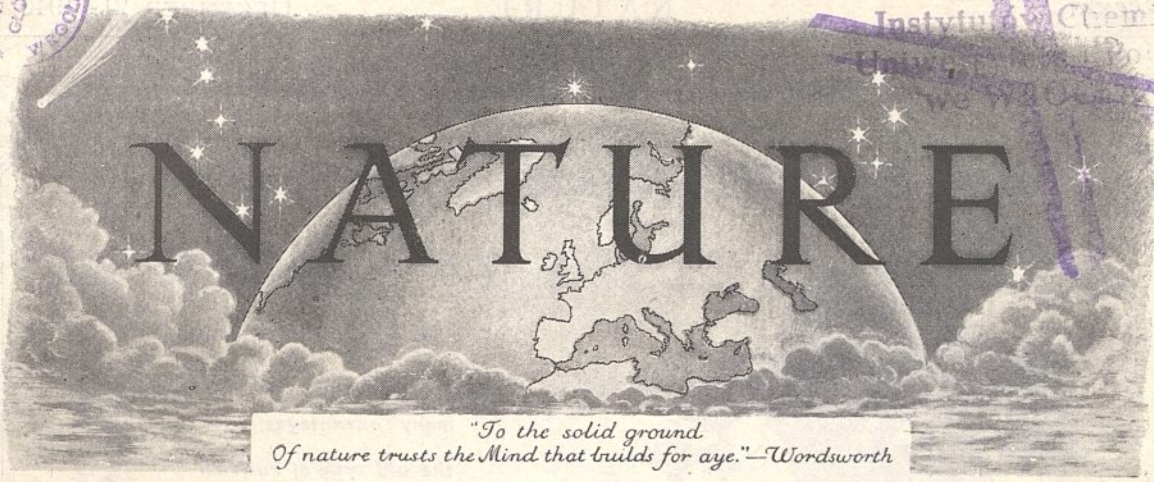


NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

Vol. 146, No. 3712 SATURDAY, DECEMBER 21, 1940 ONE SHILLING

NATURE

Vol. 146 SATURDAY, DECEMBER 21, 1940 No. 3712

CONTENTS

Editorial and Publishing Offices:

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4 Telephone Number: City 4211

Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, DECEMBER 21, 1940 No. 3712

FOOD SUPPLIES AND THE BLOCKADE

THE fact that there was a serious food shortage in Germany towards the end of the War of 1914–18 makes people more ready to believe rumours that already in this War the shortage of food in Germany and in German-occupied countries is so serious that it may soon paralyse the Nazi war effort. These rumours should be received with caution. In the two or three years before the outbreak of the present War, there were numerous statements suggesting that food shortage, financial difficulties and other internal troubles were acute and that there were signs of a breakdown in the economic system which would bring about the collapse of the Nazi regime.

Whatever the origin of these rumours, their effect was to deceive the world about the real military strength of Germany. In view of the suggestion that, on humanitarian grounds, the blockade should be relaxed to allow food to reach the people in occupied countries, it is of interest to review what happened in the War of 1914–18 and consider whether events in the present War will follow the same course, as many people are too ready to assume.

The Germans fostered the belief that their defeat in the last War was caused by the starvation of the civilian population through the Allied food blockade. The idea that the defeat of the German Army was due to the blockade on food was assiduously cultivated in Germany as a means of getting the people to believe that the Army had not really been defeated. The food blockade certainly helped. But its main help was probably in reducing the output of munitions, owing to the deterioration of the health of the workpeople. The German Army was at full fighting efficiency in the summer of 1918. The Hindenburg line was broken and the Army defeated because the accession of men and armaments from the United States had, for the first time in the War, made the military forces of the Allies superior to those of the Germans.

Nor as a matter of fact was the blockade the sole, or even the main, cause of the acute shortage of food in Germany. In the five-year period before 1914, Germany produced 80 per cent of the food she consumed. The blockade was never complete. Germany continued to receive food from neutral countries in Europe. The deficit due to the blockade might have been made good by increased home-production, saving in wastage and efficient distribution. The consumption of food in Germany among the civilian population fell not by 20 per cent, which would have been the fall necessary had there been a complete blockade, but by about 50 per cent. The acute food shortage was due to the sacrifice of food for war ends. Nitrates, which should have been used for fertilizers, were used for making explosives. About two million farm workers were taken from the land for military service or for work in munition factories, and horses were taken from the farms for the Army. Because of the diversion of the national effort from food production to war ends, food production fell. Thus, for example, the yield of grain fell by about 22 per cent and the yield of sugar by nearly 35 per cent.

Further, part of the food that was produced, especially fats and sugar, was used for making explosives. Consumption of fat fell from the pre-war level of 12½ oz. per head per week to about 2 oz., and of sugar from about 12½ to 4½ oz. The starvation of the German people was thus due more to the decision of the German Government to sacrifice food for war ends than to the blockade of the Allies. Then, as now, guns instead of butter was the policy. If the Allies had allowed food into Germany, the enemy would have been enabled to release a further part of the national effort from food production to war ends, or to use a greater proportion of the food available for making explosives. Lifting the blockade on food would have been almost equivalent to lifting the blockade on munitions.

It is very doubtful whether food shortage in Europe will play as important a part in this War as it did in the last. The building up of a food reserve was part of the Nazi 'military economy', established in 1934. Agriculture was organized to increase crops which give the maximum amount of food per acre and to adjust animal husbandry to give the maximum amount of human food for the feeding-stuffs consumed. The potato gives twice as much human food per acre as grain. Although Germany had a relatively large acreage of potatoes in 1939, an additional 15 per cent was asked for. This would provide roughly about six times as much potatoes per head of the population as the United Kingdom supplies. Reserves of grain and fat were built up. By April 1938, there was a reserve of 4 million tons of grain and by April 1939 the reserve increased to 7 million tons. Between 1933 and 1938, by developing home-production, the total supply of fat increased by 281,000 tons. But the increase was not consumed. In fact, the consumption of fat per head per annum fell from 58 lb. in 1932, before the Nazis came into power, to 55 lb. in 1937. The additional fat had either gone into reserve or, on Goering's plan for sacrificing butter for guns, been used for the manufacture of explosives.

At the end of the four-year plan, which adjusted agriculture to military ends, Germany may well have been nearly self-supporting in food with considerable reserves. Any depletion of reserves has probably been made up by food taken from the occupied countries. It is very doubtful, therefore, whether there is any food shortage in Germany, or at least any shortage likely to interfere with the war effort.

A consideration of the food position of Germany and of the countries now occupied makes it probable that the food supplies now controlled by the Nazis are sufficient to prevent any acute shortage if they are distributed according to needs. But the Nazis are likely to use their control of food to suit military needs rather than the nutritional needs of the people. Control of food can be used as a means of keeping conquered people in subjection. Although a sudden shortage of food among a previously well-fed people might cause revolt, a gradual deterioration in the diet is more likely to be accompanied by physical weakness, loss of courage and will-power and general apathy. People suffering from malnutrition and under-nutrition are easily kept in subjection.

It would be foolish to hope for a collapse of the Nazis in the near future owing to food shortage. It would be safer to assume that their present reserves will be sufficient to carry them on to the next harvest. It would be equally foolish to depend upon food shortage as a means of defeating the enemy next year or the year after. It is difficult to set limits to the extent to which food can be increased by modern agricultural science, provided there are sufficient fertilizers and labour. By exploiting to the fullest extent all the lands of Europe which they control and all the subject labour, and by arranging distribution to suit military ends, the Nazis may well be able to maintain the strength of the war machine unimpaired indefinitely.

If, as we believe, the Nazis can, by devoting sufficient effort to it, produce sufficient food to maintain the efficiency of the war machine, what is the value of the food blockade ? A food blockade is a valuable part of our war effort because any food allowed into countries occupied by the Nazis enables them to withdraw an equivalent part of the effort devoted to food production to direct war ends, and to that extent increases their military efficiency. Further, although explosives are not made from food to the same extent as in the War of 1914–18, large amounts of foodstuffs are being used for making motor-spirits and for other purposes connected with the manufacture of war material. The lifting of the blockade on food would be equivalent to the return to Germany of prisoners captured or the lifting of the blockade on petrol or other war materials.

There is evidently food shortage in unoccupied France, and there may be some degree of shortage in some of the occupied countries ; but to what extent it exists it is difficult to assess. Travellers' tales are notoriously unreliable, and official news from the enemy is calculated to deceive rather than to inform. It is being suggested that food might be allowed through in sufficient amounts to prevent suffering among the people of the conquered countries. Even if food were allowed in, there is no guarantee that the people would benefit. If the Nazis are unwilling to share the food they control with these people or even allow them to keep the food they have, it is very doubtful whether they would allow them to benefit from any food allowed in. Measures could, of course, be taken to ensure that the people received the actual food sent in, but there is nothing to prevent the Nazis, who have complete control, from withdrawing an equivalent amount of food either for the troops of occupation or for transfer to Germany. It has been suggested that dried milk and cod liver oil might be allowed in to prevent malnutrition, but the Nazis could take away an equivalent amount of dairy products.

The only way to bring relief to Europe is to defeat the Nazis and drive them out of the conquered countries. Anything which will contribute to the destruction of the Nazi war machine will contribute to the relief of the conquered people. Any food, or other material which can be used for war purposes, allowed into the part of Europe controlled by the Nazis, strengthens the Nazi war machine and, to that extent, delays the deliverance of the people of Europe. But preparations should now be made so that food and other forms of assistance may be rushed to these countries as soon as they are liberated. Attention should be given now to what foods will be most effective in rectifying the evil effects of shortage during the enemy occupation, and the organization for the transport and distribution of the food got ready.

The action which ought to be taken now and after the War should be based on facts and not on opinions formed from rumours and enemy propaganda. Until war broke out, there was an international committee of nutritional experts, including prominent American and British men of science nominated by their respective Governments. For three years before the War, this committee, in collaboration with a committee of economic and agricultural experts, was engaged in studying the food position in Europe. It would be better able to assess the true position and make recommendations than any other body which could be set up. Further, it had experience of similar work in advising on food relief measures for Spain. The United States and the British Commonwealth of Nations might well appoint the American and British members of this committee, with an American chairman, to investigate the position and report on the present food position in Europe in so far as information is available, the means which ought to be taken to relieve distress arising from food shortage in Europe, and also on the economic and political measures which should be taken to base post-War world food policy on nutritional needs. In its pre-War studies, this committee found that the basing of food policy in the nutritional needs of the people would, in addition to bringing about a great reduction in disease and a rise in the standard of living, bring prosperity to agriculture and increase international trade. The committee suggested could make sound recommendations based on ascertained fact to deal with the present position, and could also make an important contribution to the building up of the new and better world order we are looking for after the War.

Every means should then be taken to let the people in Nazi-occupied Europe know that the free countries are making elaborate preparations to bring food and other forms of assistance as soon as the Nazis are defeated. The knowledge that these preparations were being made on the recommendation of a committee of scientific men, all of whose names are well-known in every country in Europe, would help them to endure the evils of their temporary bondage and encourage them, at the appropriate time, to assist in their own deliverance.

TRADITION IN A NEW WORLD ORDER

WE live in the birth-pangs of a new world. Of what order that world will be now hangs on the arbitrament of war. Should the final decision be, as we hope and confidently expect, in favour of Great Britain and her Allies, to them will fall the task of moulding the new world in that shape which the ideals and principles for which we have taken up the challenge of dictators and totalitarian States may best be given practical effect. The burden will be heavy ; and not the least onerous part of the task will be how best to ensure that in the endeavour to attain a state of permanent peace in the future by bringing about co-operation between peoples and nations in all matters which pertain to the common interests of mankind, loyalty to these principles and ideals may be maintained without impairing either sense of freedom in action or individuality. At the close of the War of 1914–18 it is true that these elements of freedom and individuality were stressed over-strongly. The rights of minorities and the claims of the smaller national groups to self-determination were allowed to obscure the larger issue. This was largely a consequence, perhaps inevitable, of conditions which had preceded that great struggle. But when the time came for the League of Nations to take the strain, instead of a united team it proved to be rather an assemblage of disruptive forces in which sovereignty and national self-interest acted as the motive power and obscured the urgency of adherence to a common aim. The tradition of national and racial groupings, in the long run, rendered impotent attempts to secure full corporate action on the occasion of any major political crisis. A world which was to be "made safe for democracy", in the event, through the assertion of national claims in both the political and the economic spheres, became the opportunity of the dictator and of those whose specious arguments even in non-totalitarian States placed a delusive efficiency in public affairs above free discussion. In the result, democracy has been brought within measurable distance of the danger of extinction.

Many writers over a long period of years have prophesied the coming of Armageddon, when man would destroy himself and the civilization he has constructed by misuse of the powers of his own intellect and his control over the forces of Nature. Among recent writers Mr. H. G. Wells, in some of his early works, has drawn horrific pictures of a derelict world after the last great struggle has been fought to a finish. On the other hand, others, among whom Sir Arthur Keith has been conspicuous, have seen in war a moulding force by virtue of which racial, or rather national, types and characteristics are evolved. Without accepting the argument as valid in its entirety, it may at least be admitted that as a result in part of conditions arising out of the War of 1914–18 three new forms of political organization emerged—the League of Nations, the Russian Union of Soviets, and the British Commonwealth of Nations. Each of these was, in its respective method of approach to the problem of uniting a number of peoples in a single grouping, a step forward along the line of development of ever-increasing social and political units which is apparent in the evolution of human societies. Of the third of these, however, the British Commonwealth of Nations, it is perhaps not over-hazardous to say that it possessed the best chance of survival as being the least counter to tradition. It is in harmony with the trend of British institutions which have fostered local autonomy, not only in Great Britain itself in its municipal, district and county administrative bodies, but also in the legislative councils which hitherto had been responsible under the Imperial Government for the affairs of the Dependencies. At the same time the British Commonwealth stands alone in the history of political institutions in that it is a body composed of free and independent nations, in which any act of aggression of one member against another is well-nigh inconceivable.

The League of Nations was the latest of attempts since the *Pax Romana* and the Roman Empire to unite the peoples of Europe, or the greater number of them, in a single system. It differed from its forerunners in that it did not aim at complete political unity, but only at joint and corporate action in certain spheres of political, social and intellectual interest ; it went outside the geographical boundaries of Europe and appealed for the co-operation of peoples of European civilization ; and, most significant of all its differences from previous systems, it was based upon the voluntary principle and a degree of abrogation of sovereignty, and not upon force. It is, therefore, perhaps no matter for surprise that its most conspicuous success was precisely in those fields of activity in which before the first world war, interest, activities and joint action had been international and the barriers of national interests had been least operative—the field of the arts, sciences and social reform. In this respect it came near to reconstituting the international position of learning and the arts in Europe before the Reformation.

