will succeed which attempts to exclude free access by the public. Those of us who know Richmond Park, Wimbledon Common, Burnham Beeches, Epping Forest and Virginia Water will have no qualms about the bad effect of open access to pedestrians. But it would be advisable to restrict motoring and horse-riding. Motoring brings obvious evils in its train, and those following excessive horse-riding in Epping Forest were causing an outcry in the last year or two.

The prevalent opinion seems to be that where areas are set apart for preservation Nature should be left to its own devices and then all would be well. In Switzerland each canton has its laws for the preservation of plants and there are several Nature reserves; there is also the Swiss National Park situated in the Lower Engadine. Here the following rules and regulations are in force. Human interference is absolutely excluded from

the whole region. Shooting, fishing, manuring, grazing, mowing and wood-cutting are entirely prohibited, no flower or twig may be gathered, no animal killed and no stone removed—even the fallen trees must remain untouched. In this way absolute protection is secured for scenery, plants and animals : Nature alone is dominant. Any one may visit the Park, but only simple Alpine shelter-huts are provided, no hotels being allowed to be erected. Camping and the lighting of fires is prohibited.

Some would like similar regulations made for any national park we might have. But it should be pointed out that only in areas of primitive vegetation is it possible to leave well alone and be certain that it will not alter. The vegetation of Great Britain as it is now is largely the result of interference ; many of the types of vegetation are not as they would be if they were not controlled by various factors. So long as these factors remain the same, the vegetation remains the same. Taking it as a whole the vegetation of Great Britain is not static. For every type of soil there is a type of vegetation which is called a climax and there is a natural gradual change towards this. Everyone must have noticed hawthorn and other bushes 'invading' grassland adjoining woodland, but it is not always realized that this is a natural process leading to the climax vegetation—for forest is the climax.

The idea is often expressed that "Education of the average adult to respect our wild flowers may seem well-nigh hopeless. He is not interested". Certainly the normal place for beginning education is the school, and much can be done there to inculcate a proper appreciation of our native scenery and the duty of preserving vegetation from spoliation. But education does not end at school, and the B.B.C. and the cinema have brought home to many an interest in green things growing.

When the present War is over it is possible that eventually there will be many changes in our normal mode of life. Maybe some benefit other than speed will accrue from the increase in the use of mechanical devices. To one not versed in the refinements of economics the conclusion seems justified that if work is done more quickly by fewer men there must either be unemployment or shorter hours. We certainly had unemployment before the War, and in the future reconstruction we may well look for shorter hours for those engaged in manual labour, though not I fear for the rest of us. If this desirable state of affairs eventuates we are then faced with the basic problem of education, how to spend one's leisure time.

When leisure time is short, sports and spectacles are sufficient as relaxation for most ; but with longer periods of freedom normal people will need something in addition. Some will doubtless be attracted by the study of natural history. Men and women of the Forces and evacuee children will be unlikely to be content to stay put, and we shall probably have a greater number exploring the countryside than ever before. Let us have wide open spaces, call them what you will, let us keep them so that they will ever show what Great Britain was by showing what she is, let us realize that it is to the community's interest to preserve wild life, be it plant, bird, animal or insect : then when we have the same pride in our natural possessions as we have in our race we shall have gone far along the way to preserving our flora.

OBITUARIES

Mr. W. H. Caldwell

WILLIAM HAY CALDWELL died at Morar Lodge, Inverness-shire, on August 28. In the 'eighties he was notable as an original young Cambridge zoologist who had revolutionized the process of cutting paraffin sections. Born at Portobello in 1859, he went from Loretto to Gonville and Caius College, Cambridge, in 1877, and attended Francis Maitland Balfour's lectures on animal morphology. He was scholar of his College during 1878–83, and obtained a first class in the Natural Sciences Tripos of 1881, beside Walter Gardiner the botanist, who survived him three days[1]. Research on the development of Phoronis occupied his first graduate year, which was marred by Balfour's untimely death on the Alps (July 1882)—thirty years old and of world-wide reputation.

Adam Sedgwick, aged twenty-seven, manfully faced the task of carrying on the school founded by Balfour. Balfour's professorship had been created for him and died with him when he had held it seven weeks ; so when as a freshman I entered the new Morphological Laboratory, just completed by the University for Balfour but never seen by him, Sedgwick, Trinity lecturer, presided over it. Caldwell was appointed University demonstrator of comparative anatomy in succession to J. J. Lister ; Sedgwick and Caldwell, with fourteen-year-old "John" for laboratory boy, forming the entire staff.

So I found the advanced lectures on invertebrates being delivered by an attractive young man, on the tall side of middle height and well made, with finely cut features, fair wavy hair and a carefully twisted little fair moustache ; this was Caldwell. On the

bench in front of me he was faced by about eight third-year men—the very best third-year that Cambridge zoology has ever known—only two years junior to himself. He had a charming deprecatory smile, which I saw first then as he faced these fierce young critics. Lecturing was not his *forte*, but I carried away a vivid recollection of his lectures on his own work, shortly before he read his "Preliminary Note" to the Royal Society[2].

This paper made some stir. The effects have not all disappeared of his argument, from the well-known metamorphosis, that the long axis of the worm-like Phoronis is dorso-ventral, and that this appears[3] "to furnish the explanation of the relations of the surfaces in Brachiopoda, Polyzoa and perhaps the Sipunculoid Gephyrea . . . Caldwell's views were accepted by Lankester in the 9th edition of this work [*Enc. Brit.*], the Phylum Podaxonia being there instituted to include the groups just mentioned, together with the Pterobranchia". MacBride[4] concluded in 1914 "that Polyzoa Ectoprocta alone can be regarded as having affinities with Podaxonia, and that Polyzoa Entoprocta cannot be included in this group as defined by Lankester". So, after a third of a century, the new proposal of this first paper was still a matter for lively discussion.

During his research, Caldwell was cutting paraffin sections one day with a transverse razor on Jung's microtome: two or three sections stuck together in line. "I say," said Caldwell to Weldon, looking on, "if we could make them all stick together, we should have the whole larva on one strip!" He devised the plan of coating the hard paraffin with soft paraffin, and so was born the ribbon method of cutting sections. He asked Threlfall of Caius (afterwards Sir Richard Threlfall) to study the Jung and design a similar microtome to be worked by a water motor, with a travelling band to carry the sections. This was constructed and set up in the Balfour Laboratory, where it worked constantly and successfully for half a century; a version for sale is described and figured in the *Quarterly Journal of Microscopical Science* as "The Caldwell Automatic Microtome"[5]. Threlfall told me that this latter was technically inferior—some question of centres of gravity, I think, and the five-point support; he had a second example of the original made for himself because he was proud of it as a perfect machine. Caldwell busied himself over the question of the razor's edge; I saw him once heating a razor red-hot over a Bunsen and plunging it into cold water: he explained that he tempered the razor as soft as possible before honing it and then tempered it absolutely short before using it, so as to have the edge as stiff as possible. He discussed the possibility of getting very thin sections by freezing both blade and paraffin during the cut.

In 1883 Caldwell was appointed the first Balfour student, to study, as Balfour had suggested to him, "the development of the peculiar Australian Mammalia and *Ceratodus*". As student he received £200 a year for three years—extended to a fourth year—and the Royal Society furnished £500 for equipment from the Government grant. He was made a fellow of Caius before he left for Australia, which he reached in September 1883. With camps on the Burnett River and elsewhere and laboratory at Sydney, he obtained much marsupial and monotreme material and complete series of the development of Ceratodus. He sent home two papers for the *Quarterly Journal of Microscopical Science*[6,7], and on August 29, 1884, he telegraphed to the British Association at Montreal: "Monotremes oviparous ovum meroblastic"[8], a much noticed telegram which at first astonished and puzzled newspaper readers in the cryptic confusion of "Caldwell finds monotremes viviparous ovum blastodermic"[9]. But on Tuesday, September 2, the President (Moseley) was able to assure Section D that no "more important telegram in a scientific sense had ever passed through the submarine cables . . . these mammals laid eggs and the development of these eggs bore a close resemblance to the development of the eggs of the Reptilia; proving that these animals were more closely connected with the Sauropsida than with the Amphibia"[10].

By December 1886 Caldwell had finished and sent home the first instalment of his *magnum opus*: "The Embryology of Monotremata and Marsupialia. —Part I". On January 27 he married Margaret Gilchrist, daughter of Mr. J. B. Watt, of Sydney; they sailed for England, where, on March 17, he read to the Royal Society the paper he had sent home[8]. It describes, with three coloured plates, the ovum and egg-membranes of Echidna, Ornithorhyncus, Phascolarctos and Hypsiprymnus; prefacing the description with a brief narrative of his studentship.

This "Part I" in the *Philosophical Transactions* ends Caldwell's contribution to biology. He and Mrs. Caldwell came to Cambridge and in 1888 bought "Birnam", a house in Chaucer Road. A room at the laboratory housed his collections, on which he worked for many years, but no further biological papers have ever appeared.

About 1893 he left Cambridge and zoology to become a paper-manufacturer in Scotland (I believe that an uncle left him the paper-mill). He resumed possession of his house for a short time in 1904, but was not in Cambridge for the meeting of the British Association in the Long Vacation. He stayed by his mill, away in Inverness-shire, and was scarcely ever seen in Edinburgh; he had ceased to be a member of the Savile Club in London already in 1896. A writer in *The Times* of September 19, 1941, states that "several of his methods for increasing the sensitiveness of photographic emulsions have been adopted . . . while his work on paper-making processes also had practical application . . . he gave much of his time to biochemical work, and especially to the chemistry of the enzymes and digestion . . . at the beginning of the last War he was attached to the staff of the 1st Highland Mounted Brigade, and later on took up the problem of vaporising heavy oils for internal combustion engines, and also the manufacture of acetyl cellulose". There is some published work by Caldwell on vaporizers and steam-generators, but no papers on enzymes, emulsions, or any other subject by him is known to physiologists, biochemists or colloid chemists.

In 1937 he asked Prof. Reinhard Dohron for a

table in the Zoological Station at Naples; I think he stayed there a year. Making some inquiries from me before starting, he gave a most keen and enthusiastic description of what he was going to do (something biochemical based on something he had done already, in Paris if my memory serves).—"Where will you publish?" "Oh, there is a lot to be done before there is any question of publication." This was at the age of seventy-eight.

He died at eighty-two leaving three daughters; he lost his son in the War of 1914–18.

My own guess is that he had early set himself an impossible ideal of perfection and completeness in scientific papers; in the 'eighties we were still labouring under the illusion of monographs which should be final. It is possible that, when Caldwell found after five years work at Cambridge that he could not write a definitive and perfect treatise, he grasped at the chance of a new life and rid his scientific conscience of the burdensome duty of publication. Henceforward he worked at varied scientific problems for his own intellectual pleasure or financial profit.

He was undoubtedly gifted with good powers of observation, easy mastery of technique and a capacity for clear reasoning and incisive writing. Much was hoped of him by his seniors, particularly Foster and Adam Sedgwick, and Sedgwick was a great friend. Sedgwick in 1910[11], summarizing the results of biological expeditions, cites that "of W. H. Caldwell to Australia (1883–1884 [*sic*], discovery of the nature of the ovum and oviposition of *Echidna* and *Ceratodus*)". That represents his friend's summary of Caldwell's contribution, after 1883, to zoological knowledge.

But let all biologists always remember that they owe the ribbon method of cutting paraffin sections to the twenty-two-year-old William Hay Caldwell, brilliant bachelor scholar of Gonville and Caius College.

G. P. BIDDER.

[1] NATURE, **148**, 462 (1941).
[2] *Proc. Roy. Soc.*, **34**, 371 (1882).
[3] "Enc. Brit." (1911); "Phoronidea" by S. F. Harmer, p. 473.
[4] "Embryology" (Invertebrata), 1914, p. 406.
[5] *Q.J.M.S.*, **24**, 648, unnumbered plate (1884).
[6] *Q.J.M.S.*, **24**, 655, Pl. 43 (1884).
[7] *Q.J.M.S.*, **25**, 15, Pl. ii (1885).
[8] *Phil. Trans.*, B, 463 (observations and conclusions, pp.470–79) (1887).
[9] "Alumni Cantabrigienses" (Venn) *sub* Caldwell.
[10] Report Brit. Assoc., 1884, p. 777.
[11] "Enc. Brit." (1910), "Embryology", 328*a*.

Mr. H. Standish Ball, O.B.E.

HARRY STANDISH BALL was born in South Africa in 1888 and died at Haslemere after a long illness on September 26. He was a distinguished mining engineer with wide experience of South African and American methods, and during the War of 1914–18 became one of the recognized authorities on military mining. But it was his work as principal of that famous School of Metalliferous Mining at Camborne (Cornwall) by which he was best known to mining engineers.

Ball spent his school days in Johannesburg and obtained his early technical instruction at the Transvaal University College, where he won many prizes and supplemented his theoretical work by a thorough practical training in the gold mines of the Witwatersrand. Afterwards he went to McGill University, where he graduated in the Mining School. On returning to South Africa he obtained employment in various official capacities in the mines, thereby laying the foundation of his knowledge of practical mine management.

Shortly after the outbreak of war in 1914, Ball joined the Royal Engineers (Tunnelling Corps) and served throughout in France, ultimately becoming commandant of the First Army Mining School and technical military mining instructor to the American Expeditionary Force. He wrote several official treatises on military mining, was mentioned in dispatches four times and awarded the military O.B.E.

After the end of the War in 1918, he returned to South Africa, where he held various mining appointments, and during 1921–33 held posts in South Africa and South America, and made many reports on mining and oil properties in these countries as well as in Canada.

In 1933 Ball came to England and was appointed principal of Camborne. The School has long been famous as a training centre for metalliferous mining engineers and, being situated in the heart of the Cornish mining-field, the students have great opportunities for studying the art as well as the science of mining. Before Ball's time some critics considered that too much attention was paid to the practical side, and the new principal, with a sound background of scientific knowledge, recognized this. He set to work slowly and methodically to revise the syllabus, raise the entrance standard and improve the training during the course. His methods were most successful, and he had the satisfaction before the commencement of his last illness of seeing the reputation of the School of Mines raised to a higher plane than it had ever attained.

Besides possessing great technical ability, Ball was an able administrator and in himself a charming man and delightful companion. His death is a sad loss not only to his old students all the world over, but also to his innumerable friends of maturer years.

J. A. S. RITSON.

WE regret to announce the following deaths:

The Right Hon. Lord D'Abernon, P.C., G.C.B., G.C.M.G., F.R.S., on November 1, aged eighty-four.

Prof. W. F. Ganong, emeritus professor of botany in Smith College, Northampton, Mass., known for his work on plant physiology and botanical education, on September 9, aged seventy-seven.

Sir Arthur Hill, K.C.M.G., F.R.S., director of the Royal Botanic Gardens, Kew, since 1922, on November 3, aged sixty-six.

Dr. Victor Jollos, formerly associate professor of zoology in the University of Berlin, known for his work on heredity and mutation, on July 5, aged fifty-four.

Dr. J. S. Plaskett, F.R.S., director of the Dominion Astrophysical Observatory, Victoria, B.C., Canada, during 1917–35, on October 17, aged seventy-five.

NEWS AND VIEWS

American Mathematicians and the U.S.S.R.

THE Soviet Embassy in Washington has recently received for transmission to Soviet mathematicians a statement of solidarity signed by a number of their most distinguished American colleagues. The document carries signatures of ninety-three mathematicians of forty-seven American universities and colleges. Prof. Marston Morse, president of the American Mathematical Society, is a signatory, as also are eight past presidents of the Society. Fourteen are members of the National Academy of Sciences. Among the signatories are several well-known German mathematicians who now reside in the United States and who know from personal experience the destruction Hitler has wrought in German culture. These include Profs. E. Artin, R. Courant, W. Mayer, H. A. Rademacher and O. Szasz.

The statement reads as follows: "We . . . send our greetings and express our heartfelt sympathy to our colleagues of the Soviet Union in their struggle against Hitler fascism. What the future of mathematics would be in a Hitler-dominated world we know from the unprecedented destruction of mathematics in Germany after the advent of Hitler. We are deeply impressed by the heroic stand of the Soviet peoples and know that the mathematicians of the Soviet Union are doing their part in this supreme effort. The bonds between mathematicians in the United States and the Soviet Union are particularly strong since during the past two decades the center of world mathematics has steadily shifted to these two countries. We know many of you personally and more of you through your scientific writings. We know that you are fighting alongside your fellow-countrymen in their brave struggle against the invading tyrant and we assure you that we here are doing everything in our power to aid all peoples struggling against fascism. With best wishes for a successful fight against the evil forces of fascism, we remain, fraternally, your colleagues in the United States."

Commonwealth Grant to Australian Universities

UNDER the Australian federal system, public education is a function of the State Governments, and the six universities look to these bodies for financial support. Five years ago, however, the Commonwealth Government undertook a share of this responsibility by providing £30,000 a year to meet costs of research in the natural sciences and in economics, and of training young graduates in research technique. The funds are administered by the Council for Scientific and Industrial Research in consultation with the Vice-Chancellors' Conference. The Commonwealth has now announced its intention to raise its contribution to £40,000 a year, commencing in 1942, on condition that at least £9,000 a year be devoted to social science studies bearing on problems of post-war reconstruction.

American Anthropology

ANTHROPOLOGICAL Papers, Numbers 13–18, have been recently published by the Smithsonian Institution (Bureau of American Ethnology, Bulletin 128). These include "The Mining of Gems and Ornamental Stones by American Indians", "Iroquois Suicide", "Tonawanda Longhouse Ceremonies", "The Quichua-speaking Indians of the Province of Imbabura", "Art Processes in Birchbark of the River Desert Algonquin" and "Archæological Reconnaissance of Southern Utah". The last of these, by J. H. Steward, will appeal especially to archæologists interested in the ancient history of the New World. The article is based on the surveys of Judd (1926) and Steward (1933 and 1936), and deals with a culture apparently based on that of the Basket-maker Pueblo peoples of the San Juan River basin. A large number of sites were visited and are described, and the material culture found in them is catalogued and illustrated. Painted pottery, naturally, occurred as well as flint implements. It is a pity, however, that these latter are so inadequately figured—mere outlines of the tools being all that is given. An interesting series of rock-drawings was also discovered, showing conventionalized figures of animals and human beings, as well as signs of various kinds, including the spiral.