The fate of the League of Nations was a clear indication that the times were not yet ripe for so great a break away from the nationalist tradition. It has required the shock of a second world war and the imminent peril of free institutions throughout the world to bring once more into the field of practicable discussion the possibility of finding a basis of corporate action between nations which will ensure conditions of enduring peace. We may learn this lesson not only from America, where the President of the United States is urging upon peoples of very different civilizations in North, Central and South America, the necessity of a measure of common action in the interests of their common devotion to the ideal of political liberty, but also from the aims of our adversaries. They too, Germany in Europe, Japan in the East, are formulating a political system which transcends national distinctions, but under the dominance of a ruling caste—a reversion, it is to be noted, to the system of barbarism which in European history followed on the period of migrations rather than a step forward along the line of what has been noted as evolutionary social development. German dominance, however, in the occupied territories and in the countries subordinate to the Axis contrasts, to its disadvantage, with even the darker period of the Middle Ages in the complete repression of things of the spirit and the eradication of all freedom of thought by the suppression of universities, schools and centres of learning which are not prepared to follow the paths marked out by political expediency.

Over against this spreading cloud which seeks to blot out every path leading to the development of the spirit of man, there stands Great Britain, her Allies and every free people which holds fast to the ideas of democracy, even though they may not yet go all the way with the United States in giving Great Britain every aid short of war. The aim of those who fight for the cause of democracy is not merely to ensure a lasting peace, but also that it shall be a peace in conditions which are a guarantee of the continuance of free institutions, and for the individual the fullest opportunity for the development of his character and capacities. This cannot be stated too emphatically or too frequently. In this connexion attention may be directed to a volume of speeches by Lord Halifax* in which implications of the democratic ideas as a political principle are set forth with wholly admirable lucidity and force. These speeches dealing with foreign affairs and the principles of British foreign policy were, many of them, though not all, delivered in the course of debate in the House of Lords, and the editor has provided a summary of events leading up to each speech. Hence this volume may serve as a useful reminder of the course of events in the most fateful years of the history of Great Britain. Not only do they carry great weight in their more general passages dealing with political practice and theory, but also they have special authority in the later years when Lord Halifax speaks as the Secretary of State for Foreign Affairs and the spokesman of the Government in the House of Lords.

* Speeches on Foreign Policy. By Viscount Halifax. Edited by H. H. E. Craster. Pp. x+368. (London, New York and Toronto: Oxford University Press, 1940.) 10*s*. 6*d*. net.

It is especially illuminating to recall the course of events and to note here how from faith in the League of Nations and collective security with a conciliatory attitude towards Germany, the Government passed through a phase of increasing distrust of the Nazi regime and misgiving as to the efficacy of the League, a period of regional pacts and so-called realism in international relationships and finally to complete disillusionment. Throughout, however, Lord Halifax stands fast by the ideal of democracy, from the time when in 1934, in addressing the educational section of Messrs. Rowntree's factory at York, he defined the object of government as "the fuller and freer development of human life" down to the latest speech here included, "The Challenge to Liberty," delivered at Oxford in February 1940, when he contrasted the spirit of German youth and British youth and defined British policy in the War as resting upon twin foundations of purpose—"determination to resist force" and "our recognition of the world's desire to get on with the constructive work of building peace"—the latter, as he had shown, a task which must be pursued in the Christian spirit of tolerance and justice.

While it is generally agreed that in a post-war settlement which aims at conditions of enduring peace it will be essential to bring about some form of co-operative or federal organization at the very least in Europe, it is obvious that to translate the democratic ideal into a working system presents many grave difficulties. Many practical problems have to be solved, some of which have already been discussed in the columns of Nature. Of these, in a democracy, education on rising standards possibly comes first, but hygiene, unemployment and inter-State relations in exchange of commodities and in finance run education close. If we may learn from our adversaries, the *ostensible* uniformity of the system of finance and commercial relations proposed in the Nazi 'New Order' merits examination. So far as these problems approach solution so far will the task of the central organization approach fulfilment, but in both spheres, that of the practical problem and that of the affairs of the whole organization and of its relations with those outside its body, successful working will come not by the elimination of national and cultural differences, as many fear, but by their recognition and by the preservation of those forms of cultural tradition which by their very differences lead, as the history of civilization shows, to cultural advance.

THE FUTURE OF COLONIAL POLICY

THE uncertainty of the reaction of the Vichy Government to German plans for obtaining control of French West Africa has already excited alarm, not only in Great Britain and in the United States, but also among the African peoples. It is not merely the strategic issues involved that arouse concern. With the shattering, at any rate for the time being, of Anglo-French co-operation in colonial administration and development, there has come a real threat to the new and liberal ideas of trusteeship embodied in the mandate system. These fears are unlikely to be allayed by the new co-operation between France and the Axis powers, whatever form that co-operation may take.

Nowhere indeed is the contrast between the Axis powers and Great Britain more marked than in the field of colonial policy. The rule of the Axis in Africa as elsewhere would mean the subjugation of the native populations to the needs and demands of Germany and Italy, the exploitation of their resources and people in the interests of the white races alone—the complete negation of the mandate principle and a reversion to the old, evil imperialism from which Africa has slowly emerged.

There have indeed been marked differences between French and British policy, but whatever these differences, the experiments and reforms either discussed or introduced down to the fall of France all reflect the view, common to both the French and British Colonial Empires, that the native is to be treated as an end in himself, a person to be associated in one form or another with the development and administration of his country. Whereas Anglo-French co-operation in this field has been interrupted, Britain's loyalty to the principle of trusteeship remains unshaken, and indeed is reaffirmed in the developments proceeding under the policy announced by the Colonial Secretary early in the year in the Statement of Policy on Colonial Development and Welfare.

This factor may not be without some influence on the situation in Africa and on the course of the war. The Vichy Government has already aroused too much alarm in the French Colonial Empire for it to risk further alienating native opinion and support. Indeed, the whole French tradition of colonial administration is one which should make the task of General de Gaulle and the Free French forces of winning the support of the native peoples at least throughout that Empire relatively easy. The importance of wise and far-reaching propaganda should not be under-estimated, above all if it is supported by administration of the territories under the rule of Free France and of Great Britain of a type calculated to hold and encourage the loyalty of the native peoples, whose desire for a British victory has indeed already received striking demonstration.

The tactical importance of the developments in colonial policy foreshadowed in the White Paper is far from being generally realized. The practical applications of the principle of trusteeship outlined there, if wisely implemented at the present time, may even have a decisive strategic effect on the war in Africa, if it enlists fully the loyalty and enthusiasm of the African peoples. Sir William H. McLean's admirable review of the proposals and their import in his Cantor Lectures on the "Social and Economic Development of the British Colonial Empire", recently published in the *Journal of the Royal Society of Arts* (87, 871–881; 891–914; 1940) is a timely contribution which should assist in the general understanding of what is involved.

Apart altogether from tactical or strategic questions, the colonial problem has several other aspects which give it special importance at the present time. It is in the first place one of the major issues which is bound to be raised at the peace settlement. In any attempt to deal with the real causes of the present War, the question of access to raw materials will require reconsideration, and this question can scarcely be separated from that of colonial policy, administration and development.

It is fair to say that the sub-committee of the League of Nations and the Royal Institute of International Affairs have already carried out the requisite inquiries as to the facts of distribution of raw materials, and a number of important suggestions or recommendations regarding access to such materials have already been ventilated. In this sense the matter might well be regarded as in an advanced state of preparation for consideration as part of a world settlement leading to a new order after the War. Whatever specific form that settlement may take, there can be no doubt that the implementing of such a policy as that outlined in the White Paper, and the firm establishment and enlightened administration of the Colonial territories during the War in the spirit of trusteeship, would go far to create an atmosphere of confidence and respect essential to a settlement reconciling the claims of all races involved.

The plan outlined by the late Sir Arnold Wilson in an appendix to "More Thoughts and Talks" (Longmans, Green and Co., 1939) for a system of pooled trusteeship, in which all the African colonies were gradually pooled in such a manner as to make them serve the common good both of the white races and of the natives, deserves close study and careful consideration. It offers advantages in gradual application, without transfer or decision of sovereignty for a generation, thus affording time essential to the education of public opinion for the idea of colonial trusteeship.

Schemes of this nature involve both careful investigation and equally thorough educational work. Both alike must be put in hand now if the colonial problem is to assist and not handicap the attempts and plans for post-War reconstruction. The value of the recommendation of the Hailey report for the establishment of an African Bureau has indeed been enhanced by all that has occurred since the findings of the African Survey were published in the autumn of 1938.

There is, however, a further and equally important respect in which the colonial questions are linked up with the problem of post-war reconstruction. The importance of the economic aspects of such construction have been repeatedly stressed, both in relation to a war strategy of organizing relief for Europe as soon as the Nazi tyranny is overthrown, and as part of a wider scheme of settlement and economic development which would aim at raising the general standard of nutrition and living in the whole continent, but especially in the more backward parts of eastern Europe. In both of these, colonial questions and resources may play a large part.

In the first place, there must be a review of outside sources, including the colonial territories, from which the deficiencies in the distressed countries can most easily be met. This will include the building up of surpluses not only in the Americas but also in tropical Africa. Besides those of cocoa, palm kernels, groundnuts and other human foodstuffs, animal foodstuffs and other raw materials must be included, some of which, such as cotton and jute, will also be required by post-war Europe. Moreover, as Dr. Julian Huxley has pointed out, not all surpluses can be stored as such ; some require processing, notably the vegetable oils. Such processing may involve the purchase of suitable machinery from countries the industry of which is not overtaxed by armaments production and, like the provisions of storage facilities, should form part of a comprehensive plan. This again may powerfully affect the economic situation in tropical Africa, where indeed it may already be necessary to buy up the surpluses if the local producers are not to starve. Such purchasing must also be done at a fair price if inroads are not to be made on the educational and social services of the territories in question.

To buy merely to destroy would be a poor answer, both to the propaganda insinuating that we are responsible for shortage in the countries overrun by the Nazis, and to their plans for the economic reorganization of Europe. The plans already envisaged by the British Government for the building up all over the world of food reserves destined for the relief of Europe may well make as important a contribution to the economic welfare of the colonial territories as to the defeat of Germany, the countering of German propaganda, and to laying the basis for a stable post-war world. The provision of proper processing and storage facilities could be made the basis of greater stability in primary production, by providing large-scale reserves functioning as buffer pools.

Such considerations alone emphasize the importance of the economic developments envisaged in the Statement of Policy issued last February. It is only on a secure economic foundation that schemes of social advance can be planned and carried out continuously. The lack of secure markets in the past has been the main cause of suffering to the people in some Colonies ; they were unable to sell their produce and had to lower their standard of living in spite of the efforts of the Colonial Government to safeguard that standard. The real problem of raw materials, as Mr. H. D. Henderson remarks in "Colonies and Raw Materials", is that of securing a square deal for the primary producer. The first emphasis in the enlarged policy of Colonial development is accordingly on the improvement of the economic position of the Colonies. The arrangements for increased assistance from the funds of Great Britain, while related to what the Colonies can do for themselves, are intended to facilitate full and balanced development, and to place Colonial

Governments in a position to maintain administrative, technical and social services at proper standards. They are intended to ensure the adequate financing of the research and survey work, the schemes of major capital enterprise, and the expansion of administrative and technical staffs which are essential for full and vigorous development, as well as the maintenance of an adequate standard of health and education services.

There is already much evidence that malnutrition is a factor in ill-health and inefficiency in many parts of the Colonial Empire. According to the report of the Committee of the Economic Advisory Council on "Nutrition in the Colonial Empire", malnutrition there is due first to a low standard of living; secondly, to the great ignorance and prejudice both as regards diet and the use of land; and thirdly, to the influence of diseases, particularly the widespread parasitic infections in the tropics, which react upon the state of nutrition of the individual. Improved nutrition depends largely upon economic development, and in the Colonial Empire this means primarily an improvement in agricultural development. Accordingly, in agricultural policy, the nutritional needs of the community are of first importance, and the report urges that the aim should be the establishment of a balanced agriculture for the production of commodities to be used either for direct consumption by the producer and his family, or for sale for consumption elsewhere in the territory, or for sale in overseas markets. Colonial Governments should encourage the people to grow at least a part of the foodstuffs they consume and endeavour to improve colonial dietaries by increasing the quantity of foodstuffs consumed and by increasing the variety.

It is not in eastern Europe alone that developments, designed to raise the standards of nutrition and living generally by relieving economy of some of its excessive dependence on primary products, may assist in raising standards of living and increasing social and economic stability elsewhere. Policies of social development undertaken to raise the standard of health and nutrition in the African Colonies, with their repercussion on the standard of living in those countries, should provide the same expanding market to the industrialized nations that the developments suggested by Mr. McDougall would provide in eastern Europe. The developments advocated by Lord Hailey in regard to research and adopted by the Government in the establishment of a Colonial Research Advisory Committee and in the allocation of a separate sum for Colonial research, have a direct bearing on the new order to be established in Europe, no less than in Africa.

It is indeed reassuring that such developments should be encouraged by Government action during the present struggle. Further co-operation in the study of agriculture and husbandry, of soil erosion, or of transport needs, the pooling of information about the methods used in checking the diseases to which the African is prone and for dealing with the widespread malnutrition that exists, may prove indirectly almost as valuable a contribution to the solution of some European post-war problems as directly to those of Africa itself. The prosecution of research into African problems on an adequate scale and the keeping up to date of the admirable African Survey may offer a most important contribution to reconstruction, possibly even to peace itself.

The developments at present contemplated are intended to facilitate the long-term planning which is a *sine qua non* of effective research in many such fields. Moreover, the emphasis thus placed on the economic development of the colonial peoples, the protection and raising of their standard of living, and their social development and training for self-government, should ensure that the position of the Colonies is viewed in all its issues at an international settlement. It affords unmistakable evidence that the principle of trusteeship is sincerely accepted and loyally fulfilled. It attests our capacity to shape within our own commonwealth at least our own form of co-operative society—in Mr. Herbert Morrison's words: "A free partnership of freely active groups, in which there is no room for mutual attempts at exploitation or for sharply differing levels of social and economic opportunity." Recognition of our responsibilities for the physical and moral welfare of these peoples and a determined effort to honour our trust are in such sharp contrast to all that has been revealed of the German attitude to such questions, of which the exclusion of the native peoples on principle from higher schools and universities enunciated by Dr. Gunther Hecht in "The Colonial Question and Racial Thought", is only one illustration that it can scarcely fail to enlist the loyalty and support of the native peoples of the African territories in a way which should effectively counter the consequences there of the collapse of France.

ELECTRIC AND MAGNETIC UNITS

M.K.S. Units and Dimensions and a Proposed M.K.O.S. System
By Prof. G. E. M. Jauncey and A. S. Langsdorf. Pp. viii+62. (New York: The Macmillan Company, 1940.) 4*s*. net.

A VERY large number of conferences has been held in recent years on questions connected with electric and magnetic units. Most scientific workers are content to use the units without discussing them, and have probably been relieved to find that in spite of many weighty pronouncements there has been no very noticeable change in current usage. There is, however, a vague idea abroad that important changes took effect in January 1940, and one of the objects of this book is to introduce to students the new position, the authors adopting the view that this is represented by the M.K.S. system.