Indian Jute Production

A BROCHURE containing much valuable statistical material on the jute trade and industry, including estimates which are not available elsewhere, has been issued by the Indian Central Jute Committee, Calcutta, under the title "World Consumption of Jute" 1938–39 and 1939–40 (Economic Research Bulletin No. 1, R.1, 1*s.* 6*d.*). The estimates of the total consumption of jute in the world given in this bulletin for the period 1933–34 to 1939–40 indicate that consumption reached its peak in 1936–37 with an aggregate consumption of about 123 lakhs of bales, but world consumption in 1938–39 fell to 107 lakhs of bales, and only rose again to 109 lakhs of bales in 1939–40, in spite of the hectic buying at the beginning of the War. Independent estimates of the yield of the jute crop are also included for the 1938–39 and 1939–40 seasons.

The War has seriously affected the export of raw jute, but this was more than compensated by the rise in the export of jute manufactures, the countries within the British Empire considerably increasing their consumption of Indian jute manufactures, although there was a substantial reduction in the normal commercial demand for jute goods. The consumption of raw jute by the Indian mills fell in 1938–39 but increased considerably in 1939–40, and the total stock of raw jute for the Indian mills was 20 lakhs of bales at the end of 1939–40, or about 9 lakhs of bales less than the stock at the end of 1937–38. The total yield of the jute crop in the 1938–39 season was a little more than 80 lakhs of bales, which was less than the world total demand

for the year by 17 lakhs of bales. The yield of the crop in 1939–40 was more than 109 lakhs of bales and the jute crop of 1940–41 is expected to give a record yield of 125 lakhs of bales. The consumption of raw jute this season is likely to be abnormally low, and a considerable quantity of jute is expected to be left over from the crop of 1941. The bulletin embodies the results of investigations carried out by the Economic Research Sub-Section of the Committee.

Cements for Glass Inserts in Electrical Apparatus

THE fixing of glass or porcelain insulators to metal parts by means of cement in the construction of switch gear and other apparatus has been a practice employed since the early days of electrical apparatus. At one time a mixture of sulphur and ground glass was extensively used for porcelain, the well-known litharge and glycerine cement being employed for the finer classes of work. This latter material is still in extensive use, but much work is also done with cements of the calcium sulphate type. As certain new products of this latter class have been introduced, an investigation has been carried out by the British Electrical and Allied Industries Research Association in order to elicit information bearing on the performance of these materials in practice (Technical Report, Ref. *G./T.* 131, "Recent Experience with Calcium Sulphate and other Types of Cement for Glass Inserts in Flame-proof Enclosures". By A. P. Paton). A table is given in the report summarizing the information collected on the quantities of cement mixed at a time and used for each article, and the time necessary before the articles could be released from the jigs. The latter varied from a maximum of 48 hours to a minimum of a quarter of an hour. This latter figure was exceptional and referred to meter glasses and windows fixed with Hawkins iron cement. A minimum period of $\frac{1}{4}$ hour was given for flame-proof lighting fittings and cover glasses of housings fixed with C. Fine Keene's cement. The figures, however, varied somewhat and were not closely connected with the type of cement. In one case it was stated that $2\frac{1}{2}$ lb. of gum arabic to a gallon of water was used in making up C. Fine Keene's cement. No difference in strength was found, and the cement adhered more firmly to glass or metal.

In certain conditions, C. Fine Keene's cement may give rise to electrolytic action if used with Bakelite. This cement is essentially an anhydrous calcium sulphate, which is slightly acid, due to the addition of a small percentage of alum. The presence of this potassium salt is considered undesirable when the cement is in contact with insulation of the synthetic resin impregnated type. Alternatives which have now been developed are termed Kaffir Plasters. They consist of calcium sulphate hemi-hydrate and are manufactured by Messrs. Cafferata. The product hydrates almost fully within about two hours, so that 'dry out' is almost impossible. The report states that it is a little unfortunate that the word plaster conveys to the general public the idea of a product which is inferior in strength and performance to a 'cement'. Actually, it is technically accepted in the gypsum trade that a cement is a high-temperature dead-burnt product, and that, without exception, all hemi-hydrates are designated plasters. The specially prepared hemi-hydrates known as Kaffir Plasters, while chemically similar to plaster-of-Paris, are different in their mechanical and physical properties, and give strength figures many times higher than those of plaster-of-Paris. They harden rapidly, and jigs may be fixed in 2–3 hours.

Health of the Sudan

IN his recently issued report for 1939 Dr. E. D. Pridie, director of the Sudan medical service, maintains that in spite of the occurrence of epidemic diseases, especially cerebrospinal fever, relapsing fever, smallpox and measles, the health of the Sudan in that year was very satisfactory. The epidemic of cerebrospinal fever which broke out in Equatoria and was not suppressed by the end of the year, comprised 2,714 cases with 647 deaths—a fatality-rate of 25 per cent against an expected rate of 60 per cent. The mortality at the onset of the epidemic was 80 per cent, but treatment with drugs of the sulphamide class reduced it to about 10 per cent. There were 1,000 cases of relapsing fever with 92 deaths, and 502 cases of smallpox which originated in French Equatorial Africa. On the other hand, the incidence of typhoid fever and bacillary dysentery was low. Although the range of most of them was limited, practically every endemic tropical infection was present in some part of the Sudan.

Earthquake in Alaska

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the provisional epicentre of the earthquake of July 30, 1941, which took place at 1 h. 51·5 m. U.T. This was at latitude 60·9° N., 149·2° W. which is very near the railway between Seward and Anchorage, Alaska, and about midway between these two places. It is not known whether or not there was any damage due to the earthquake. Alaska and the Aleutian Islands form part of the circum-Pacific ring of instability, around which earthquakes and tremors are fairly frequent. Recently earthquakes have been very frequent among the Aleutian Islands, and what was probably the most notable earthquake of recent years on the mainland occurred on April 26, 1933, to the north-west of the Kenai Peninsular. (NATURE, May 27, 1933, p. 757.)

University of London

DR. H. L. EASON retired from the office of principal on September 30 and Mr. Harold Claughton entered upon his duties as acting principal on October 1.

The title of reader in geography in the University has been conferred on Dr. R. E. Dickinson, in respect of the post held by him at University College.

The degree of D.Sc. has been conferred on the

following: Mr. W. P. K. Findlay (Imperial College of Science and Technology), Mr. P. L. Hsu (University College), Mr. Louis Hunter (Queen Mary College), Mr. R. A. Kekwick (University College), Mr. A. R. Martin (Imperial College of Science and Technology) and Mr. J. R. Nicholls. The degree of D.Sc. (Engineering) has been conferred on Mr. W. K. Wilson.

Dr. Timothy Richards Lewis (1841–1886)

DR. TIMOTHY RICHARDS LEWIS, a pioneer in tropical medicine and medical parasitology, was born on October 31, 1841, at Llanboidy, Carmarthenshire. He received his medical education at University College, London, and qualified at Aberdeen in 1867. He entered the Army Service at Netley in 1868 and successively held the office of assistant surgeon, surgeon and surgeon-major. After working for three months with Max von Pettenkofer at Munich, he went with his friend D. D. Cunningham to Calcutta in 1869, and for the next ten years collaborated with him in the study of cholera and other Indian diseases. In 1870 he gave the first authentic account of amœba found in man, and in the same year described *Filaria sanguinis hominis*. In 1878 he described the non-pathogenic form of trypanosoma found in rats. In 1883 he was made assistant professor of morbid anatomy at Netley, and in 1885 he was appointed honorary secretary of a committee convened by the Secretary of State for India with Sir William Jenner as president to investigate Koch's discovery of the cholera bacillus. He was recommended by Council for the fellowship of the Royal Society, but died on May 7, 1886, before this honour was conferred upon him. At the time of his death he was carrying out an extensive series of cultures and inoculations of bacilli in the human alimentary canal.

Jean Victor Audoin (1797–1841)

JEAN VICTOR AUDOIN, an eminent French entomologist, was born in Paris on April 27, 1797, the son of a lawyer. His early interest in natural history prevented him from following his father's profession, for which he was first intended, and he took up medicine, qualifying in 1826 with a thesis on the natural history and the chemical, pharmaceutical and medical aspects of cantharides. He had already in 1823 founded with J. B. A. Dumas, the chemist, and A. Brongniart, the geologist, the *Annales des Sciences Naturelles*. In 1824 he became assistant to H. Latreille, professor of entomology and director of the Natural History Museum in Paris. In 1832 he was one of the founders of the Société Entomologique de France, and in the following year succeeded Latreille. In 1837 he was elected to the Paris Academy of Sciences in the Section of Agriculture. His best-known investigations were carried out with Milne-Edwards on the anatomy and physiology of Crustacea, and on the parasites of the vine and silk-worm. He died on November 9, 1841. At a meeting of the Academy of Sciences on August 13, 1844, D. Gruby gave the name of *Microsporum* (afterwards changed to *Microsporon*) *Audouini* to the fungus causing ringworm of the scalp, a term still in current use, in recognition of Audoin's having directed attention to parasites which destroy the living tissues of animals.

Comets

Comet van Gent (1941 *d*). The elements of an orbit of this comet, and an ephemeris, assuming parabolic motion, have appeared in NATURE (148, 139, 370, 530; 1941). Davidson and Sumner have computed a new orbit, using the observations of Mr. W. T. Hay at Hendon, and have found that it is slightly hyperbolic. Another orbit will be computed, using later observations of Hay, and as these extend over a period of a month, August 29–October 3, it will be possible to give a definite pronouncement on the nature of the orbit.