The general situation, however, remains a little obscure. Some years ago the International Bureau of Weights and Measures announced its intention of abandoning the present International units, based on the silver voltameter and the standard column of mercury, and adopting units based on the absolute system. In practice, this would have meant that the familiar units, the ohm, ampere, volt, joule, watt, henry, and farad would have had their values adjusted to the extent of a few parts per 10,000. These changes, which were to have been made in January 1940, would have had legal backing, but, owing to the War, no action was taken and the International units still remain in force.

The decisions of the other conferences were on quite a different footing. The International Union of Pure and Applied Physics, and the International Electrotechnical Commission, made recommendations to physicists and electrical engineers respectively. The physicists were recommended to adopt the gauss, oersted, maxwell and gilbert as their magnetic units, and the C.G.S. system generally, while the engineers were recommended to use the weber as their magnetic unit, and the M.K.S. system generally. The physicists afterwards recognized the M.K.S. system as a tolerable modification of the C.G.S. system, and both physicists and engineers decided by majority votes that magnetic induction B, and magnetic force H, should be regarded as quantities of a different kind, and that therefore permeability (and permittivity or dielectric constant) should be regarded not as mere numbers but as quantities having dimensions.

The possible effects of these decisions on scientific workers is a matter of some importance. Will they in fact follow the recommendations of the conferences? A first glance at the literature of the last five years suggests that they will not; that they will continue to use the units to which they are accustomed. The September issue of the *Proceedings of the Physical Society*, for example, contains an account of a recent discussion in which the recommendations were attacked at least as frequently as they were supported. Mr. C. R. Cosens deplored "the redundant names of units", which "appear to be largely by-products of the labours of International Commissions", and Dr. Burniston Brown proves that μ and ε are pure numbers, as they certainly are if one accepts his definitions of B and H, which are at least workable. However, it does not follow that other concepts are unworkable. As Prof. Henri Abraham pointed out, as president of one of the conferences, "une question d'opinion métaphysique" is involved. Clearly such questions will not be decided by any fixed date. The final decision, if there is one, must depend on the experience of those who use and teach the concepts, and will probably rest largely with the university professors.

In this connexion this small volume by two American professors, one of physics and one of engineering, is of considerable interest. It is one of the very few signs which suggest that the M.K.S. system has made a little headway, and that physicists and engineers may ultimately agree to abandon the curious assortment of units which they now use in favour of a single system. For the most part, the book is a clear, straightforward exposition, suitable for students new to the subject, of the point of view implied by the decisions of the various conferences, although the authors express disapproval of the one decision which would have had legal backing, namely, the adjustment of the value of the ohm. They support the view, which has already been advocated in several quarters, that since even in an absolute system one electrical unit must be regarded as a primary unit on the same footing as the metre, kilogram and second, then for reasons of practical convenience in the preservation of the primary units, that unit should be the ohm, which should remain fixed in value, just as the kilogram and metre remain fixed, in spite of the failure to give them the values originally intended. The treatment of the M.K.S. system follows mainly the lines laid down in the pioneer work of Giorgi and G. A. Campbell, but whereas these writers would advise the student not to waste his time over superfluous systems like the two C.G.S. systems, the present authors outline all the systems. It may be doubted whether students will welcome the M.K.S. system merely as an addition to the others.

B and *H* are presented as quantities measured in different ways, and therefore of different dimensions. Some readers may doubt whether there is an inevitable connexion between the nature of a quantity and its dimensions, but the subject is skilfully expounded. The student is shown how the ideas work by a series of theoretical experiments, and even if the ideas may afterwards require overhauling, the book forms a good introduction to the subject.

L. HARTSHORN.

SEXUAL DISPLAY IN BIRDS

Courtship and Display among Birds
By C. R. Stonor. Pp. xv + 140 + 57 plates. (London: *Country Life* Ltd., 1940.) 8*s*. 6*d*. net.

AS is well known, the term 'sexual selection' was originally used by Darwin in two senses: first, with reference to the evolution of weapons like horns in ungulates and spurs in birds, such structures rendering their male possessors more efficient in combats for the mastery of the females with which they desired to mate; and secondly, in relation to decorative features possessed by the males and thereby making them more attractive to the female, which was supposed to exercise a preference towards mating with such males. The former process, as freely admitted by the earlier Darwinians, did not differ in principle from any other type of natural selection; but about the second there has always been much dispute.

Wallace, who based his conclusions largely on field observation, but partly on deductive reasoning, denied its existence in Nature, and other field naturalists have done the same. Mr. Pycraft in his book on the "Courtship of Animals" published in 1913, while saying that the theory of sexual selection was by no means exploded, was one of the first to give it a new interpretation. This he did in a way which now has the approval of many other zoologists, saying that the utility of the display and of the ornamentation which is correlated with it is to quicken desire in the individual to whom the display is directed, or, as he expresses it, that it has a sort of aphrodisiac action. According to this view, which was reinforced by the observations of Dr. Julian Huxley, sexual selection, wherever it occurs, must be a special case of natural selection, a conclusion which was arrived at on slightly different grounds by Sir John Graham Kerr. Of the many objections to the Darwinian theory of sexual selection the most cogent is one that oddly enough does not appear to have been urged until comparatively recently, namely, that sexual display is very usually performed by birds after they are already mated and cannot, therefore, have any connexion with any supposed preferential choice on the part of the female. There is, however, evidence that selection may take place with the ruff and the blackcock, as the late Edmund Selous has shown, as well as with some kinds of ducks.

In recent years there has been a convergence between the methods and results of field observation and those of physiological experimentation, and in no subject is this more marked than in the study of sexual behaviour. Researches into the comparative physiology of the generative processes as carried out in the laboratories have provided clues to the interpretation of animal behaviour as recorded by field naturalists, and there has been a stimulating reaction between the two kinds of study. This is well illustrated by such works as those of Mr. Eliot Howard and Dr. Fraser Darling, and the beneficial effects of such convergence are further shown in Mr. Charles Stonor's book on courtship and display. This is not saying that miscellaneous observations of natural occurrences in the field are not of value provided always that they are careful and accurate, and it is to be hoped that such studies, uncorrelated though they may be, may continue if only for the delight they afford to the watcher. Bateson some fifty years ago referred to such purely observational work as though it were a thing of the past: "In the old time," he said, "the facts of Nature were beautiful in themselves and needed not the rouge of speculation to quicken their charm, but that was long ago, before Modern Science was born." This is certainly not true of to-day, at least so far as bird watching is concerned. Nevertheless the æsthetic delight gained in this way is no whit depreciated by adding to it the intellectual pleasure of attempting to formulate a scientific hypothesis which co-ordinates and explains the facts.

In Mr. Stonor's very attractive book a definite physiological theory of sexual display and courtship is adopted and some of the evidence put forward and described. Such a theory had already been adumbrated by me in an article in NATURE of October 26, 1929, but the evidence in support of it as derived from comparative physiological studies as well as from the observation of animals is now much more considerable than it was then. It is thus picturesquely described by Mr. Stonor. After referring to the pituitary gland as a kind of general prompter or activator of the other ductless glands, and as "the leader of the endocrine orchestra", he proceeds as follows : "The important point for us is that this pituitary body is known to be affected in a direct way by messages sent to the brain via the eye. So that when a Paradise Bird performs his dances, or a Peacock shows the dazzling magnificence of his train, the unusual and arresting sight he presents to the female, like the incomplete clutch of eggs (of which birds also show a physiological awareness), makes a strong impression on her eye, is flashed back to the brain and to the pituitary gland, which sends out its message to the rest of the body via the substance it secretes, to tone itself up and get ready for the breeding season," the ovaries being stimulated.

In the second chapter Mr. Stonor describes and compares the displays of two quite unrelated groups of birds, namely, the birds of paradise and the gallinaceous or game birds, and the probable evolution of the different kinds of display. He shows that whereas in birds of paradise variations in form and in display have gone hand in hand, in gallinaceous birds variation in form has largely outstripped the development of display. He concludes by stressing one outstanding fact, that "no matter where the special adornments of a bird may be situated, no matter what form they take, they are always combined and synchronised with one another to produce the maximum possible effect."

The next two chapters are upon mutual and communal displays, and instances are described from among many different sorts of birds. It is shown that with mutual displays one sex is very usually more active than the other, but this is not always so, for with the great crested grebe and the wandering albatross the female is every bit as active as her mate. Moreover, there are certain birds, such as the button quail, the tinamous and the New Zealand paradise duck, where the female is the active partner in courtship, and in some of these species the incubation and care of the young are left to the male. It is pointed out that in the case of communal displays, apart from the 'advertisement value' of the gatherings, the presence of a large number of birds which perform in common helps to key up and stimulate each individual male and female which visits the group. This is in accordance with the observations of Dr. Fraser Darling, who found that collective display in communities favours and accelerates successful breeding as a consequence of mass effect in stimulation.

The next chapter is on display grounds which, as the author shows, provide a suitable and conspicuous setting for the display, and suggests that though these areas may have become mainly 'recreational', they were originally solely for the purpose of courtship. Communal display is shown by the ruffs and reeves, the black game, the herring and other gulls and many different kinds of birds in which the practice has been independently developed. There are also other kinds of display, such as the threat display, but, as pointed out, the same kind may be used at different times for more than one purpose by identical birds.

The final chapter deals with the author's general conclusions. Here he compares the different kinds of display, and points out among other important matters that not "*all* bright-coloured birds have a brilliant display as the reason for their colours"; for example, the greens of the parrots, the bizarre colours of the fruit pigeons and the brilliant hues of the kingfisher. Another point of interest is that among species with no need for concealment while breeding, the sexes are generally similar, and with this similarity goes joint action in display; and even "where the male and female differ, the plain female often seems to be anxious, as it were, to imitate the male, and only held back by circumstances from becoming like him". These are only a very few of the important and interesting matters which are referred to or discussed in this chapter or in other parts of the work.

The photographic plates illustrating the book are well chosen and for the most part excellent. The only mistakes I have noticed relate to the references to some of these plates in the final chapter (p. 124 *et seq.*).

Mr. Percy Lowe has contributed an appreciative foreword and tells us of Mr. Stonor's qualifications —his biological training, his practical experience in the Zoological Society's Gardens, his work in the British Museum (Natural History) and his field experience. There can be no doubt that this exceptional combination of circumstances has helped the author to produce an attractive book which presents the facts in simple and, for the most part, non-technical language, and yet is full of information for the sexual physiologist and the specialist in bird behaviour.

F. H. A. MARSHALL.

CHEESE-MAKING: SCIENTIFIC RESEARCH AND CONTROL

THE oldest and one of the best ways of concentrating and conserving in a palatable form a large part of the nutritive value of milk is to make cheese of it. Whilst butter contains little more than the fat of the milk, cheese contains the casein, a large proportion of the valuable mineral salts and an important part of the vitamins as well. Only a relatively small proportion of the original water of the milk—approximately 2·5–3 per cent—remains in the ripened cheese, which if it is one of the more popular types of cheese in Great Britain, may be taken as containing about a third each of animal protein, fat and water. Cheese is probably, weight for weight, the most valuable of the ordinary foodstuffs in our dietary, since neither dried whole milk nor dried skim milk are purchased, nor readily purchasable, by the ordinary consumer in Great Britain. Approximately 200,000 tons of cheese, of which about twenty-five per cent was made in Great Britain, were consumed annually in this country before the War.

But there is cheese—*and* cheese. Unimpeachable organoleptic evidence exists for the statement that even under modern conditions cheese-making is not by any means a fully controlled industrial process. It is an art, as well as an "essay in applied biochemistry and bacteriology", and an art that sometimes breaks down seriously. Of late years, however, scientific research and control have made cheese manufacture less erratic.

At a joint meeting, under Mr. E. B. Anderson's chairmanship, of the Food Group of the Society of Chemical Industry and the Society of Public Analysts held in London on December 4, some aspects of recent research on cheese quality and its control were described by Prof. H. D. Kay and three of his colleagues of the National Institute for Research in Dairying. These investigations are a small part of an extensive programme of research on cheese-making and cheese quality that was getting under way at the Institute and at various co-operating cheese-making and other centres at the outbreak of war, and in which a fairly large team of research workers including a physicist, a statistician and a psychologist were collaborating. The War has inevitably interfered seriously with this plan ; but a portion of the work, which has a direct bearing on cheese-making under war conditions, is still going on.

In an introduction by Prof. Kay this general plan was briefly outlined. Cheese is a complicated living system rather than a stable end-product, and a variety of techniques, chemical, biochemical, bacteriological, physical, physiological and psychological, are needed if the measurement and control of the many factors that go to make up cheese quality are to be satisfactorily effected. Methods for improved control of the quality of the original milk, of the cultures of lactic acid bacteria ('starters') added to promote acid production and flavour, of the enzymic characteristics of the rennet used, of the temperature and acidity of the milk and curd at various stages, of the timing of the succession of operations, of the physical properties of the curd and ripening cheese, are being considered. It is particularly necessary to define cheese quality so far as possible in precise terms, otherwise it cannot be consistently achieved.

Some recent findings on the nutritive value of various types of cheese were described in the introduction. Mr. J. Houston, who with Dr. S. K. Kon is investigating the proportion of the various vitamins of the original milk that remain in several staple varieties of cheese after different periods of ripening, has found that almost the whole of the vitamin A and carotene of the original milk remain in the cheese made from it, whether it is Cheddar, Cheshire or Stilton, and whether it is made in summer or winter.

It is not surprising that both these accessory factors, being fat-soluble, stay in the cheese, which contains practically the whole of the fat of the original milk ; but it is of considerable significance that during the four to five months of the ripening process the conditions in the cheese are such that there is no destruction of either vitamin A or carotene.

Of the vitamin B group, preliminary experiments show that vitamin B_1 is lost in the whey to the extent of about nine tenths of that present in the original milk. Of the lactoflavin (riboflavin) distinctly less—only about three quarters—appears to go into the whey. On the supposition that these two vitamins are present in simple aqueous solution, it would be expected that more than 95 per cent of each would be lost. There is now little doubt, however, that a considerable proportion of each of these vitamins—particularly riboflavin—is more or less firmly bound to the proteins of the milk which are clotted by rennet. About 10 per cent of the B_1 vitamin in the original milk, and about 25 per cent of the lactoflavin remain, therefore, in the cheese, and suffer no serious change in amount during at least four months of ripening. If anything, Stilton contains a slightly larger proportion of the vitamins than the other two varieties.

Prof. Kay also brought forward some analytical work of Dr. E. C. V. Mattick by which she has shown that there is considerable variation in the content of mineral salts as between the commoner cheeses—Cheddar, Cheshire and Lancashire on one hand, and Stilton on the other. In the making of Stilton the curd is allowed to remain in contact with the whey for a longer time than in the case of the other three cheeses. As a consequence the Stilton curd is bathed in an increasingly acid medium (owing to the bacterial fermentation of the lactose which is still proceeding rapidly in the whey). As this increasingly acid medium slowly drains away it leaches out much of the calcium and phosphorus originally present in the curd. Whilst ripe Cheddar cheese, for example, contains 57 per cent of the calcium of the original milk and 50 per cent of the phosphorus, Stilton cheese of the same age and made from a portion of the same original bulk of milk only contains 7 per cent of the calcium and 26 per cent of the phosphorus. It is nutritionally of importance in war-time that each of the three most widely consumed cheeses—Cheddar, Cheshire and Lancashire—contains an equally high proportion of calcium. Stilton, a luxury cheese, is consumed for the most part by those whose diet is unlikely to be lacking in this mineral.