Comet du Toit-Neujmin. This comet was discovered by du Toit at Bloemfontein on July 18 and also independently by Neujmin at Simeïs. Its magnitude at the time of discovery was 10. The aphelion of the orbit lies close to the orbit of Jupiter and the last close approach to the planet probably occurred in 1824, when the planet may have annexed it as one of its family. The elements of the orbit, computed by H. R. H. Grosch, are given below, and also an ephemeris.

T	1941. July 21. 18766 U.T.			Ephemeris	1941.0
ω	69° 10′ 33·3′			α	δ
Ω	229 37 07·2 } 1941·0	Nov.	6	22h. 40·5m.	−4° 34′
i	3 14 49·4		14	0 52·3	3 55
q	3·095176		22	23 03·9	3 10
e	0·5789569		30	0 15·6	2 20
P	5·4456 years.				

The geocentric and heliocentric distances on November 30 are 1·89 and 2·3, respectively. As it is receding from the earth and sun, it is becoming fainter.

Periodic Comet Schwassmann-Wachmann (2), 1921 *l*. This comet has been discovered by Dr. H. M. Jeffers at Lick Observatory, its magnitude at the time of discovery, September 20, being 17. In "The Handbook of the British Astronomical Association, 1941", there is an ephemeris based upon the orbit computed by Mr. W. P. Henderson and Dr. H. Whichello, planetary perturbations being taken into consideration. The comet was discovered almost exactly in the predicted place, a discrepancy of only 18^s in the right ascension occurring.

New Asteroid. Harvard College Observatory Card No. 606 has announced that an object, probably a new asteroid, has appeared on the 40-in. reflector plates used at the U.S. Naval Observatory. An orbit will be computed later.

Announcements

THE Lord President of the Council has appointed Sir Franklin Sibly, vice-chancellor of the University of Reading, to be a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. The Right Hon. Viscount Falmouth has retired from the Council on completion of his term of office.

ERRATUM.—In NATURE of October 25, p. 479, the Lawrence referred to was not, of course, T. E. Lawrence (of Arabia), but D. H. Lawrence.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

A Mendelian Situation in the Birthcoat of the New Zealand Romney Lamb

DR. T. M. OLBRYCHT[1] finds it difficult to believe that our *N*-type coat[2] can have a comparatively simple genetic basis. That conclusion was adopted very tardily here, as papers published show[3,4] and, as stated before, we have bred a few *N*-type animals in which, from breeding data, the genetic basis is regarded as multifactorial. In these animals, we suspect, the factors responsible interact to produce very high abundance of halo-hairs in geometric, not just additive, fashion. The early experiments dealt in differences in the abundance of halo-hairs on the back of not-*N* lambs, and revealed strong multifactorial inheritance. Lambs are graded by eye when not more than a few days old. *N*-type has one halo-hair to an average of about nine curly-tip fibres. In not-*N* six grades are distinguished, ranging from no halo-hairs at all in Grade I to one halo-hair to about 200 curly-tip fibres in Grade IV, and one to about 27 in Grade VI. Lambs of high Grade VI may be called borderline-*N*, and for our present purpose all Grade VI lambs are called near-*N*. There is good evidence, strengthened in 1940, that some near-*N* animals carry the same factors for *N*-type as typical *N*-type sheep of our 'mendelian' stock. In determining ratios, *N* and near-*N* are counted together, but it will be seen that the near-*N* lambs are few compared with the *N*-type. We now give the results up to 1940 most pertinent to the point at issue.

Mendelian ratios. On mating together *N* or near-*N* animals which from their parentage we regard as heterozygous (for an *N*-complex on one chromosome) there have been born 42 *N*, 4 near-*N*, 1 V, 4 IV, 2 III, 4 II, 3 I. This gives 46 *N* and near-*N* combined and 14 not-*N*; a good 3 : 1 ratio.

In back-crosses of *N* and near-*N* deemed heterozygous, put to mates with no or few halo-hairs on the back (Grades I and II) or of unknown grade (supplied by the College Sheep Farm and virtually certainly not-*N*), we have obtained: 146 *N*, 35 near-*N*, 7 V, 8 IV, 37 III, 110 II, 50 I. *N* and near-*N* together number 181 against 212 not-*N*. On testing this departure from equality we find $\chi^2 = 2{\cdot}45$. On our present hypothesis a slight excess of not-*N* is in fact expected on account of crossing over between closely linked duplicate factors. The scarcity of lambs of intermediate grades in these back-crosses affords good evidence for the simplicity of the genetic situation.

Homozygous rams. Four *N*-type rams, with both parents *N*-type, but with one grandparent on each side not-*N*, were back-crossed in 1940. One proved heterozygous, siring 6 *N*, 1 near-*N*, 12 not-*N*. Three had families containing only *N* and near-*N* lambs, the individual results being: 14 *N*, 1 near-*N*; 14 *N*, 1 near-*N*; 7 *N*. Another *N*-type ram bred in a way that need not now concern us was back-crossed in 1940 and sired 28 lambs, every one of them *N*-type. These four homozygous rams clinch our argument.

Monofactorial explanation inadequate; suggested comparatively simple hypothesis. The results presented may suggest a single dominant factor. Things are not quite so simple, as we realized earlier, and we have further to report that an *N*-type ram which, in experiments referred to in our previous communication, mated with not-*N* ewes not its own daughters, had sired 2 *N* and 57 not-*N*, all of low grades, was mated in 1940 with its own daughters. Its lambs were 6 *N*, 1 near-*N*, 6 not-*N*. This is taken to be a 1 : 1 ratio.

We are used to changing our views, and we may be right or wrong in now postulating two pairs of linked duplicate factors, with two doses necessary to give *N*-type, and any two doses able to produce *N*-type unless there is present a suppressing factor, which we think exists, but is scarce. Our point is that the genetic situation is a relatively simple one.

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J. A. SUTHERLAND.

Massey Agricultural College,
Palmerston North,
New Zealand.
June 4.

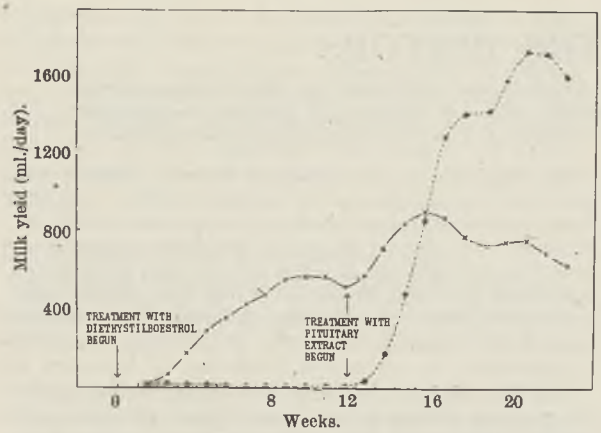
[1] NATURE, 147, 57 (1941).
[2] NATURE, 145, 390 (1940).
[3] *N. Z. J. Agric.*, 46, 1 (1933); 47, 5 (1933).
[4] *J. Text. Inst.*, 26 (1935).

Artificial Induction of Lactation in Virgin Animals

THE discovery by Folley and his co-workers that treatment with diethylstilbœstrol alone will induce copious lactation in virgin goats[1] and heifers[2] has recently been confirmed for the goat by Lewis and Turner[3]. Since the administration of a crude extract of ox anterior pituitary gland strikingly stimulates the milk production of the cow during the normal decline of lactation[4], it was of importance to determine if the production of milk resulting from treatment with diethylstilbœstrol could be further increased by injections of anterior pituitary extract.

Two nulliparous 'scrub' goatlings, which had been dry for some months after having been brought into artificial lactation with diethylstilbœstrol during the previous year, were subjected three times weekly to inunction of the udder with 1·0 gm. of 1 per cent diethylstilbœstrol ointment. In one case lactation quickly set in and the yield rose to a maximum of about 570 ml. daily, and then began to decline. It is of interest to note that this peak yield was approximately the same as in the previous artificially induced lactation. At this point, subcutaneous injection on alternate days of 5 ml. of an alkaline extract of ox anterior lobe (10 ml. = 2·5 gm. fresh tissue) was begun and the inunctions continued. The milk yield rapidly rose to about 870 ml./day and thereafter declined somewhat despite continuation of the treatment with both œstrogen and pituitary extract. Pituitary treatment therefore increased the peak yield induced by diethylstilbœstrol alone by some 40 per cent.

The other goat, rather surprisingly in view of the fact that similar treatment had induced substantial



MILK YIELDS OF VIRGIN GOATS TREATED WITH DIETHYLSTILBŒSTROL AND ANTERIOR PITUITARY EXTRACT. MILK YIELDS ARE EXPRESSED IN TERMS OF THE AVERAGE DAILY YIELD FOR EACH WEEK.

Diethylstilbœstrol. x——x. Inunction of udder with 1 gm. of a 1 per cent ointment effected three times weekly for 18 weeks. ⊙ – – – – ⊙ Inunction of udder with 1 gm. of a 1 per cent ointment effected three times weekly for 6 weeks, then with 2 gm. of 1 per cent ointment for 4 weeks. Over the remainder of the experiment the original dose was used.