Flavour in cheese is bound up, to a large extent, with the presence of fatty acids, particularly the lower fatty acids, liberated during lipolysis. Miss E. R. Hiscox dealt with developments which she and her collaborators have introduced in the methods of determining volatile fatty acids in cheese, and with the significance of some of the recent findings obtained with the new technique.

Simple steam distillation of an acidified cheese mush gives results which are far too low, since both the fat and the protein of cheese hold back appreciable amounts of some of the volatile acids. Miss Hiscox gave details of a new method of analysis which depends on water extraction of the cheese mush, followed by extraction of the separated cheese fat with very dilute alkali, ether extraction of the residues and steam distillation of the acidified extracts. A particularly interesting finding is that the blue cheeses, Roquefort and Danish Blue, are in a different class from the blue cheeses Stilton and Gorgonzola as regards their content of fatty acids, and the behaviour of the fatty acids on extraction. The former pair are highest, Stilton and Gorgonzola lowest, in their volatile fatty acid content, whilst typical Cheddar and Cheshire are intermediate. The correlation between these and other findings and flavour of the different cheeses was pointed out.

The chief chemical changes in ripening cheese are proteolysis, fermentation of the remaining lactose to lactic, acetic and propionic acids, and a certain degree of lipolysis. Dr. J. G. Davis described the part played by enzymes in these processes. He stressed the importance, from the point of view of cheese quality, of beginning with chemically normal (that is, mastitis-free) milk, and with rennet of good quality. Pasteurization (which destroyed most of the enzymes of the milk as well as a large majority of the micro-organisms) previous to cheese-making slows down ripening and prevents the attainment of the fullest flavour. It also prevents the development of certain taints and aids in the production of cheese of long keeping quality. Commercial rennet contains enzymes having at least four distinguishable activities: (*a*) clotting, (*b*) proteolysis of the pepsin type (*p*H optimum of 2), (*c*) proteolysis of the papaïn type (optimum *p*H about 4·6), (*d*) proteolysis of the peptidase type (optimum *p*H about 6). Nevertheless, pure rennin free from pepsin produces equally good, if not better, cheese than commercial rennet.

Two of the enzymes which normally occur in raw milk—lipase and proteinase—are concerned in cheese-ripening. The latter produces a mellowing of the body of the cheese, owing to protein breakdown, but does not seriously affect the quantity of desirable flavour substances. Lipase, on the other hand, has an important effect on cheese flavour. It has recently been found that if small amounts of lipase are added to milk, a strong and slightly rancid flavour is produced in the cheese. This flavour, called by graders a "kexey" flavour, has been known for a long time, but its origin was not previously understood. Dr. Davis stated that cheese flavour is for the most part bound up with the lipolytic enzymes, which may be inherent in the original milk or of bacterial origin. The mild flavour of cheese made from pasteurized milk, or from very clean milk, can be correlated with the absence of bacterial lipase.

Quality in cheese was also dealt with, but from an entirely different angle, by Dr. G. W. Scott Blair. He pointed out the desirability of establishing objective criteria, both for controlling the various stages in the making of cheese and in the assessment of its final quality, rather than relying entirely on subjective personal judgment, though the latter could never be entirely dispensed with. He described new methods and apparatus, devised by himself and his colleagues at Shinfield, by which certain of the rheological properties of cheese and other products can now be measured in C.G.S.

units. One of these is a simple practical apparatus for deciding when curd shall be pitched (allowed to settle), the correct timing of which is highly important from the point of view of cheese quality. This apparatus, already in use in a few cheese-manufacturing centres, gives a numerical measure of the quality of the cut curd just before pitching time, which enables this time to be decided with some precision. Dr. Scott Blair showed also another simple apparatus, recently made for measuring the 'body' of ripening (or ripe) cheese, previously assessed literally by rule of thumb (pressure) or by the use of a special skewer. He described a rather more complicated apparatus now in use by which it is possible to maintain constant pressure per unit area on a sample of material the cross-section of which is increasing, and mentioned some of the unexpected results which cheese and a variety of materials have recently given when tested by it.

APPLICATION OF X-RAYS TO THE STUDY OF ALLOYS*

BY DR. H. LIPSON,
CAVENDISH LABORATORY, CAMBRIDGE

THE use of X-rays has proved to be of fundamental importance in the investigation of alloy phase diagrams. The classical methods—cooling curves and the microscopic examination of etched surfaces—are, of course, of immense value where the problem is simply that of the precise determination of phase boundaries, and it is probable that the use of X-rays for this purpose is not of great importance. Where, however, more complex problems of equilibrium arise, the knowledge of crystal structures involved is essential.

As an example of this may be quoted the system aluminium-copper. Several investigators[1] had recorded their views on that part of the system which lies between 15 and 30 per cent aluminium ; but it was first found by X-rays[2] that the problem was not one of ordinary phase equilibrium. The phases have all essentially the same crystal structure, and vary only in the way in which the two sorts of atoms are arranged on the positions available. This results in changes of symmetry[3] which are not ordinary phase changes and which do not produce regions of two-phase equilibrium. Thus the problem is not one of which the microscope could be expected to produce a solution.

For the investigation of this type of structural change it is necessary to use apparatus of high resolving power. As in certain types of optical interferometer, this is achieved by using the high orders of interference, particularly those which are scattered back almost into the incident X-ray beam. Since, however, the deviation of a particular order is fixed by the dimensions of the unit cell and the wave-length of the radiation, the only control one has over the resolution lies in the dimensions of the apparatus. Increasing distances decrease the intensity of the diffracted beams, and so the advantage of increased resolution has to be balanced against the disadvantage of increased exposure time. Progress has therefore been dependent on the improvement of X-ray tubes and X-ray film, and at the present day cameras can be used which would have been considered of fantastic size only ten years ago. At Prof. W. L. Bragg's laboratory in Manchester in 1924 a camera of diameter 2·5 cm. was used, followed by one of 5 cm. In 1926 a 'large' camera of 9 cm. diameter was introduced and was used to find the structure of γ-brass[4]. This camera was a standard instrument for many years, and in 1934 a still larger one of 19 cm. diameter was made and was used for special problems[5]. At Cambridge this has now become the standard instrument, and a camera of 35 cm. has also been used with some success[6]. With this camera it is probable that the limits of resolution for the high orders have been reached, but still larger ones may be necessary for separating the multitude of lines at low angles given by complex structures.

PHASE DIAGRAMS

Although the most important function of X-rays must always be the determination of crystal structures, a great deal of valuable information has been obtained about the equilibrium, and approach to equilibrium, of many alloy systems. This information merely adds to the vast amount already obtained by the standard methods of metallurgy ; but it is data which would be obtainable in no other way. The reason for this is two-fold. First, each phase gives its own characteristic X-ray

* Many references are made to the paper by Bradley, Bragg and Sykes (*J. Iron and Steel Inst.*, **141**, 63 ; 1940) as well as to original papers. This is referred to in the footnote references as '*B.B.S.*' followed by the page number of the particular item. The diagrams are also from this paper.

NEW AMERICAN BOOKS

Human Nature and the Social Order

E. L. THORNDIKE

This book presents certain facts and principles of psychology which students of sociology, economics, government, law, and other sciences of human affairs need to know. It will be found useful not only to college students of the social sciences, but also to thinking men and women. *18s. net.*

Feeding the Family

MARY SWARTZ ROSE, Ph.D.

Professor of Nutrition, Teachers' College, Columbia University

This famous book on the diet and health of the family is now presented in a new and revised edition. The results of the latest research have been included, such as data on minerals and vitamins, and the recognition of allergy as a dietary problem. It is a complete and accurate guide to the proper feeding of both individuals and family groups. *Fourth edition.* 15*s. net.*

Textile Testing: Physical, Chemical and Microscopical

JOHN H. SKINKLE

Assistant Professor of Textile Chemistry, Lowell Technical Institute

The book is divided into three parts dealing with physical, chemical and microscopical testing respectively. Each chapter deals with a particular test, and where several tests are available, that considered best is given in detail and the others mentioned more briefly. Where approximate results are attainable with little or no special apparatus, these are described. A bibliography of references follows each test. 15*s. net.*

Engineering Surveys

HARRY RUBEY, B.S., C.E.

Professor and Chairman of the Department of Civil Engineering, University of Missouri

GEORGE E. LOMMEL, B.S., C.E.

Professor of Topographic Engineering, Purdue University; and

M. W. TODD, M.S.C.E.

Associate Professor of Topographic Engineering, Purdue University

This text is designed for a one-semester beginning course in surveying. It covers all the standard and accepted surveying techniques of a fundamental nature in a somewhat briefer compass than is customary. In the new edition the authors have given special attention to presenting a practical, up-to-date and teachable text adapted to modern trends in surveying instruction. *Revised edition. Illustrated.* 15*s. net.*

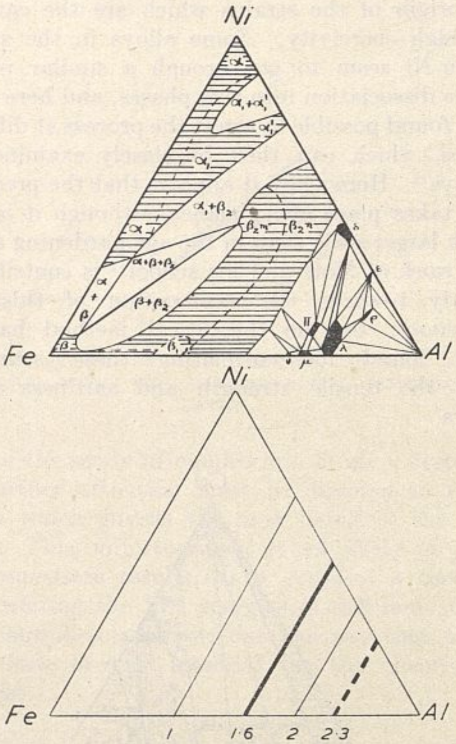
MACMILLAN & Co. Ltd., LONDON, W.C.2

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

pattern, and secondly, incomplete approach to equilibrium is usually indicated by broadening of the X-ray lines. In most binary systems the first point is not of great importance, since any method which will distinguish between an alloy which is duplex and one which is not—the only two possible equilibrium states—will give all the information needed. This, however, is not true for ternary systems ; for these a technique is needed which will distinguish the various phases. This is a difficult matter for the microscope, but falls naturally within the scope of X-rays. This explains the comparative ease with which ternary equilibrium can be studied by X-rays. The discovery of new intermetallic compounds has arisen as easily and as naturally as the discovery of new stars followed the invention of the astronomical telescope.

Of more practical importance, however, is the study of the equilibrium of the simpler structures. The number of reflections is small, and any variations in their sharpness are easily noticed. An interesting example of this occurs in the iron-nickel system. It had been known for some time that it was difficult to produce equilibrium in certain iron-rich alloys, many of the physical properties showing hysteresis in their variation with temperature. With normal heat treatments X-ray photographs showed lines that were very blurred, but it was found that by heat treatment at low temperatures for lengthy periods much sharper lines were obtained. This gave a valuable indication of the direction of the approach to equilibrium, and two diagrams[7,8] based solely on X-ray data have recently been published. The second has perhaps departed too far from probability, but the first, although it has received some support from magnetic measurements[9], is still too simple to explain all the experimental results.

Another most interesting phenomenon occurs within this same system. Although in their equilibrium state certain alloys contain both body-centred and face-centred cubic phases, they can be maintained as single-phase alloys with a face-centred structure by quenching from high temperatures. If such a single-phase alloy be now put into liquid air, its structure changes over completely to body-centred cubic. This does not happen if the alloy is in the duplex state. At first sight it seems rather paradoxical that alloys which are so reluctant to change their structures at temperatures as high as 400° C. should be able to change so completely at $-200°$ C. The explanation lies in the difference between transformations which require migration of atoms and those which do not. The change from a single-phase state to a duplex one requires that atoms of one sort shall move from a uniform distribution in the alloy to one of greater concentration in certain crystal grains. This may involve the atoms in total movements of many atomic diameters, and this process of diffusion is helped by thermal agitation. Below a certain temperature, diffusion may be so slow that it is negligible, and a structure which is not that of lowest free energy may be 'frozen in'. The change from one single-phase structure to another, provided it does not involve complicated motions of the atoms, can take place without the help of thermal agitation, since it does not demand migration of the atoms. In this case the change can take place as soon as the temperature is such that the free energy of the second structure is lower than



A comparison of the ternary diagram for FeNiAl with the corresponding electronic ratios.

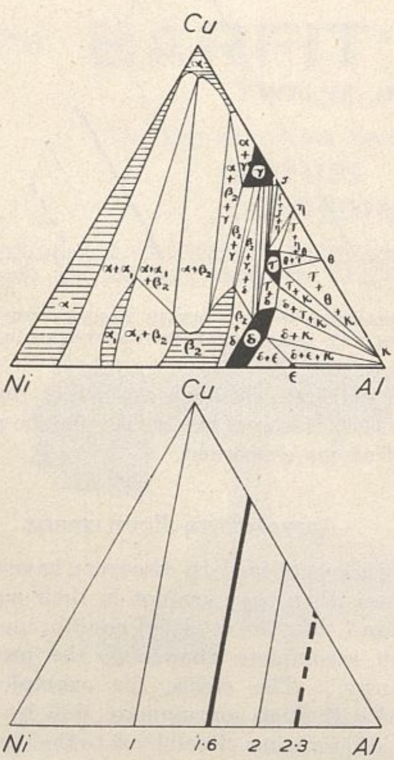
that of the first, although neither of these states may be that of lowest free energy for the particular ratio of atoms concerned.

Approach to Equilibrium

Many alloys of modern discovery have their best properties when they are not in their equilibrium states, and thus the study of equilibrium can give only an incomplete answer to the problems of metallurgy. The steels, for example, though handled with such consummate skill by the technician, still remain a closed book to the theoretician. A valuable start has, however, been made on the explanation of the properties of certain other alloys.

Perhaps the most fascinating of these studies is that of the age-hardening of aluminium alloys. The work of Guinier[10] and of Preston[11], who have used the oscillating crystal method, has shown that the atoms of the alloying element, copper, tend to precipitate out along planes in the original aluminium lattice. This effect was manifested on the photographs only by certain faint streaks which may have remained unnoticed by less meticulous workers.

Another subject which has been tackled with some success by X-rays is the Mishima permanent magnet alloy, which is essentially Fe_2NiAl. Bradley[12] has produced a very plausible theory of the origin of the strains which are the cause of the high coercivity. Some alloys in the system Fe-Cu-Ni seem to go through a similar process in the dissociation into two phases, and here it has been found possible to arrest the process at different stages, which can then be closely examined by X-rays[13]. Here again it appears that the precipitation takes place along planes, although it is on a much larger scale than in the age-hardening alloys. The work of Mott and his school[14] is contributing greatly towards the explanation of this phenomenon; but no theoretical method has yet been found for correlating these structures with the tensile strength and hardness of the alloys.