Pituitary extract. 5 ml. (equiv. to 1·25 gm. of fresh ox anterior lobe) given on alternate days from the twelfth week of the experiments onwards.

lactation in the previous year, secreted no more than 20 ml. daily of milk during the period of inunction alone, even when the dose of diethylstilbœstrol was doubled for a time, but addition of anterior pituitary treatment immediately evoked copious milk secretion, the daily yield rapidly rising to nearly 1,700 ml. This amount is comparable with the peak yield expected in a normal lactation period from such an ill-bred animal, and is about 20 per cent above that attained on the previous occasion with diethylstilbœstrol alone. Chemical analyses (fat, non-fatty solids, nitrogen partition, lactose) showed that the milk secreted by both goats was normal.

These experiments, which are being continued, indicate that, in the goat, combined treatment with diethylstilbœstrol and anterior pituitary extract can produce a much more intense lactation than with the former alone. It seems likely that under suitable conditions the artificial lactation so evoked may rival that normally following parturition, which is not surprising in view of the fact that its genesis presumably simulates the mechanism whereby normal lactation is induced.

This work has been aided by a grant from the Agricultural Research Council.

National Institute for Research in Dairying, University of Reading. S. J. FOLLEY.

National Institute for Medical Research, Hampstead, N.W.3. Oct. 8. F. G. YOUNG.

[1] Folley, S. J., Scott Watson, H. M., and Bottomley, A. C., (*Proc. Physiol. Soc.*, March 9, 1940) *J. Physiol.*, **98**, 15P (1940); *J. Dairy Res.*, **12** (in the press).

[2] Folley, S. J., Scott Watson, H. M., and Bottomley, A. C., (*Proc. Physiol. Soc.*, March 26, 1941) *J. Physiol.*, **100** (in the press).

[3] Lewis, A. A., and Turner, C. W., Proc. 33rd Ann. Meeting of Amer. Soc. Animal Production. Nov. 29–Dec. 1, 1940, p. 63.

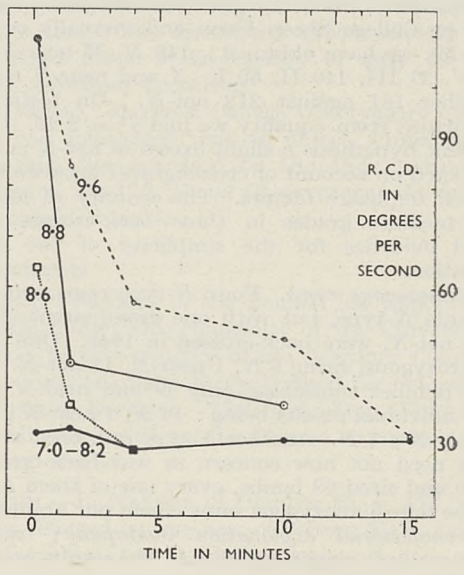
[4] Folley, S. J., and Young, F. G., *J. Endocrinol.*, **2**, 226 (1940).

Klino-kinesis of Paramecium

IT has been shown by Ullyott[1] that the aggregation reaction of the flatworm, *Dendrocœlum lacteum*, in a gradient of light intensities, can be described in terms of the rate of change of direction and the process of sensory adaptation in the eyes. This reaction has since been named 'klino-kinesis'[2]. More recently[3], it was suggested that the well-known 'phobo-taxis' ('avoiding reaction', 'trial-and-error') of Paramecium might be sufficiently similar to be included under the same name. Preliminary experiments by one of us (B.M.W.), which cannot now be continued, provide support for this suggestion. Briefly, the experiments consisted in transferring Paramecium from the culture medium at *p*H 8·0 to various strengths of acid or alkaline media, and finding the rate of change of direction as soon as possible and at intervals afterwards. It was found that it did depend on the change in *p*H at first, and that it soon fell to the original basic level; these are the essential features of the klino-kinesis scheme.

The amounts of acetic acid and sodium carbonate required to produce the required changes in the *p*H of the culture medium were first determined. The Paramecium were pipetted, in a known volume of culture medium, into a watch glass and the appropriate amount of acid or alkali was added; the liquid was rapidly mixed with a pipette and some of it transferred to a suitable slide. The first reading began 6–10 seconds after adding the acid or alkali. A reading consisted in drawing free-hand the tracks of animals taken at random, as seen under the microscope, and marking the tracks at 5-second intervals, with the aid of a metronome; further readings were taken after 1–2, 3–5, 10 and 15 minutes. At least ten tracks were made in each case. The amounts of turning carried out by the organisms were estimated from the drawings, the angles being measured to the nearest 5°.

The accompanying graph shows that on transfer to culture medium made neutral or slightly alkaline (actually *p*H 7·0, 7·6, 8·0 and 8·2), the rate of change of direction is about 30° per second after 6–10 seconds and remains at that basic level; but on transfer to medium made more alkaline, it is at



*p*H	Rate of change of direction in degrees per second				
	After 6–10 sec.	1–2 min.	3–5 min.	10 min.	15 min.
4·6	70	41	27	42	23
5·2 and 5·6	42	33	30	30	29
7·0 to 8·2	31	32	28	30	30
8·6	64	37	28	—	—
8·8	109	45	—	37	—
9·6	109	84	57	50	31

first raised and then falls to the basic level. The table gives more extended data and shows a similar effect when Paramecium is transferred to acidified culture medium. On the whole, the greater the change in *p*H, the greater the rise in rate of change of direction and the longer the time taken to revert to the basic value.

In a further experiment, specimens which had been kept for 15 min. in acidified culture medium (*p*H 5·6) were transferred back to culture medium at *p*H 8·0; the rate of change of direction was 58° per sec. after 3 sec. and fell to 31° per sec. after 3 min. This indicates that the rate of change of direction depends on the change in the medium, even when that change is a return to the original culture medium at *p*H 8·0.

It cannot be said that this work is more than indicative and preliminary. The reactions may not be towards the *p*H of the medium but may depend on the particular acid or alkali used, and so on. The methods used do not reveal the amount of turning carried out in the first few seconds after transfer to a new *p*H, when, as the graph suggests, rate of change of direction is likely to be much higher than it is at the time when the earliest reading could be taken. The behaviour during these first few seconds must be most important if the reaction in a gradient is to be effective. The results of the experiments encourage belief in the validity of the description of the behaviour of Paramecium in terms of klinokinesis, and thus help to avoid using terms like 'trial-and-error', which may carry unjustifiable implications.

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B. M. WALSHE.

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[1] Ullyott, *J. Exp. Biol.*, 13, 253 (1936).
[2] Gunn, Kennedy and Pielou, NATURE, 140, 1064 (1937).
[3] Fraenkel and Gunn, "The Orientation of Animals" (Oxford, 1940).

Flour and the Growth of Tribolium

IN a recent paper, Fraenkel and Blewett[1] described experiments on the growth of Tribolium on flour. They conclude that for this insect: (1) the addition of vitamin B_1 (aneurin) to patent flour does not in the least alter its nutritional qualities; (2) the nutritional difference between patent (40 per cent extraction) and N.S.R. (73 per cent extraction) flour is almost entirely due to lack of riboflavin in patent flour.

Experiments on Tribolium conducted in these laboratories do not support these conclusions, as a few examples will show. Like Fraenkel and Blewett, the growth period was taken as being the time between the hatching of the larva from the egg and the formation of the pupa.

Temperature, 30°C. Relative humidity, 75 per cent. 20 Larvæ per sample.

		Days in larval period	Number of pupæ
Patent flour (35 per cent extraction)	i	46·8	18
	ii	46·3	18
Patent flour + aneurin (20γ/gm.)	i	41·7	20
	ii	42·4	19
Patent flour + riboflavin (3γ/gm.)	i	29·7	20
	ii	28·5	18
Patent flour + nicotinic acid (3γ/gm.)	i	29·7	20
	ii	28·7	19

It will be seen from this experiment that the addition of B_1 to patent flour does produce a significant increase in growth, while the addition of *either* riboflavin *or* nicotinic acid induces a great improvement, since the larval period is reduced by a third. Moreover, the amount of riboflavin added was only about one fifth of the lowest quantity employed by Fraenkel and Blewett, and thus bears a truer relationship to the actual amounts of riboflavin present in germ (0·2–0·3 mgm. per 100 gm. germ)[2]. The fact that the addition of nicotinic acid to patent flour brings about the same rate of increase as an equal amount of riboflavin disposes of Fraenkel and Blewett's argument that white flour is *specifically* lacking in riboflavin.

For critical experiments on the vitamin requirements of any animal, vitamin-free diets should be employed. In the subsequent experiments with Tribolium, the following vitamin-free diet (here called *A*) was used: vitamin-free casein (15 per cent), fat (3 per cent), Osborn-Mendel salts (4 per cent), starch to 100. It has been known for a long time that the addition of germ or dried brewers' yeast to this vitamin-free diet will supply optimal growth conditions for Tribolium. Further, it has been shown by Street and Palmer[3] that the addition of aneurin alone to such a vitamin-free diet is not sufficient to bring about pupation in this insect, whereas in the presence of aneurin plus autoclaved yeast (in which the aneurin has been destroyed) pupation takes place normally. The following experiments with dried brewers' yeast and autoclaved yeast are relevant in this connexion.

Temperature, 30° C. Relative humidity, 75 per cent. 20 larvæ per sample.