A COMPARISON OF THE TERNARY DIAGRAM FOR CuNiAl WITH THE CORRESPONDING ELECTRONIC RATIOS.

FACTORS AFFECTING THE OCCURRENCE OF STRUCTURES

Of parallel importance to the deduction of the physical properties of alloys from their crystal structures is the deduction of the crystal structure from the composition. In this, more positive results have been obtained, based on the now famous Hume-Rothery rule[15]. This points out that there is a general connexion between crystal structure and concentration of valency electrons. By valency electrons is meant those electrons in the outer shell of an atom which are not firmly bound to the nucleus; it is these electrons which give to the atom its peculiar metallic properties. Copper atoms, for example, have one such electron, zinc atoms have two, and aluminium atoms have three. The transition elements, such as iron, which have incomplete inner shells, may take extra electrons into those shells and thus cancel out the effect of their own valency electrons. Thus over large ranges of composition these elements behave as though they were nulvalent.

The valency electrons may be considered as trains of waves moving in the three-dimensional field of the nuclei. The interactions of the two may be summed up in a very neat geometrical way, using the concept of 'reciprocal space'[16]. Planes are drawn which bisect at right angles the lines joining the origin to each point of the reciprocal lattice. Those planes which are connected with strong X-ray reflections should also be connected with strong reflection of those electron beams which make the right angle with them and have the right energy. It has been shown, however, that waves of these energies are forbidden[17]. With these forbidden energies is associated a band of energies which is large when the X-ray reflection is large, and tends to zero as the reflection tends to zero. Electron states may also be plotted in reciprocal space (it is in this case usually called *k*-space), and the effect may be interpreted as a reduction of energy for those states which lie just within the planes, and an increase for those which lie just outside.

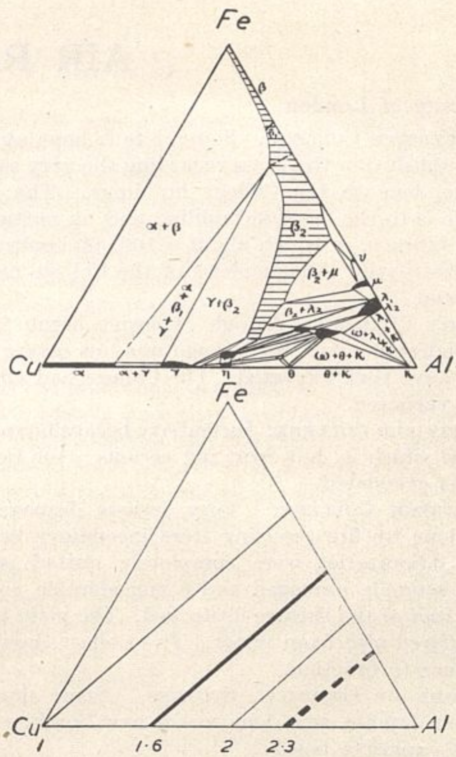
The planes outline zones called 'Brillouin zones', and the volumes of these give the numbers of electrons per atom which they can contain. These numbers are of importance only when the highest occupied electronic states are in the neighbourhood of the surface of a Brillouin zone. This is not the case for a monovalent metal such as copper, and the structure is fixed by other considerations. The first Brillouin zone for the face-centred cubic structure of copper is very uneconomic for holding more electrons, however, as some of its faces are much closer to the origin than are others. Thus, if electrons are added, for example, by adding zinc, the electronic states must either overlap into the second zone or spread out along the surface of the first zone. Both these processes involve rapid increases of energy, in the first case, because of the energy discontinuity, and in the second, because the states occupied quickly become farther from the origin. Thus, another structure may be favoured. The body-centred cubic structure has a Brillouin zone of which the faces are farther from the origin than are those of the face-centred cubic structure. More electrons can therefore be added before the rapid increase of energy occurs, and so the occurrence of this structure in the copper-zinc system is accounted for. When the electronic states reach the boundary of this zone another adjustment may be made. The atoms are rearranged in such a way[4] that they give a Brillouin zone which is almost spherical. Thus the last electrons added are in states of depressed energy, since they must all be near the boundary.

After this stage has been reached in the copper-zinc system, the electrons give up the attempt to confine themselves in the first Brillouin zone, and quite different structures follow. In the copper-aluminium system, however, the electrons make a last desperate attempt to confine themselves within the zone. The number of atoms per unit cell is reduced as electrons are added, and the number of electron states occupied in each Brillouin zone remains practically constant[18]. The same device is resorted to in the body-centred phase field of the aluminium-nickel system, and this results finally in a rhombohedral deformation of the structure[19]. Direct experimental support for these ideas is given by the fact that in the aluminium-copper-nickel system the effects are extended along lines of constant electron concentration[20].

The theory can give a rough estimation of the phase boundaries in systems which contain the structures mentioned above, and quite good agreement with experimental results is found. Moreover, the frequent occurrence is accounted for of complicated structures based on the body-centred cubic structure, whereas those based on the face-centred structure are very rare.

The importance of electron concentrations in ternary alloys is illustrated in the accompanying illustrations, which show a comparison of the important features of three ternary systems with their lines of constant electron concentration[21]. The lines of 1·6 and 2·3 electrons per atom are shown, and it will be seen that these lines coincide roughly with the limits of the body-centred cubic phase fields, and of the complicated structures, respectively.

From all these facts it seems fairly certain that the Brillouin zone theory must form the main basis of the study of equilibrium in alloy systems, and further attention must be directed to those factors which govern the finer detail of the diagrams. This, unfortunately, is not likely to yield any immediate results, as it requires a method of calculating the free energies of different structures, but in any event, one can say that there is no lack of raw material for the theoretical physicist.



A COMPARISON OF THE TERNARY DIAGRAM FOR FeCuNi, WITH THE CORRESPONDING ELECTRONIC RATIOS.

[1] '*B.B.S.*', 90.
[2] Westgren, *Trans. Amer. Inst. Min. Met. Eng.*, Inst. Met. Div., **13** (1931).
[3] Bradley, Goldschmidt and Lipson, *J. Inst. Met.*, **63**, 149 (1938).
[4] Bradley and Thewlis, *Proc. Roy. Soc.*, A, **112**, 678 (1926).
[5] Bradley and Lu, *Z. Krist.*, A, **96**, 20 (1937); '*B.B.S.*', 71.
[6] Lipson and Petch, *J. Iron and Steel Inst.*, 1940 (in the Press).
[7] Owen and Sully, *Phil. Mag.*, **27**, 614 (1939).
[8] Bradley and Goldschmidt, *J. Iron and Steel Inst.*, **140**, 11 (1939); '*B.B.S.*', 90.
[9] Pickles and Sucksmith, *Proc. Roy. Soc.*, A, **175**, 331 (1940).
[10] Guinier, *C.R.*, **206**, 1641 (1938). Calvet and Guinier, *C.R.*, **206**, 1972 (1938).
[11] Preston, *Proc. Roy. Soc.*, A, **167**, 526 (1938); *Phil. Mag.*, **26**, 855 (1938).
[12] Bradley and Taylor, NATURE, **140**, 1012 (1937).
[13] Bradley, *Proc. Phys. Soc.*, **52**, 80 (1940); '*B.B.S.*', 112.
[14] Mott, Physical Society Reports on Progress in Physics, **6**, 207 (1940).
[15] Hume-Rothery, "The Metallic State", 328 (Oxford, 1931).
[16] Bernal, *Proc. Roy. Soc.*, A, **113**, 117 (1926).
[17] Mott and Jones, "The Theory of the Properties of Metals and Alloys", 58 (Oxford, 1936).
[18] Konobeevsky, *J. Inst. Met.*, **63**, 161 (1938).
[19] Bradley and Taylor, *Phil. Mag.*, **23**, 1049 (1937).
[20] Lipson and Taylor, *Proc. Roy. Soc.*, A, **173**, 232 (1939).
[21] '*B.B.S.*', 100.

AIR RAID DAMAGE

University of London

UNIVERSITY COLLEGE. Some details have already been published in the Press regarding the very serious damage done to the College buildings. The main damage is to the original building and, in particular, to the Library, in which about a 100,000 books have been destroyed. All Faculties of the College remain evacuated.

KING'S COLLEGE. A high explosive bomb fell in the quadrangle, but the damage was less severe than might have been expected. The College had already been evacuated.

WESTFIELD COLLEGE. Incendiary bombs have done damage which is, however, not serious; the College remains evacuated.

BIRKBECK COLLEGE. Very serious damage has been done by fire resulting from incendiary bombs. Three laboratories were completely gutted and a fourth severely damaged and a considerable portion of the roof of the theatre destroyed. The main building suffered also from water. The College, however, continues to function.

SCHOOL OF ORIENTAL STUDIES. Some damage, not considerable, was done to the new building from a high explosive bomb.

GOLDSMITHS' COLLEGE. The buildings have been damaged twice and partly wrecked.

MEDICAL SCHOOLS: *St. Bartholomew's*: severe damage has been done to that part of the College which adjoins the hospital. Later, the roof of the College Hall in Charterhouse Square was destroyed by incendiary bombs, and considerable damage was caused by water. *St. Thomas's*: very severe damage has been done, but work is continuing. *Guy's*: headquarters and also school properties at Tunbridge Wells have been damaged. *London*: damage has been done to the Dissecting Room, the Bacteriological Department and Students' Hostel. *London School of Medicine for Women*: damage has been done by incendiary bombs, particularly to the Anatomy Department; other departments damaged by water. Students' Hostel severely damaged by blast.

Royal College of Surgeons

BLAST has broken all the windows and window frames on the north front of the Royal College of Surgeons, torn off doors inside the building and shattered many of the roof lights in the Museums. No structural damage was done except to two partition walls on the fourth floor, which houses the work rooms for the Museum. In the Library Reading Room, little damage was caused. Books and periodicals were found in the College forecourt and on the roadway outside. Broken glass and soot covered the periodical tables and lay thickly all over the floor. Careful cleaning of the books and periodicals was started by the staff and, within a day, the reading room, although windowless, was in use again. Ceiling and shelves damaged by the blast were repaired rapidly and the window openings boarded up. The Museum damage was relatively slight. In Room I, some of the shelving on which is housed the craniological collection collapsed and about twenty skulls were damaged, but most of them not irreparably. Anatomical specimens, also in the wall cases, escaped major damage. Specimen jars were cracked or broken, but no specimens were lost. Room V and the War Museum have also been damaged. Roof lights in Room V were broken and most of the windows of the War Museum were smashed. About one hundred specimen jars were either broken or cracked, but all the specimens were retrieved and identified.

Precautions which had been taken to protect the Museum specimens worked admirably. Historic specimens and a complete series of pathological material suitable for medical students were stowed in a safe place almost two years ago, the idea being, that if the remainder of the Museum were destroyed, its connexion with John Hunter and his work would be preserved, and its usefulness to coming generations of students would remain unimpaired. Arrangements are now being made to remove at least the whole of the Periodical Collection in the Library to a safe place, so that, in the event of further air activity, at least one large series of medical periodicals would remain intact. The laboratories of the College suffered little damage beyond broken windows and wood frames, but as a precautionary measure the laboratories are being moved out of London.

Museum of Practical Geology

THE office block has been hit by a high explosive bomb. Two office rooms were damaged and about a quarter of the windows of the building were broken, together with others in surrounding buildings. Little damage was done to material in the Museum.

Royal Observatory, Greenwich

THE Observatory has been damaged by high explosive and incendiary bombs. The revolving globe and observatory clock and parts of the telescope room were damaged, but the time ball continues to function.

University of St. Andrews

MOST of the windows of one side of the University Library have been broken and damage has been done to books, especially those in the Science Reading Room. One wall of the new building housing the Departments of Botany and Geology has been seriously damaged, and the Bute Medical Buildings were also affected, much damage being done by the breakage of skylights and windows.

University of Manchester

THE University and the College of Technology have suffered certain damage.

NEWS AND VIEWS

Pitfalls of the Tannic Acid Treatment of Burns

In the past several months opportunities for testing the tannic acid treatment of burns have been only too abundant, and the method, which was highly commended at the start of the War, has not emerged from the tests so successfully as had been expected. The Minister of Health recently stated in the House of Commons that tannic acid is not satisfactory for certain types of burns and more definite statements had previously been made by authoritative speakers in the course of a discussion at a meeting of the Royal Society of Medicine. Thus, Rear-Admiral C. P. G. Wakeley said that no tannic acid preparation must be used on burns of the hands or face, and he gave ample reasons for this opinion. Mr. A. H. McIndoe said the local treatment of war cases has shown that coagulation treatment, especially by tannic acid, has been carried too far. So overwhelming is the evidence that this method is fraught with great danger when applied to burns of the hands and face, that first-aid posts have been officially instructed not to use tannic acid in the treatment of them.

It might be a wise course to advise the public generally of these dangers since hundreds of thousands of tannic acid preparations were bought by them in the early stages of the War, before experience had shown the defects of the treatment. The use of tannic acid in the treatment of burns is a comparatively recent innovation; it was first described in 1925. The rationale of the treatment is based on two factors as explained by Dr. Ethel Browning in "Modern Drugs in General Practice" as follows: (*a*) its precipitation of tissue proteins, with formation of a coagulum which prevents absorption of toxins, and (*b*) the analgesic and protective covering afforded by this coagulum.

Galapagos: a Zoological Landmark

In September 1835 Charles Darwin landed on the Galapagos Islands, and twenty-four years later the "Origin of Species" was published. The two events are linked together, almost as cause and effect, in the history of the theory of evolution, for, according to Darwin himself, the conception of the "Origin of Species", and all that it meant in revolutionizing the outlook of men, lay away back in that month's visit to the Archipelago. It was a touch of inspiration that suggested to William Hunter and David Lack that the sort of evidence which appealed to Darwin might be embodied in a cinematograph film of the Islands and their characteristic vegetation and animals. Their film, "Galapagos", produced by the Dartington Hall School Film Unit, is a novel and notable instrument for bringing realism to many biological truths the evidence of which students often find it difficult to appreciate. The zoning of plants and animals is illustrated by the waterless and porous lava formations of the low grounds with xeprohytic vegetation and scanty fauna, and by the rain-forest of the misty uplands; the effect of isolation, by endemic animals showing various degrees of distinctiveness from their mainland ancestors. An outstanding example of adaptive radiation is illustrated by the ground-finches, six different types of which range from the normal seed-eater to the remarkable Cactospiza, which is seen digging insect larvæ from their lairs by means of a twig—a tool-using bird.

Darwin paid much attention to the unique reptiles of the islands and they are here well shown, the land and sea-lizards and the giant tortoises, although we should have appreciated a comparative picture of some of the different island forms of the tortoises which so much impressed the naturalist of the *Beagle* and Mr. Lawson, who first pointed them out to him. The zoologist will see many other good teaching points in this valuable film, the photography of which, made during the Lack-Venables Galapagos Expedition of 1938–39, is of the highest standard. Indeed "Galapagos" should be part of the teaching outfit of every department in university and secondary school which is endeavouring to impart the essential truths of zoology. It is a two-reel, 16-mm. film, occupies half an hour, is accompanied, although it is fully captioned, by teaching notes, and may be hired at a moderate rate from the Dartington Hall Film Unit, Totnes, South Devon.