Diet	Days in larval period	Number of pupæ
1. *A*	—	0
	—	0
2. *A* + 10 per cent yeast	18·1	20
	17·5	19
3. *A* + 1 per cent yeast	20·3	18
	21·4	20
4. *A* + 0·625 per cent yeast	24·7	17
	24·8	20
5. *A* + aneurin (20γ/gm.)	—	0
	—	0
6. *A* + 10 per cent autoclaved yeast	—	0
	—	0
7. *A* + 10 per cent autoclaved yeast + aneurin (20γ/gm.)	23·6	18
	23·8	19

In some further experiments to discover which other members of the vitamin B complex are required for the pupation of Tribolium, it was found that neither riboflavin nor nicotinic acid, either alone or in conjunction with aneurin, will bring about pupation. On the other hand, pupation would take place in the presence of aneurin plus a factor present in liver or yeast eluate. The particular sample of liver eluate used was stated to contain no riboflavin but to be rich in vitamin B_6 (adermin). Unfortunately, the amount of adermin present was not known. It is

known, however, that the amount of adermin in whole wheat is at least three times as great as the riboflavin content[4]. Later, by using a pure sample of vitamin B_6 it was confirmed that pupation will take place in the presence of this vitamin plus aneurin. These results are summarized below.

Temperature, 30° C. Relative humidity, 75 per cent. Number of larvæ per sample, 20.

	Diet	Days in larval period	Number of pupæ
1–9.	*A*, with riboflavin, nicotinic acid, aneurin riboflavin, liver filtrate factor and liver eluate factor, alone and in various combinations	—	0
		—	0
10.	*A* + aneurin (20γ/gm.) + liver eluate factor	60·4	10
		59·8	14
11.	*A* + B_6 (10γ/gm.)	—	0
		—	0
12.	*A* + B_6 (10γ/gm.) + aneurin (20γ/gm.)	62·3	14
		64·5	17
13.	*A* + B_6 (10γ/gm.) + aneurin (20γ/gm.) + riboflavin (3γ/gm.)...	61·8	15
		63·4	16
14.	*A* + B_6 (10γ/gm.) + aneurin (20γ/gm. + riboflavin (3γ/gm.) + nicotinic acid (30γ/gm.)[5]	60·7	16
		60·9	17

It should be noted that although pupation does not take place in the presence of vitamin B_6 alone, yet the larvæ remain alive and healthy for as long as 70 days and increase considerably in size, whereas in the riboflavin or nicotinic acid mixtures they die off in about 30 days.

It is evident from these experiments that although aneurin and vitamin B_6 are essential for pupation, there must also be present, even in patent flour, some other growth factor which is as important as any of the known members of the vitamin B complex in promoting rapid growth and pupation.

I am indebted to Mr. A. L. Bacharach for supplying the samples of liver filtrate and eluate, riboflavin, nicotinic acid and vitamin B_6.

E. BARTON-WRIGHT.

Research Association of British Flour Millers, St. Albans.

[1] Fraenkel, G., and Blewett, M., NATURE, 147, 716 (1941).
[2] *Nutr. Abs. and Revs.*, 9, 820 (1940).
[3] Street, H. R., and Palmer, L. S., *Proc. Soc. Exp. Biol. Med.*, 32, 1500 (1935).
[4] Swaminathan, M., NATURE, 145, 780 (1940).
[5] Kodicek, E., *Biochem. J.*, 34, 712 (1940).

Surface Tension and Molecular Dimensions

THE following argument is advanced in support of the hypothesis that the molecules of long-chain compounds tend to stand up like a carpet pile in their own liquid surfaces just as they do on substrates such as water. By the application of the usual thermodynamical reasoning to the following cycle: (1) transfer 1 gm. of substance isothermally from the liquid to the surface and thereby increase the area by A sq. cm.; (2) carry out a small adiabatic expansion; (3) transfer 1 gm. of substance isothermally from the surface to the liquid at the lower temperature; (4) carry out an equal adiabatic contraction—we obtain the equation

$$\text{Efficiency} = \frac{dT}{T} = -\frac{AdS}{H}\text{; that is, } \frac{H}{T} = -\frac{dS}{dT}A, \quad (1)$$

where S is the surface tension.

The surface energy, or total work of transfer, per gram of substance, is

$$SA - T\frac{dS}{dT}A = \left(S - T\frac{dS}{dT}\right)A, \quad . \quad . \quad . \quad . \quad (2)$$

This is usually obtained in the form:

$$\text{Surface energy per sq. cm.} = S - T\frac{dS}{dT},$$

by an argument involving 'stretching the film'. We consider the standard Kelvin method is faulty, because what is called 'stretching the film' is actually a transfer of molecules from the liquid to the surface state. Equation (2) can only apply when the surface is practically complete, that is, the probability of the vapour state can be neglected.

It is well known that, for this region of low vapour pressure, the $S-T$ curves for many liquids are very approximately linear, so that the surface energy per sq. cm. is practically constant. We suggest that this is so because the surface area per gram of substance is changing but slowly, and that it is really the surface energy per gram that is constant. The linear portion of the $S-T$ curve, extrapolated to cut the axis of T, intercepts it at T_c, which is approximately the same as the critical temperature obtained from vapour pressure measurements. This gives the constant surface energy as $-T_c\frac{dS}{dT}A$. Per gram-molecule this constant surface energy is $-T_c\frac{dS}{dT}AM = nRT_c$. The surface area per molecule will then be

$$\frac{AM}{N} = -\frac{nR}{N\,dS/dT} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

We further suggest that the number 'n' in the above equation is the same for all chain-molecular liquids. Substitution of values AM/N, the basal molecular area obtained from X-ray diffraction patterns of aliphatic compounds in the solid state, suggests that $n = 1{\cdot}5$. The constant surface energy is thus equal to the kinetic energy of translation at the critical temperature. Using this value in equation (3), we can find molecular lengths if we assume that the density in the surface state is not very different from that in the liquid state. If l is the length per molecule,

$$l = \frac{1}{\rho_s A} = -\frac{M\,dS/dT}{\frac{3}{2}R\rho_s} \quad . \quad . \quad . \quad . \quad (4)$$

Since l is the molecular thickness associated with the molecular weight M, we see that the surface tension is independent of chainwise association in the surface layer.

The values obtained for a typical series are given below:

Alcohol	Formula	$-\frac{dS}{dT}$	$a \times 10^{16}$ cm^2.	$l \times 10^8$ cm.	Increase per CH_2
Methyl	CH_3OH	0·0875	23·8	2·82	
Ethyl	C_2H_5OH	0·0875	23·8	4·05	$1{\cdot}23 \times 10^{-8}$ cm.
n-propyl	C_3H_7OH	0·0820	25·4	4·88	$0{\cdot}83 \times 10^{-8}$ cm.
n-butyl	C_4H_9OH	0·0840	24·8	6·12	$1{\cdot}24 \times 10^{-8}$ cm.
n-octyl	$C_8H_{17}OH$	0·0820	25·4	10·35	$1{\cdot}06 \times 10^{-8}$ cm.
Miricyl	$C_{30}H_{61}OH$	0·0780	26·6	32·6	$1{\cdot}01 \times 10^{-8}$ cm.

The approximate equality of the values of dS/dT for the above series indicates that the molecular basal area is approximately the same for all the

members. The same is true in each of the aliphatic series studied.

We wish to thank Dr. W. T. Astbury, of Leeds, for encouragement and for advice with regard to the form of this communication.

A. E. RIDLER.
J. H. SMITH.

High Storrs Grammar School,
Sheffield, 11.
Oct. 8.

Poultry as Food Converters

MR. E. E. JONES, in his letter in NATURE of October 18, states that the goose is the only grass-eating bird available for egg production. While the main object of his communication, which is to encourage the breeding of a superior kind of goose, is no doubt of value, he would seem to infer that the hen does not eat grass. It is true that on a confined run with plenty of other food and no supply of fresh young grass the hen does not because there is none, not because she would not if it were available.

On a limited run, the hen willingly eats cabbage leaves for the sake of fresh green food, and is often made to jump for it for exercise, but with a large area of good grass on which to roam, a hen will not touch cabbage. I used to let out the hens for an hour to forage in the garden, and they used to dive at once into the edges of the borders in the lawn where, among the leaves collected there, they found plenty of 'creepy-crawleys'. But I noticed that they ate with avidity large quantities of the young grass on the edge where it is freshest and greenest, preferring this to the abundance which they had in their own territory. While no doubt the proportion of grass in their diet is not so great as it is with the goose, it is still an important item if they can get it, but not when it is denied to them.

Will geese any more than hens keep on laying if they are not provided with concentrated food, which it is the object of Mr. Jones to save ?

C. V. BOYS.

St. Marybourne,
Andover.
Oct. 24.

A British-American Scientific Reconstruction Expedition

ONE of the points generally agreed upon during the proceedings of the Conference on Science and World Order arranged by the Division for the Social and International Relations of Science of the British Association was that careful scientific planning is essential for post-war relief and reconstruction work ; and Sir Richard Gregory, in his concluding speech, stated that the Council of the British Association will appoint, at an early date, committees to study the problems and make appropriate recommendations. One problem, however, did not receive the attention of the Conference, a problem which in my opinion is of the greatest importance in planning the reconstruction of the smaller European countries.

The small European countries actively involved in the present War have lost a considerable proportion of their scientifically trained youth. A large number of the leading scientific personalities, professors and members of the staffs of the universities, social and administrative workers have been killed. It is the deliberate policy of the Nazis to destroy cultural and scientific centres, and thus to deprive conquered nations of the backbone of future reconstruction. Germany is doing everything to make the revival of the nations as difficult as possible. This is exemplified not only by the murder of the leading minds of each nation and of scientifically trained youth which could replace their masters and continue their work, but also by the destruction or removal of scientific equipment, by burning libraries, pulling down essential buildings, etc.

There can be no doubt that after an armistice has been signed, the smaller countries of Europe will need help from the outside world to re-establish scientific centres. There is no purpose in planning co-operation of scientific bodies on an international scale if such bodies in the various countries are unable to organize their work, or may not even exist, because of the lack of personnel to revive them and to carry out the work.

I know that Britain and the United States will be willing to do their utmost to help, but in order that assistance may be rendered in the most efficient way plans and foundations for it must be laid immediately. I suggest, therefore, that a detailed scheme be drawn up now for a British-American Scientific Reconstruction Expedition to the smaller countries of Europe.

A plan ought to be devised in collaboration with scientific workers from Nazi-dominated countries who have happily managed to escape and are at present continuing their work in hospitable British scientific centres, so that, immediately hostilities come to an end, arrangements might be made to send into each of the liberated countries a unit of scientific workers, which will be able to administer 'scientific first aid' and to establish in the shortest possible time conditions suitable for carrying out scientific work, and where necesary to initiate it. Not only will senior scientific workers be required to take over the lead and direct the work of reconstruction, but also a considerable number of younger workers, with up-to-date knowledge in the different branches of science, will be essential to pave the way for science during the first post-war years, before the huge loss in scientific man-power of these nations is made good again.

The Scientific Reconstruction Expedition will have to be able to provide scientific instruments, to re-equip laboratories, to rebuild essential buildings, to re-stock libraries, and perhaps also to provide the necessary funds. Like the Red Cross in the field of medicine and human welfare, the Scientific Reconstruction Expedition would be a mission of goodwill in the field of science. Its aim would be to help to restore the life of the smaller nations by assisting to re-establish their national centres for scientific work, and by doing so, to serve the cause of science throughout the world.

R. BRAUDE.

Poland :
at the National Institute for
Research in Dairying,
Shinfield,
Near Reading.

RESEARCH STUDIES IN EDUCATION

IN the last few years the U.S. Office of Education has published an annual Bibliography of Research Studies in Education. The most recent volume to hand* reveals activity in the sphere of education which must be without parallel anywhere else in the world. Altogether, for the year 1938–39, it lists 3,569 theses, submitted by research workers in 174 institutions. Taken in the broad view they give one the impression that in the United States the whole field of education is open to inquiry, that policy is in no way bound down by tradition; instead, accepting democratic principles, it is adjusting itself to the continual changes taking place outside school and college. These research studies provide the material for informed opinion, which cannot fail to exert a beneficial influence upon teachers, administrators, parents, and incidentally upon the pupils, too.

Of the papers listed in the Bibliography almost a half are concerned with curriculum studies and with problems met with in the teaching of individual subjects. Some measure of the interest taken in developments in the different subjects, in their American setting, may be gathered from the number of papers devoted to each. There are, for example, 135 papers on physical training and recreation, 115 on scientific subjects, 109 on commercial education, 108 on reading, 103 on mathematics, 84 on music, 69 on home economics, 65 on English, 56 on agriculture, 43 on health education, with only 27 papers devoted to art, 22 to history, 14 to modern languages and 12 to the classics. One gains the impression that formal methods of teaching are yielding place to more varied and more actual lines of approach. Attempts to build up logical unity are being abandoned for methods based upon the pupil's own experience and active co-operation. The conception of education is broadening, not only to fit pupils into suitable occupations in adult life, but also to see that they take their part as useful members of the living community. This emphasis on the social side of education is exerting an influence upon teacher-training, for it is found that teachers who are maladjusted professionally are often maladjusted in other walks of life.

Many other papers deal with the organization of education and administrative problems. Much thought is being given to fitting the school into its proper place, a question which is looked upon more from the personal and communal angle than as a matter of national concern. The same line of thought accounts for many papers devoted to the development and present position of education, treated both historically and on the comparable basis of what is happening in other countries. Given certain types of social and economic setting, and certain standards in pupil and parent requirements, it is clear that American educational institutions are meeting fairly adequately such demands as are made upon them.

As one might expect, the large majority of the papers are almost purely descriptive in nature, or they survey known facts and existing circumstances in the attempt to shed new light upon them. Nevertheless, in spite of their short range and empirical character, suggestive results are obtained, some of which are capable of broad application. One investigation, for example, shows that children are more interested in the text than in the format of the books they read, and another, based upon differing interests, points to separate reading-books for girls and boys. Studies in child vocabulary indicate that many books read in school contain words which lie far beyond the child's own age experience. This point applies with some force to science text-books, and deserves more attention than it has so far received. The way is clear for an accepted vocabulary for school use, expanding as the child-mind develops.

Surveys of pupils' leisure time activities show that there is among girls a desire for more physical activity in place of sedentary occupations. Man craves for physical exertion. The school camp is becoming a definite part of the school programme. A number of surveys indicate that inadequate attention is given to health education, in which application lags behind the pupil's own actual knowledge. A comparison between farmers and future farmers in Pennsylvania revealed little difference in total scientific knowledge. The farmers excelled in biological and health knowledge, the young boys in the exact sciences. The fathers were slightly more superstitious than their sons, and both groups tended to correct misconceptions by direct experience. Almost inevitably, an investigation of pupils' honesty showed that there is a positive correlation between cheating and the importance attached by the teacher to the particular test; and for the pessimists, an experiment in trying to teach secondary school students to resist propaganda showed that the instruction offered was ineffective.

One paper reports that mathematics feature considerably more in the curriculum in Great Britain than in the United States, and that British mathematical teachers are more intensively drilled. The theses on scientific subjects are nearly all concerned with general science, biology and chemistry, with scant attention being devoted to physics in education. There is one paper on astronomy and three on geology. Nearly all these papers are taken up with details of teaching technique and with the comparative study of text-books and syllabus requirements within the framework of existing conditions. Relating the science teaching more directly to the pupil's own experiences has a beneficial effect upon their work. Nevertheless, except for some interest in wild life, soil conservation and consumer requirements, there is little evidence of any attempt to lift science teaching on to a plane which would give it broad contacts with human life and with human thought.

Few inquiries have been directed to nutritional standards in the school population, and while in the United States access to educational facilities is widely available to children of all social grades, almost no studies have been concerned with the relation between education and social opportunity, except for those dealing specifically with the Negroes. Much work has been done on the reliability of intelligence tests and on the psychology of memorizing, but little thought has been given to the relations between intelligence, personal effectiveness and physical well-being, and between intrinsic intelligence and success in later life.

Altogether, it is the long view which seems to be missing. What in Great Britain is beginning to be termed human biology, in which biological knowledge

* Bibliography of Research Studies on Education, 1938–1939. U.S. Office of Education, Bulletin, 1940, No. 5.

is applied to individual development, family and social life, is a subject scarcely touched upon. The psychological problem of the relation between knowledge acquired at school and its application in personal living, and the deeper psychological problem of the relation between the inculcation of cultural standards and their expression in personal conduct, are fields almost untilled.

In the United States, where the impact of science has changed social and cultural standards more extensively than elsewhere, and where the rate of change shows every sign of both increasing and continuing indefinitely, altering in its train the environmental framework of man, insufficient attention has as yet been given to science as an educational force, so that the influences affecting man's destiny might be understood, and in that measure brought under control.

HYPERFREQUENCY ELECTROMAGNETIC WAVES AND THEIR PRACTICAL USE

IN a paper by Dr. Léon Brillouin presented at a meeting of the Franklin Institute held on April 6, 1939, and reprinted in the *Journal* of the Institute of June 1941, the author begins by discussing the meaning attached to the word hyperfrequency. It has commonly been used for frequencies higher than 10^9 c./s. (1000 Mc./s.) which correspond to electromagnetic waves the wave-lengths of which are shorter than 30 cm. Brillouin has studied the behaviour of electromagnetic waves of which the lengths are comprised between approximately 1 cm. and a few decimetres.

At the present time, this region of the electromagnetic spectrum is of great interest in many practical fields. The radio engineer is specially anxious to study wave-lengths of the order of one centimetre or less. Very little is known of this region until we reach wave-lengths of 0·1 mm., which correspond to the extreme infra-red. Emission and absorption spectra have still to be measured, together with optical properties of chemical compounds. Some very remarkable results have already been obtained, such as an absorption spectrum for ammonia and a strong change in the dielectric properties of water. These researches will become still more interesting when wave-lengths of a few millimetres, or fractions of a millimetre, can be produced with sufficient energy. It is to be foreseen that all chemical compounds which have an electric dipole should show a typical variation of their electric properties in this region. These waves should enable us to build up new methods of making investigations on molecular structures.

The physicist is waiting for the gap between radio and optics to be filled up. He is still very anxious to link these two different fields together. Experiments have already been tried with damped waves, but so far precise measurements have only been made with undamped and continuous waves, and precise measurements are what the physicist is anxious to obtain. The problem presents as much interest to the radio engineer as it does to the physicist. For the last twenty years or so the tendency in radio is to push in the direction of measuring even shorter wave-lengths. We do not yet know where the practical limit of measuring short waves precisely will be reached. But it has already been demonstrated that wave-lengths some centimetres long may prove of great value for radio-communication, television, signalling (radio-beacon), obstacle detection, not forgetting the use of dielectric cables. All this is more than sufficient to arouse keen interest and promote very active technical research in engineering and technical industries.