Recent Earthquakes

A strong earth tremor with epicentre probably near Pwllheli in North Wales was felt at about 10.20 p.m., B.S.T. on December 12. The shock caused some apprehension in the town, where it rattled windows and shook floors, though no damage or casualties have been reported. The tremor was felt in Pwllheli, Conway, Carnarvon, Bangor, and also in Anglesey, and is said to have lasted about forty-three seconds. Two slight aftershocks have been reported, the first about three minutes after midnight on December 13, and the second about forty minutes later. The strong earthquake in the same area on June 19, 1903, which was preceded by a slight foreshock, was stated by the late Dr. C. Davison to have been a simple shock with the innermost isoseismal area about 33·5 miles by 15 miles, and connected with movement along the Aber-Dinlle fault. It was followed by thirty-three aftershocks, and another tremor associated with this fault occurred in 1906. Other minor disturbances have occurred in Carnarvonshire since, of which two may be mentioned. The disturbance of April 14, 1931, in south Carnarvonshire, which was attributed at the time to earth tremors, was afterwards shown to be due to a meteor which fell in the district. On January 13, 1932, there was a small tremor in south Carnarvonshire, but it was not recorded by seismographs.

Two earthquake shocks occurred at Glaruo in Switzerland at 9 a.m. and 2.30 p.m. local time on December 12. The only information available at present is that the latter shattered some houses.

Catalogue of Meteorites of the U.S.S.R.

THE scientific secretary of the Meteorite Committee of the Academy of Sciences of the U.S.S.R., Mr. L. A. Kulik, has prepared for publication a catalogue of meteorites of the U.S.S.R., which is to appear in an early issue of the Soviet publication *Meteoritika*. Up to November 1, 1939, ninety-five meteorites were counted as having been found on territory of the U.S.S.R. With the inclusion of the newly acquired territory of Western Ukraine and Western Belorussia and the Baltic republics, this number has now been increased to 112.

The Academy of Sciences of the U.S.S.R. has one of the largest collections of meteorites in the world, numbering ninety-three specimens found in the Soviet Union and fifty-five specimens which have fallen in other countries. The aggregrate weight of the Academy's collection is 4,189 lb. The collection includes some unique specimens, of which the most valuable is the 'Pallas Iron'. This is the largest meteorite in the U.S.S.R., weighing more than half a ton. It was found on the banks of the River Yenisei in 1749, and in 1771 was brought to St. Petersburg by Pallas.

Although at that time science denied the possibility of stones falling to earth from cosmic space, Pallas was convinced that the iron mass he had brought to St. Petersburg was a meteorite. The 'Pallas Iron' laid the foundation for the meteorite collection of the Russian Academy of Sciences. The second remarkable meteorite in the Academy's collection is the 'Boguslavka'. This is the largest iron meteorite in the world observed falling by eye-witnesses. The 'Boguslavka' meteorite fell on October 18, 1916, in the Far Eastern districts of Russia. It is in two parts, weighing 439 lb. and 121 lb. respectively. Another remarkable iron meteorite in the collection is one which is streamlined and shaped like the nose of a shell. The 'Pallas Iron' and 'Boguslavka' meteorites with a number of others are on view at the Karpinsky Geological Museum of the Academy of Sciences of the U.S.S.R.

Mortality in 1940

THE July issue of the *Statistical Bulletin* contains a study of the mortality of the first six months of 1940 of the many millions of men, women and children insured in the Industrial Department of the Metropolitan Life Insurance Company, New York. It shows that the record of the individual causes of death contains both favourable and unfavourable items. For each of the diseases typhoid fever, measles, scarlet fever, whooping cough, diphtheria, pneumonia, tuberculosis, diarrhœal diseases, appendicitis and puerperal conditions, the indications are that mortalities for 1940 will be lower than ever before. The same is true of homicides and all kinds of accidents combined. The greatest single achievement is reduction in a single year of 22 per cent in the mortality from pneumonia. Unfavourable aspects, on the other hand, are the continued rise in the mortality-rates from cancer, diabetes and diseases of the coronary arteries.

Origin of Cosmic Rays

AN interesting note appears in *Electrotechnics* of September, telling of the visit of Prof. R. A. Millikan and his colleagues Dr. H. V. Neher and Dr. Pickering, of the California Institute of Technology, to the Indian Institute of Science at Bangalore last January. Bangalore was one of three places in India chosen by Prof. Millikan for carrying out measurements on cosmic rays. These experiments form a part of a series conducted by him which it is hoped will yield valuable data regarding the source of cosmic rays and their precise function in the working of the universe. Results so far obtained seem to confirm his hypothesis about the behaviour of the rays and his suggestion that they create atoms of helium, oxygen, silicon and iron, and are in fact replenishing the earth's diminishing supplies of these elements almost as fast as they are used up. At the invitation of the council of the Indian Institute of Science, Prof. Millikan arranged a series of four lectures for the benefit of workers in the Institute. Of these four lectures, the first and the last were delivered by Prof. Millikan himself. In the first one he traced the history of our knowledge of cosmic rays up to the present day. The second and third lectures were given by Drs. Neher and Pickering respectively, and they dealt with the technique of measurement of cosmic rays. In the concluding lecture, Prof. Millikan gave a critical survey of the various existing theories regarding the origin and nature of cosmic rays.

Canadian Seismological Stations

ALL seismological stations in Canada now come within the jurisdiction of one department, with the Dominion Observatory at Ottawa as the Central Station (*Earthquake Notes*, **12**, Nos. 1 and 2, Sept. 1940). There are seven stations besides Ottawa, and several improvements have recently been made. The Victoria station is now in the Dominion Astrophysical Observatory, where a vertical Wiechert seismograph and improved Milne-Shaw instruments are in operation. At Saskatoon two horizontal Mainka seismographs are in operation, whilst at Toronto the two Milne-Shaw seismographs have been improved by mirror replacements. The Kirkland Lake station commenced operation in December 1939 with a standard geophone and special recorder made by the Heiland Research Corporation. The Shawinigan Falls station employs a Wood-Anderson seismograph, whilst the Seven Falls station has Wood-Anderson and Milne-Shaw seismographs. The Halifax station has been entirely re-equipped. The Mainka instruments have been discarded and the station has now photographic recording Bosch seismographs formerly at Ottawa. Ottawa discarded the Wiechert vertical seismograph and installed

Benioff short- and long-period vertical seismometers in addition to the two Milne-Shaw instruments. The Canadian Broadcasting Corporation now transmits the Dominion Observatory noon time signals over the entire Canadian network, so that accurate timing is possible at all the seismograph stations. Seismograms from all the Canadian stations are now sent to Ottawa for analysis and interpretation, and the results published in the *Monthly Bulletin* issued by the Dominion Observatory.

Scientific Equipment and the Laboratory

IN the *Nivoc Supplement* (edited and published by Messrs. W. and J. George, Ltd.—F. E. Becker and Co., London and Birmingham, No. 17, July 1940) the importance of up-to-date scientific equipment in, and correct planning of, a laboratory is stressed. Facilities for research and scientific control and testing have become an essential part of manufacturing organizations. Particularly is this so in the case of companies supplying materials to the aircraft industry, since the progress of aeronautical development is largely dependent upon the development of improved materials, both for air-frames and engines, and a very high standard of material testing and inspection has been set up. It is therefore necessary for the supplier of materials to maintain adequate research and testing establishments staffed with competent personnel. Messrs. George have recently equipped new laboratories for High Duty Alloys, Ltd. New buildings, designed by Colonel A. L. Abbott, house eleven different laboratories and departments in addition to a library and lecture theatre, and are considered to be an outstanding example of modern laboratory planning and furnishing. Teak bench tops are strongly advocated for general use. A brief note is given on the Burma teak forest and methods of exploitation, the information having been made accessible by the High Commissioner for India.

Cancer Research

IN order to ensure opportunities for the publication of the scientific results of cancer research, a group of representatives of interested organizations are to co-operate in making possible a new journal *Cancer Research*, to be devoted to articles and abstracts of articles having to do with cancer research. This journal is sponsored by the American Association for Cancer Research, the Anna Fuller Fund, the International Cancer Research Foundation, and the Jane Coffin Childs Memorial Fund for Medical Research. It is hoped to start publication with the issue of January, 1941. Manuscripts should be addressed to the Secretary of the Editorial Committee, 333 Cedar Street, New Haven, Connecticut. Subscriptions are now being received at the office of the Business Manager, American Oncologic Hospital, 33rd Street and Powelton Avenue, Philadelphia. Annual subscription, one volume of twelve issues per year, will be: to members of the American Association for Cancer Research, five dollars; to non-members, seven dollars.

Announcements

As president of the Royal Society, Sir Henry Dale becomes *ex officio* a member of the War Cabinet Scientific Advisory Committee under the chairmanship of Lord Hankey. Sir William Bragg, at the special request of Lord Hankey, will remain a member of the Committee until next October, when he will have completed a year of service with it.

DR. J. HUTCHINSON, keeper of museums of botany, Royal Botanic Gardens, Kew, has been awarded the Loder Rhododendron Cup of the Royal Horticultural Society.

PROF. W. M. SMART, regius professor of astronomy in the University of Glasgow, has been appointed Halley Lecturer at Oxford for 1941.

PROF. G. PÓLYA, formerly professor of higher mathematics in the Technical High School, Zurich, has joined the Department of Mathematics in Brown University.

IN moving the second reading in the House of Commons of the War Damage Bill, Sir Kingsley Wood, Chancellor of the Exchequer, announced that whereas the general charge on buildings, etc., would be at the rate of 2*s*. in the pound on the annual value, that on institutions for the advancement of education, science or research would be at the rate of 8*d*. in the pound. Agricultural properties are to pay 6*d*. in the pound, and hospitals and churches are exempted from payment.

THE title of professor of physics as applied to medicine in the University of London has been conferred on Dr. W. V. Mayneord in respect of the post held by him at the Royal Cancer Hospital (Free). The following have been awarded the degree of D.Sc.: Mr. J. H. Burgoyne (Imperial College of Science and Technology); Mr. S. L. Cowan (University College); Mr. C. H. Johnson (University College); Mr. R. W. B. Pearse (Imperial College of Science and Technology); Mr. M. J. D. White (University College); Mr. J. G. King, an external student. The Sir John William Lubbock Memorial Prize in mathematics for 1940 has been awarded to Mr. M. G. Pimputkar, of University College.

APPLICATIONS for fellowships under the Finney-Howell Research Foundation, Inc., for 1941 must be made by January 1. This Foundation was provided for in the will of the late Dr. George Walker of Baltimore for the support of "research work into the cause or causes and the treatment of cancer". Fellowships carrying an annual stipend of 2,000 dollars are awarded for a period of one year, with the possibility of renewal up to three years; when deemed wise by the Board of Directors, special grants of limited sums may be made to support the work carried on under a fellowship. The address of the Foundation is 1211 Cathedral Street, Baltimore, Maryland.

IN NATURE of December 7, p. 743, reference was made to the jubilee of the City and South London Railway. We regret to learn, however, that the details of reconstruction work given in the second paragraph refer to the Waterloo and City Railway.

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.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Diffuse Reflections on Laue Photographs

Sir C. V. Raman and P. Nilakantan, having first of all in NATURE[1] described the appearance of diffuse spots and streaks on Laue photographs as "a new type of X-ray reflection", now claim[2] that they were justified in ignoring all previous experimental and theoretical work on the subject. Their claim, however, cannot be admitted. Preston's photographs[3] of aluminium, sodium chloride and magnesium oxide, at room temperatures and at 500° C., were beautifully clear and typical of the phenomenon, whether his theory be accepted or not, while his photographs taken with monochromatized radiation proved beyond a doubt that the diffuse spots were due to the characteristic part of the beam. A further purely experimental paper, which pre-dates the work of Raman and Nilakantan, is that of Jean Laval[4], "Étude Experimentale de la Diffusion des Rayons X par les Cristaux", which is a most comprehensive study of the phenomenon using ionization spectrometer methods.

Nor can the previous theoretical work, whether of Brillouin[5], Faxén[6], Waller[7], Preston[3] or Zachariasen[8], be so lightly dismissed. Raman and Nilakantan state that certain limited observations on diamond "wholly exclude any explanation of these reflections in terms of the diffuse thermal scattering of X-rays". Yet Preston showed that at elevated temperatures the intensity and size of the diffuse spots given by aluminium, sodium chloride and magnesium oxide are remarkably increased, and that some new spots appear that were not previously visible, while the Laue spots suffer a corresponding diminution in importance; he also found a slight increase in the effect for diamond. Laval observed and measured a marked temperature enhancement of the effect in the case of potassium chloride, while Raman and Nilakantan[9] observed the same for sodium nitrate.

In this laboratory we have taken many photographs at liquid air temperatures, and have found that for potassium chloride, sodium nitrate, calcium carbonate and every organic compound so far examined the diffuse reflections have either almost or completely disappeared at −180° C., while the Laue spots have increased in definition and number. It is true that for diamond alone the diminution of intensity at liquid air temperatures is slight, but on the other hand the characteristic temperature of diamond is exceptionally high (2340° A.), and a change of temperature of 200° is relatively unimportant. These temperature changes are completely reversible in every case, and are so striking that it seems unnecessary to suppose the phenomenon to be anything but a temperature effect, although the exact manner in which the thermal movements of the particles are related to the structure and to the elastic constants of the crystal is still a matter for further theoretical investigation.

The empirical formula which Raman and Nilakantan[10] have given for diamond, $\lambda^* \sin(\theta + \varphi) = \lambda \cos \varphi$, where θ, φ are the glancing angles of incidence and reflection with respect to the crystal planes of which λ^* is the spacing, is identical with the simple formula given by Faxén in 1923[6], $a\ (\sin \theta + \cos \theta \tan \theta_1) = \lambda$, where a and θ_1 have the same significance as λ^* and φ. This simple formula, however, though it may apply approximately in certain cases, was never intended to be generally applicable. It occurs, but again only as an approximation, in Waller's more complete exposition of the effect of thermal vibration of atoms in a crystal on X-ray scattering[7]. This effect is dependent upon the elastic constants of the crystal, and the theory cannot be fully tested unless these are known; but in principle the effect of thermal vibration in reducing the atom-factors, of which the theory of diffuse thermal scattering is a necessary corollary, is universally accepted[11].

KATHLEEN LONSDALE.

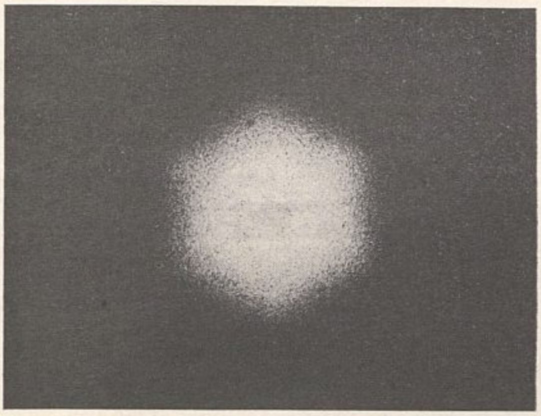
Davy Faraday Laboratory,
Albemarle Street,
London, W.1.

[1] Raman and Nilakantan, NATURE, **145**, 667 (1940).
[2] Raman and Nilakantan, NATURE, **146**, 686 (1940).
[3] Preston, *Proc. Roy. Soc.*, A, **172**, 116 (1939).
[4] Laval, *Bull. Soc. Française Min.*, **62**, 137 (1939).
[5] Brillouin, *Ann. Phys.*, **17**, 88 (1922).
[6] Faxén, *Z. Phys.*, **17**, 266 (1923).
[7] Waller, *Z. Phys.*, **17**, 398 (1925); dissertation, "Theoretische Studien zur Interferung- und Dispersionstheorie der Röntgenstrahlen". *Uppsala Univ. Arsskrift.*
[8] Zachariasen, *Phys. Rev.*, **57**, 597 (1940).
[9] Raman and Nilakantan, *Proc. Ind. Acad. Sci.*, **11**, 405 (1940).
[10] *ibid.*, p. 393.
[11] Waller and James, *Proc. Roy. Soc.*, A, **117**, 214 (1927); "Int. Tabellen zur Bestimmung v. Kristallstrukturen", **2**, 559 (1935).

Grinding and Scratching Crystalline Surfaces

IT is well known that the orientations with respect to the crystalline axes of the facets of the etch figures on a basal plane of quartz can be used to locate the a axis of the quartz. De Gramont[1] has described a convenient method by which this may be done. A face of the specimen parallel to the etched surface is polished and a point source of light is viewed through the specimen normally to the etched surface. A pattern, consisting of spots of light, is formed, due to refraction at the facets of the etch figures, and the orientation of these facets, relative to the crystal lattice, may be found from the positions of the spots of light.

This method of studying a surface broken up into a large number of small facets of various orientations can be applied to the study of the ground surfaces of transparent materials, and yields interesting results with crystals. Thus, if a (0001) plane of quartz is ground, instead of etched, and viewed in a manner similar to that used by de Gramont, a refraction pattern of the type shown in the accompanying reproduction is seen. The intensity distribution over the pattern can be interpreted in terms of the orientations of the facets formed on the surface in the process of grinding, and in terms of the extent to which facets of any specified orientation occur.



A density analysis of the above photograph, made by the 'sharp outline' method described by Dobson, Griffith and Harrison[2], shows that preferential fracture of the quartz takes place on planes belonging to the zones $(1\,0\,\bar{1}\,l)$. The diameters of the hexagon bisect the angles between the a axes, and hence the pattern can be used to determine these axes even when the quartz crystal does not possess natural faces.

Refraction patterns have also been obtained for ground surfaces parallel to other planes of quartz than the (0001) plane, and for ground surfaces of calcite, selenite, rock salt, etc., and for surfaces of these crystals on which a large number of parallel scratches is made.

Generally, any marked cleavages possessed by a crystal are apparent in the refraction patterns of ground or scratched surfaces of the crystal. The refraction patterns are not, however, entirely explicable in terms of the usually observed cleavage planes, but lead to the assumption of a number of zones of easy fracture. The patterns formed on scratched surfaces depend to some extent on the direction of scratching, as well as on the surface of the crystal which is used.

The results obtained can in some cases be partially confirmed by microscopic examination of the ground or scratched surfaces.

R. S. RIVLIN.

Research Laboratories of the
General Electric Company, Ltd.,
Wembley.
Nov. 18.

[1] de Gramont, A., "Recherches sur le Quartz Piezoelectrique". (Editions de la *Revue d'Optique Theorique et Experimentale*, 1935.)

[2] Dobson, G. M. B., Griffith, J. O., and Harrison, D. N., "Photographic Photometry" (Oxford, 1926), p. 42.

Electron Diffraction Intensities

Yearian[1] and Lark-Horovitz[2] have explained certain anomalies in the intensities of the rings in electron diffraction patterns of zinc oxide on the assumption of atomic distortion. It is, however, implicit in their calculations that extinction of the electron beams owing to inelastic scattering has an equal effect on all diffractions ; this would not seem to be the case.

It has been shown both with the microscope[3] and by electron diffraction[4] that the structure of zinc oxide coagulated from an ærosol consists partly of very thin filaments, and that it is these that are mainly responsible for the diffraction of electrons. The sharpness of the $(00.l)$ as compared with the $(hk.0)$ diffractions shows that the crystals are longest along their c axes, which presumably coincide with the axes of the filaments. Thus the depth of crystals to be penetrated by an electron beam is greater along the c axis than along the a or b axis, and consequently greater extinction results. Fewer crystals will be small enough to transmit electrons along the c axis than can do so along the a or b axis. In this way the intensities of the $(hk.0)$ diffractions should be reduced as compared with those of the $(00.l)$ diffractions, as is observed experimentally.

Experiments with suitably evaporated metal films[5] have shown good agreement between calculated and observed diffraction intensities, and in these cases the ring-breadths give no indication of rod- or plate-shaped crystals. It seems to me that variations in extinction due to irregular crystal shape or to anisotropy will explain at least qualitatively many of the observed differences between calculated and observed electron diffraction intensities.

S. FORDHAM.

24 Ardrossan Road,
Saltcoats,
Ayrshire.
Nov. 21.

[1] Yearian, *Phys. Rev.*, **48**, 631 (1935).

[2] Cf. Thomson and Cochrane, "Theory and Practice of Electron Diffraction" (London: Macmillan, 1939).

[3] Whytelaw-Gray, Speakman and Campbell, *Proc. Roy. Soc.*, A, **102**, 604 (1923).

[4] Finch and Fordham, *Proc. Phys. Soc.*, **48**, 85 (1936) ; also Finch and Wilman, *J. Chem. Soc.*, 751 (1934).

[5] Thomson, G. P., *Proc. Roy. Soc.*, A, **125**, 352 (1929) ; also Mark and Wierl, *Z. Phys.*, **60**, 741 (1930).

Increase of Heavy Potassium in Plasma

IN a previous communication[1] we described results of investigations on the isotopic constitution of potassium in normal and tumour tissue from the rat. It was shown that the percentage of the heavy isotope, $^{41}_{19}$K, in potassium present in bone-marrow and Jensen sarcoma differed slightly from that in mineral potassium, being higher in the former case, lower in the latter.

Similar investigations have since been carried out on potassium in the blood plasma of normal rats. Five plasma samples were tested, each being a mixture obtained from an equal number of males and females ; the animals numbering 2–12 had an average weight between 155 and 220 gm. The blood, taken by heart puncture, was added to a sodium citrate solution and centrifuged immediately. The ash of the citrate-plasma was used for the mass-spectrographic measurement.

The results showed that the content of ${}^{41}_{19}K$ in plasma potassium was distinctly higher than in mineral potassium contained in ordinary potassium chloride (A.R.). The average increase was 2·5 per cent, the individual figures varying between 1·8 and 3·2 per cent. This increase was of the same order as that found in potassium from bone-marrow. Since potassium from all normal tissues other than bone-marrow has shown a ${}^{41}_{19}K$ content close to that of mineral potassium, it appears that the assimilation of potassium by the cell is connected with an isotope effect. A kinetic mechanism, concerned with the movements of ${}^{39}_{19}K$ and ${}^{41}_{19}K$ atoms, can be devised to account for this effect.

A. LASNITZKI.

Cancer Research Department,
University, Manchester.
Department of Physiology,
University, Birmingham.

A. K. BREWER.

Bureau of Plant Industry,
U.S. Department of Agriculture,
Washington, D.C.
Nov. 28.

[1] Lasnitzki, A., and Brewer, A. K., NATURE, 142, 538 (1938).

Nature of the Feulgen Reaction with Nucleic Acid

THROUGH the courtesy of Messrs. Barber and Price I have now seen particulars of the tests referred to in their criticism[1] of my note[2] on the nature of the Feulgen reaction with nucleic acid. It is obvious from their account that they have failed to see the main point of my suggestion, that is, that polymerization, via a nitrogen linkage, between leuco-base of fuchsine and the purines available in hydrolysed chromatin is just as likely to result in a coloured product as the similar polymerization between aldose and leuco-base via an oxygen linkage. Their experiments, though apparently made in good faith, were mainly concerned with certain elementary details of the Feulgen reaction which have no bearing on my suggestion.

C. S. SEMMENS.

Department of Cytology,
King's College,
at the
University of Bristol.
Nov. 8.

[1] Barber, H. N., and Price, J. R., NATURE, 146, 335 (1940).
[2] Semmens, C. S., NATURE, 146, 130 (1940).

MR. SEMMENS' "suggestion" that purines available in hydrolysed chromatin might be responsible for Feulgen staining was quite clear to us, and it was to test it that we re-examined the behaviour of certain purines with the Feulgen reagent. Since these experiments were a repetition of Semmens', their bearing on the point in question should be sufficiently clear to him. We consider his suggestion untenable because our tests, contrary to his, show that purines do not give any colour with the Feulgen reagent.

The reason we repeated these experiments was that they led to a grave theoretical difficulty, namely, that yeast nucleic acid and thymonucleic acid, which have the same purine components, give a different Feulgen reaction. This difference we consider (in agreement with the general view) as due to the different carbohydrate components of the two acids.

H. N. BARBER.
J. R. PRICE.

John Innes Horticultural Institution,
Mostyn Road, Merton Park,
London, S.W.19.
Nov. 8.

Mind and Matter

MAY I say how touched I am by the spirit with which your reviewer, F. S. Marvin, points the moral "that mind and not matter rules the world"[1]. I also was taught to believe that mind came first, and I should naturally prefer to retain a conviction which has been sufficient for so many generations of historians and philosophers. But admittedly, the bearing of this observation lies in the application of it, and I am compelled to ask myself how I am to apply the priority of mind to my own detailed and perhaps trivial explorations.

I am concerned with chromosomes. Some people have come to look upon these microscopic whim-whams as determining (if one may speak of determination) the properties of heredity and development. Now if the chromosomes determine the development of the whole organism, of which the mind is one (albeit the most precious) aspect, then these scarcely animate particles of matter, the mutations of which obey elementary physical laws, can determine the difference between mind and no mind at all; and particularly, if I were to follow this argument, I should be led to a most disturbing conclusion, namely, that the sperm which will give rise to a man (and his mind) differs from one which will give rise to a female of the species (and her mind) merely by the absence of a piece of one chromosome, a speck of matter. To this end are we led through blindly following the sophistries of material dialecticism, which (as Mr. Marvin laments) are so prevalent to-day. This view needs only to be stated for its contradictory nature to become evident.

On the other hand, if mind or spirit or purpose determine both sex and loss of chromosome at the same time, everything will, I suppose, be clear and straightforward. I say, 'I suppose', since Plato and Aristotle were unfamiliar with this situation, and Epicurus in any event gives me the wrong answer. I now turn to Mr. Marvin in confidence that he will be able to tell me (with or without the help of Dr. Federn) how I may come to apprehend a deeper truth from the misleading images recorded by science. Then I may perhaps myself be able to rewrite the present theory of heredity with a proper appreciation of higher things.

C. D. DARLINGTON.

John Innes Horticultural Institution,
Mostyn Road, Merton Park,
London, S.W.19.
Nov. 13.

[1] NATURE, 146, 600 (1940).

RESEARCH ITEMS

Biological Control of Lantana

IN *Indian Forest Records* (Entomology) (6, No. 3; 1940) C. F. C. Beeson and N. C. Chatterjee discuss the possibilities of the biological control of *Lantana aculeata*. The problem of destroying Lantana by means of insects is one of special interest to forest officers in India. It is concluded that no indigenous species of insects feeding on this shrub is sufficiently promising for this purpose, yet altogether 400 species of insects are known to visit Lantana in India. In the Dehra Dun district the biology of 54 species has been investigated. The regular breeders on the plant are prevented from increasing abundantly by wilt-like diseases and parasites. The most promising lines for the future seem to be (*a*) the introduction of the Lantana bug, *Teleonemia scrupulosa* and (*b*) eventually to explore the original home of Lantana in tropical America in search for additional insect enemies or diseases. The subject is one for the consideration of the Board of Forestry with the view of developing an all-India policy to be followed. In the meantime unauthorized importations of Lantana insects into India should be prohibited.

A New Genus of Fossil Sponges

A NEW genus (Protohyalostelia) of sponges discovered in lower Cambrian strata in South Australia has been described by Frederick Chapman in a paper recently read before the Royal Society of South Australia. All previous records of sponges in the Australian Cambrian have been confined to sporadic occurrences of anchoring spicules and separated sponge spicules. This new discovery is remarkable in that actual sponge bodies have been preserved with the spicular structure more or less in position. They are, therefore, the first of their kind to afford definite evidence of their taxonomic position among Lower Palæozoic sponges. In form they are cup-shaped, varying from vase-like to elongate, almost cylindrical bodies. The spicular structure shows that they belong to the Lyssakine group of the Hexactinellida. It is suggested that the present Cambrian genus, Protohyalostelia and other related ones, as Hyalostelia (Cambrian to Carboniferous) should be placed in a new family, the Hyalosteliidæ.

House-Sparrow in New Environment

IN the fifties of last century the house-sparrow, *Passer domesticus*, was set free in the United States of America and since then it has settled and flourished in the entire continental United States except Alaska. Most of the original individuals were imported from England, some from Germany, and it is a matter of interest to inquire what changes, if any, have been induced by an environment which has enforced some changes in food and in predators, as well as changes in climate. Some years ago the writer obtained a series of skins of American house-sparrows from Dr. Outram Bangs, and found that the range of variation in colour of plumage did not exceed that shown by the sparrows in Great Britain, but David Lack has submitted certain characters to the test of measurement (*Condor*, 42, 239; 1940). The characters chosen were length of bill from nostril to tip, depth of closed bill, and length of wing (standard measurement). American sparrows were found to have on the average rather larger bills and wings than English ones; but they are not larger than German specimens, so that it would be hazardous to say that any significant change had taken place. In America itself, however, analysis by region shows that the sparrows from southern California have larger bills, as regards length and depth, than those from other regions, and they are also larger than in German sparrows, so that some variation appears to be taking place in accordance with the trend observed elsewhere, that extremities, such as bills and legs, become longer in regions of warmer temperature.

Analysis of Winter Temperature

THE *Monthly Weather Review* of the U.S. Weather Bureau of June 1940 (vol. 68, No. 6) contains a summary by C. J. Root of the winter temperatures recorded at one of the stations in America with the longest unbroken record (eighty years). The station is Marengo, Ill. The summary is made in such a way as to bring out most clearly the long-period trends, graphs being given of the five-year and ten-year averages for the winter (December–February) from 1856–57 to 1936–37. Both these graphs show a decline from initial warmth to a minimum for the period ending with the winter 1885–86, and then a recovery to more than the initial warmth. Thus the five-year mean for the period ending in February 1886 was only just above 18°F. and that for a similar period ending in February 1932 was more than 25° F. This winter mildness of recent decades is shown not to be due to a change in the site of the instruments; it is in agreement with the trend at many other places in America as well as in Europe.