Wave-lengths some decimetres long were first used by Hertz to repeat optical experiments, such as prismatic deflexion or diffraction; and this similarity of short radio-waves to optical waves has been emphasized by a great many experimenters. Optical lenses, mirrors, parabolic reflectors are very effective as soon as they can be built with dimensions of a few wave-lengths. Another and more recently discovered point is the analogy between hyperfrequency radio-waves and acoustics. Since the wave-lengths are of the same order of magnitude in both cases, we may now note the very important use of electrical apparatus curiously similar to acoustical instruments: hollow pipes, like organ pipes; hollow resonators reminiscent of Helmholtz's acoustical resonators, and dielectric cables, which show a marked relationship with pipes as used in acoustics. Hollow tank resonators have been suggested by several physicists, mostly on the basis that they give very slight damping. As commonly expressed by radio engineers, these hollow resonators show very high Q factors; a high Q means that the resonator oscillates freely a great many times before the amplitude of the oscillations is reduced to a small value. There is another aspect of the question which seems worth noticing; this is the possibility of first storing up energy in the resonator, and afterwards radiating this energy.

The question arises: How far can we increase the fields? If air is at atmospheric pressure, its disruptive potential is about 30,000 volts per cm., that is, 100 c.g.s. electrostatic units. This upper limit will never be reached in practice. If one wishes to accumulate electromagnetic energy in a given volume, it can only be done by producing high electrical and magnetic fields inside this volume. Making certain assumptions, Brillouin calculates that the average field attains perhaps 15 e.s. units. This means that it contains 1 joule of energy per cubic metre. For short radio-waves, ordinary inductance capacity circuits cannot be used. The technical practice is to use parallel lines or coaxial lines as resonators. These lines can only be built if the distance between the two parallel wires is small with respect to the wave-length. This can no longer be done with hyperfrequency waves, and we are thus forced to work with tank resonators.

The Laboratoires L.M.T. (laboratories of Le Matériel Téléphonique in Paris) have been very active for a good many years in the field of hyperfrequencies. The researches were conducted by MM. Clavier, Darbord and various co-workers and resulted in radio transmission across the English Channel, using a wave-length of 18 cm. Photographs are given of the apparatus employed. The reflectors

produce a linear beam of very small aperture, directed from the transmitting to the receiving station. The reflectors must be in direct sight. In the cross-Channel communications, for example, one of the stations was at St. Inglevert on the French side, the other at Lympne in England, the distance between being about 50 kilometres. The electro-optical equipments were installed on suitable steel towers at St. Inglevert and Lympne. The results of operation were very good on this link, which represents the shortest wavelength circuit in commercial use. The link was used for two-way teleprinter messages as well as duplex telephony. Atmospherics are never heard on the circuits. No interference whatever is caused either by thunderstorms or motor-cars; the background noise in the receiver exactly resembles normal tube noise.

A very important step was taken when Southworth, Carson, Mead and Schelkunoff, of the Bell Laboratories, first began investigating short-wave propagation along conducting hollow tubes (so-called dielectric cables). Very similar researches were started almost at the same time by Barrow at the Massachusetts Institute of Technology. Brillouin concludes by discussing the theory of dielectric cables for various kinds of cross-sections. These high-frequency oscillations have opened up a new field of research in which are very curious theoretical and technical problems, and good prospects for important practical applications.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

MONDAY, NOVEMBER 10

FARMERS' CLUB (at the Royal Empire Society, Craven Street, London, W.C.2), at 3 p.m.—Mr. Thomas Peacock: "Farming's Great War Effort".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Lieut. A. R. Glen: "Recent Changes in the Spitsbergen Glaciers".

SOCIETY OF CHEMICAL INDUSTRY (under the auspices of the Institute of Chemistry in the General Lecture Theatre of the University of Leeds), at 6.30 p.m.—Dr. Dorothy Jordan Lloyd: "Application of X-Rays to Leather Manufacture".

TUESDAY, NOVEMBER 11

CHADWICK PUBLIC LECTURE (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 2.30 p.m.—Mr. Fredk. R. Hiorns: "Hygiene Technique in Building, or the Economic, Psychological and Health Aspects of Surface Treatment".*

WEDNESDAY, NOVEMBER 12

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. A. J. Amos: "Microbiology and Baking".

THURSDAY, NOVEMBER 13

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 2.30 p.m.—Dr. Harold King, F.R.S.: "Chemistry and Pharmacy".

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 3.30 p.m.—Dr. W. E. Gye, F.R.S.: "Filterable Tumours" (Imperial Cancer Research Fund Lecture).

APPOINTMENTS VACANT

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

HEAD OF THE MATHEMATICS DEPARTMENT—The Secretary, The Technical College, Sunderland (November 15).

CHIEF ASSISTANT ENGINEER—The Engineer to the Witham and Steeping Rivers Catchment Board, 50 Wide Bargate, Boston, Lincs. (November 17).

LECTURER IN ELECTRICAL ENGINEERING—The Principal, County Technical College, Worksop, Notts. (November 18).

PROFESSOR OF EDUCATION—The Bursar and Deputy Registrar, University College of North Wales, Bangor (November 22).

SENIOR PHYSICS MASTER at the Rutherford College Boys' School, Newcastle-upon-Tyne—The Director of Education, City Education Office, Newcastle-upon-Tyne, 2 (November 29).

ASSISTANT ENGINEER to the Sudan Government Railways—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (endorsed 'Assistant Engineer').

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Rubber Producers' Research Association. Publication No. 13: Analytical Methods in Rubber Chemistry, 4: The Determination of Peroxidic Oxygen. By J. L. Bolland, A. Sundralingam, D. A. Sutton and G. R. Tristram. Pp. 4. (London: British Rubber Producers' Research Association.) [1510

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 13, No. 1, June 1941. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Alexander. Pp. iv+78. (London: H.M. Stationery Office.) 4*s.* 6*d.* net. [1510

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 17: The Comparative Genetics of *Gossypium anomalum* and the Cultivated Asiatic Cottons. By R. A. Silow. Pp. 259–358. (London: Empire Cotton Growing Corporation.) 2*s.* 6*d.* [1510

Other Countries

Publications of the Observatory of the University of Michigan. Vol. 8, No. 9: The Measurement of Space Motions of Solar Prominences. By Robert R. McMath, with the collaboration of H. E. Sawyer and Orren C. Mohler. Pp. 123–132+1 plate. Vol. 8, No. 10: Fourth List of New Southern Double Stars found at the Lamont-Hussey Observatory of the University of Michigan at Bloemfontein, Orange Free State, South Africa. By Richard A. Rossiter. Pp. 133–140+2 plates. (Ann Arbor, Mich.: University of Michigan.) [1310

Smithsonian Miscellaneous Collections. Vol. 101, No. 2: A New Salamander of the Genus Gyrinophilus from the Southern Appalachians. By M. B. Mittleman and Harry G. M. Jopson. (Publication 3638.) Pp. ii+5+1 plate. (Washington, D.C.: Smithsonian Institution.) [1310

Transactions of the Academy of Science of St. Louis. Vol. 30, No. 5: Archæological Investigations in Jefferson County, Missouri, 1939-40. By Robert McCormick Adams. Pp. 145–222. (St. Louis, Mo.: Washington University.) [1710

National Research Council of Canada. N.R.C. No. 1002: Twenty-fourth Annual Report of the National Research Council of Canada, 1940–41. Pp. 28. N.R.C. No. 1012: Review of Potato Research, Part 1: Potato Research in Canada. By Muriel E. Whalley. Pp. iii+54. 50 cents. (Ottawa: National Research Council of Canada.) [2010

India Meteorological Department. Scientific Notes, Vol. 8, No. 91: The Hindu Kush Earthquake of November 21, 1939. By S. M. Mukherjee and A. R. Pillai. Pp. 85–90+2 plates. (Delhi: Manager of Publications.) 8 annas; 9*d.* [2010

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 106: A Report on Agricultural Features of the Australian Potato Industry. By Dr. J. G. Bald. Pp. 72. (Melbourne: Government Printer.) [2010

Field Museum of Natural History. Zoological Series, Vol. 24, No. 21: The Herpetological Fauna of the Salama Basin, Baja Verapaz, Guatemala. By Karl P. Schmidt and L. C. Stuart. Pp. 233–248. 15 cents. Zoological Series, Vol. 24, No. 23: A New Subspecies of *Sceloporus jarrovii* from Mexico. By Hobart M. Smith and Bryce C. Brown. Pp. 253–258. 10 cents. (Chicago: Field Museum of Natural History.) [2010

U.S. Department of Agriculture. Farmers' Bulletin No. 1880: Control of Insect Pests of Grain in Elevator Storage. By R. T. Cotton and Geo. B. Wagner. Pp. ii+22. (Washington, D.C.: Government Printing Office.) 5 cents. [2010

Catalogues

Electrochemical Analysis Apparatus: a New Apparatus designed for use in the Speedy and Accurate Analysis of Alloys of all Kinds. (GT. 1325.) Pp. 4. (London: Griffin and Tatlock, Ltd.)

New Glaxo Products and Revised Price List. Pp. 8. (Greenford: Glaxo Laboratories, Ltd.)

Rotherham's Instruments. (Ref. L.123/41.) Pp. 4. (Coventry: Rotherham and Sons, Ltd.)

General Catalogue of Books of All Ages. (Catalogue No. 658.) Pp. 102. (London: Francis Edwards, Ltd.)

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