Crustal Structure of the United States

Two papers presented at the Cincinnati meeting of the Eastern Section of the Seismological Society of America on May 31 and June 1, 1940 (*Earthquake Notes*, 12, Nos. 1 and 2; September 1940), are important in that they suggest a different structure in the United States from that determined previously for certain other regions in the world. The first paper is by Henry F. Birkenhauer, *S.J.*, and concerns the Illinois Basin earthquake of November 23, 1939, with epicentre near Redbud, Illinois. The velocities of seismic waves determined from records from thirteen observatories were found to be $\overline{P}$ 5·9, $\overline{S}$ 3·3, P^* 6·6, S^* 3·9, P_n 7·3, and S_n 4·1, all km. per sec. To fit the seismogram readings the author suggests an upper layer 26 km. thick and an intermediate layer 12 km. thick above the Mohorovicic discontinuity. The second paper, by Edward J. Walter, concerns "Earthquake Travel-Times and Structure South of St. Louis". Six local earthquakes were studied, and the structure suggested consists of three layers above the substratum. From the top downwards the author suggests layers 5 km., 20 km. and 12 km. thick and velocities of P 6·03, 6·33, 7·19 and 7·73 km./sec. respectively, and of S 3·63, 3·74, 4·08 and 4·40 km./sec. respectively in these layers and the substratum. The improved or new teleseismic stations mentioned by N. H. Heck of the U.S. Coast and Geodetic Survey at the same meeting, namely, those at Burlington, Vt.; Pittsburgh, Pa.; Columbia, S.C.; Des Moines, Iowa; Logan, Utah; Reno, Nev.; and Ukiah, Cal., should prove exceedingly useful, along with stations already existing, in testing the above hypothesis.

Determination of the Depth of Glacial Deposit

A SERIES of seismic profiles has recently been run in the Riverside Section of the town of Weston by L. D. Leet and T. J. Smith, *S.J.* (*Earthquake Notes*, **12**, Nos. 1 and 2; September 1940). Using the seismic exploration unit belonging to the Humble Oil Company of Houston, Texas, the authors showed the average depth of glacial deposit in the area to be approximately 100 ft., increasing to 250 ft. in the pre-glacial valley of the Charles River near by.

A New Fine Oil

IN view of the difficulty which is now experienced in obtaining from the usual sources supplies of clock oil or Jouvain oil suitable for use as a lubricant for many precision and other instruments and for light machines, it is of special interest to learn that a new product has been introduced to take its place. This new lubricant, which is referred to as Clock Oil R.304, has been evolved by Messrs. Stafford Allen and Sons, Ltd., of Wharf Road, London, N.1, working in conjunction with the chemists of the Admiralty Research Laboratory, and has secured the approval of the latter. A sample which has been submitted for inspection shows a preparation possessing the physical and chemical properties requisite for the purposes indicated, while the fact that it has passed all the stringent tests required by the Admiralty Research Laboratory carries the assurance of its suitability for use with instruments under normal conditions of service. The makers offer to answer further inquiries as to the characteristics of the oil.

Softening Point of Glass

AT a meeting of the Society of Glass Technology held on November 20, J. T. Littleton presented a paper on the above subject. Two definitions of softening point are at present in use. According to Dr. Littleton, it is that temperature at which a fibre of glass, 9·25 in. long, of a diameter between 0·55 and 0·75 mm., suspended vertically in a furnace of specified characteristics, will elongate under its own weight at the rate of 1 mm. per minute. Under these conditions such a rate of extension takes place when the glass has a viscosity of $10^{7\cdot6}$ poises. The second definition is that agreed on by the Society of Glass Technology and the Deutsche Glastechnische Gesellschaft, and is the maximum point reached on the complete thermal expansion curve of a glass. Again this point is dependent on the experimental conditions, and the apparatus employed has to be standardized before a definite viscosity value can be allocated to the point so determined. The two methods were then described and the results obtained by them compared. The fibre-extension method was claimed to give results precise to better than one degree, whereas the interferometer method is not so precise. The latter method is based on the measurement of a temperature at which an effect having no magnitude occurred, whereas the fibre-extension depends on measuring the temperature at which the magnitude of the effect has a definite value. Softening point determinations are a rapid and reliable means of ascertaining if any variation in the characteristics of a glass has occurred. The fibre-extension method has been in use at Corning Glass Works, U.S.A., for more than thirty years, and during the last few years about ten thousand measurements a year have been made.

Atmosphere of Venus

DR. R. WILDT makes an interesting suggestion as to the chemical constitution of the clouds which are observed on the disk of the planet Venus (*Astrophys. J.*, **92**, 247; 1940). The atmosphere of the planet is at present spectroscopically free from water vapour but rich in carbon dioxide, and is filled with white clouds the nature of which is still unknown. Dr. Wildt makes the assumption that the primordial atmosphere was one mainly of carbon dioxide, but containing small quantities of water vapour. A photochemical reaction between these constituents when they are illuminated by ultraviolet sunlight will produce formaldehyde, the oxygen so released being chemically absorbed by the surface layers. Moist formaldehyde gas rapidly polymerizes into a mixture of solid white polyoxymethylene hydrates $(CH_2O)_x.H_2O$, which, it is suggested, constitute the observed clouds. The vapour pressure of formaldehyde in equilibrium with the solid polymers is small, so that the ultra-violet electronic absorption bands of the gas will not be expected to appear, as Dr. Wildt indeed finds from his observation of the spectrum of the planet. The vapour pressure of the polymers themselves is of the right order at the temperature of the Venusian atmosphere to allow of the formation and dissolution of clouds by the processes of condensation and sublimation. An attractive feature of the theory is that its basic assumption as to the primordial constituents of the atmosphere accounts for the present lack of free oxygen on the planet.

Absorption of Light by Interstellar Matter

THE solutions of many problems of stellar distribution in our galaxy depend on the value assumed for the mean coefficient of absorption of light by interstellar matter. Many investigators have in fact used such a mean coefficient without making a critical examination of its validity for the purpose in hand. Doubt is now thrown on the legitimacy of this procedure by Stebbins, Huffer and Whitford (*Astrophys. J.*, **92**, 193; 1940). From their recent investigation of the colours of 1332 B-type stars near the galactic plane and out to 2,000 parsecs from the sun, they conclude that the effect of the interstellar material is too irregular to be represented by a mean coefficient of selective or of total absorption. Even when taken over such a limited region of the sky as one 10° square, the values of colour excess obtained for stars of the same spectra and apparent magnitude (that is, for stars at approximately the same distance) show such a large dispersion that the authors are forced to postulate the existence of small clouds of obscuration. No reasonable treatment of the data can make the star colours fit relations in which absorption is put proportional to distance. An attempt to remove from the data the effect of the more obvious clouds leads to a decrease in their mean coefficient of selective absorption from 0·17 mag. per kiloparsec to 0·12; but, as the authors point out, their exclusion of abnormally reddened stars is arbitrary and results in a coefficient the physical significance of which is scarcely less open to criticism than that of the original one.

EDUCATION OF WORKERS IN APPLIED PHYSICS*

By Dr. H. Lowery,

Principal of the South-West Essex Technical College, Walthamstow

IN observing the rapid growth during recent years of large industrial research organizations which have for their declared object that of producing advances in industry and commerce, we are apt to be tempted to think that the relationship between science and industry is something peculiarly modern, whereas in point of fact it dates back to the dawn of communal life. Actually all that has happened is a quickening of the pace of what is but a natural interaction between the acquisition of new knowledge and its application to human needs. When once man had learnt some new fact by his trial-and-error methods, say in the handling of metals, he proceeded immediately to turn the discovery to his advantage, thus extending the range of application of his material and its general utility. Just so, the continued improvement of the products of modern industry and the evolution of new industries are due to the successful application of recently acquired ideas and the development of improved techniques and processes of manufacture. The interesting point to note, however, is that we no longer rely upon the crude method of trial and error, fruitful as this method was in the past; on the contrary, most industrial advances are the result of the deliberate application of the scientific method. The rapidity of the advances is due to the existence of a great co-operative effort between those who practise a given industry and those who endeavour to discover new facts, principles and practical possibilities. Discoveries are thus no longer left to chance, and though they cannot be made to order at least we can ensure that existing knowledge is put to the best possible use and the ground carefully cultivated by systematic observation and experiment so as to favour the growth of new knowledge.

That the relation between the acquisition of knowledge and its subsequent application to the satisfaction of human wants is perfectly natural in character and that the discoverer and the practical man are therefore on an equal footing has unfortunately too often been overlooked in the past, with the result that there has frequently arisen an attitude of superiority on the part of the discoverer towards the manual worker, followed by a curious superiority of attitude of the academic research worker towards the technologist or scientific worker who deliberately aims at applying knowledge in the fields of industry. Happily this type of snobbery is gradually being broken down, but where it still persists it is a constant source of irritation to the people concerned and leads to regrettable industrial inefficiency.

In view of the splendid successes already achieved by industrial research laboratories in developing old-established industries and inaugurating new ones, the recognition of the professional scientific worker as an essential part of the industrial organization seems assured. Hence arises the educational problem as to the best kind of training to enable him to play his part to the full in the new scheme of things. Not less important is the necessity for making the ordinary employee scientifically minded at least to the extent that he may be led to co-operate freely in the industrial changes dictated by scientific investigation. This in turn demands of the scientific worker personal qualities such as will enable him to strike a bond of friendship with the worker in the factory, thereby inspiring a spirit of co-operation helpful alike to present production and future developments.

It is important that all industrial workers should realize that the man of science has much of value to say not only on material matters but also on the many human problems that arise daily in the modern factory; the view that the man of science is a narrow specialist must be combated until it is entirely removed and confidence engendered so that his opinion and advice may be freely sought when difficulties arise either in the works or among the staff. Moreover, it is worth while pointing out that Governments can no more dispense with the aid of the scientific worker than can industrial undertakings.

The demands made by industry upon scientific workers are so diverse that it has long been found necessary for those workers whose interests are somewhat related to form themselves into groups for the pooling of knowledge, the interchange of ideas, and the discussion of problems arising from their employment in industry. In this way many learned societies and professional organizations have come into being. The latter have usually emphasized the personal relationships between the scientific worker and industry, and have quite naturally been concerned with determining the most appropriate form of training to enable their members to render effective aid to industry. For a variety of reasons (into which we need not enter here) professional organizations for engineers and chemists were established long before that for workers in applied physics; but in 1918 the Institute of Physics was founded with the object ". . . of the elevation of the profession of physicist and the advancement and diffusion of a knowledge of physics, pure and applied, and for this purpose especially: To promote the efficiency and usefulness of its members by setting up a high standard of professional and general education and knowledge, and by compelling the observance of strict rules of personal conduct as a condition of membership".

The foundation of the Institute came at a most opportune time, for the results of a period of unprecedented activity in physical research were beginning to find their practical applications, with consequent rapid expansion of industrial enterprise.

The Institute began by enrolling physicists of approved status and was thus able to form a panel of

* Based on a paper read before the London and Home Counties' Branch of the Institute of Physics on October 26. (The views expressed here are not necessarily those of the Institute of Physics.)

consultants which has been of invaluable assistance to industry. Lectures on "Physics in Industry", given by eminent industrial physicists, not only provided much-needed surveys of the achievements of physics in various industrial processes but also prepared the way for new advances by suggesting fresh lines of research in applied physics. The scope of the activities of the Institute was greatly widened by the formation of branches, the first of which began in Australia and India. In 1931 a local branch was formed in Manchester. This was quickly followed by a Midland Branch with its centre in Birmingham, and later (1936) by the London and Home Counties' Branch.

By means of the local branches the Institute is able to provide for the 'continued education' of its members; up-to-date surveys of recent advances in pure and applied physics are given at the branch meetings by various specialists; conferences and exhibitions on the applications of physics are arranged, and facilities provided for social intercourse among the members, so furnishing the means for the exchange of ideas between workers from different industries.

It is perhaps natural that the standards for admission to full membership adopted by the Institute were based on those of the universities, for at the time of the inception of the Institute these were the only standards easily definable, namely, an honours degree in physics coupled with some post-graduate training. Subsequent experience derived mainly from observations on the employment of physicists in large industrial laboratories seems to show that other standards of assessment of the status of the physicist may now be applicable. For example, in view of the overlap of the work of the physicist into the fields of biology, chemistry and engineering, a training in 'general' scientific subjects is found by many organizations to provide the most suitable preparation for the young physicist, together with some later appropriate specialist technical training.

Opinions differ as to whether the young physicist should carry out post-graduate training in the university before entering industry, or whether he should go direct into the industrial laboratory, or even whether his degree training should not perhaps be modified by some preliminary contact with the works. If one may judge by the reports given by directors of industrial research at the Conference on the Training of Industrial Physicists held by the Institute in February 1936[1], it would appear that each industry has its own individual preferences on these points. Moreover, the position in the United States does not seem materially different in this respect[2]. Nevertheless, given a certain approved minimum training, all employers emphasize the importance of the possession of those personal qualities which will not only enable the research worker to work amicably with those in the factory but will also help him to express the results of laboratory investigations in such a way that they will be acceptable even to those whose long experience in industry has rendered them almost impervious to anything that breaks with tradition.

We may note that industry now employs large numbers of young people who proceed directly into the works at the end of their school careers, a fair proportion of whom develop into highly valued workers in applied physics. They attend part-time day or evening classes at their local technical college and ultimately obtain a degree or professional diploma and possibly even a research degree as well[3]. It is gratifying that increasing numbers of employers are willing to co-operate with the local colleges by releasing their junior employees for several half days' college work per week, and there seems to be no reason why this practice, at least in normal times, should not become universal. The benefits to the student are immeasurable and in the end it is unlikely that the firm would be the loser; indeed, some large firms testify highly to the value of the product of such a 'sandwich' system[4].

The technique of teaching has now reached such a point that we can almost 'teach anyone anything'; certainly we have little to learn regarding the art of getting people through examinations, and yet this does not guarantee that those who are coached successfully even to the taking of the highest academical honours shall be of more than average value in industry. Indeed, one physicist[5] has seriously asked whether "we are not actually harming some of our best men; lessening their vitality, delight in their work, and common sense by too efficient a system of training them to answer the questions we set in their examination papers".

When we come to the consideration of the content of the physics course we are again faced with the problem that individual firms often expect their own special requirements to be catered for. Despite the fact that it is impossible to produce a course of training that will meet every demand, there are certain general matters that any well-balanced course should provide, namely, a readily applicable mathematical equipment; some practical acquaintance with workshop processes such as turning and glass-blowing; the uses of industrial instruments such as the spectrometer, polarimeter, microscope, camera, thermionic valve and oscillograph; some acquaintance with the general principles of instrumental design; a knowledge of how and where to find technical information; and a reasonable command of the English language, both spoken and written. Complaints have often been made (quite justifiably) by employers that such general things as these have often been neglected in favour of an overdose of atomic physics.

War-time is perhaps not the best time for making changes; but it is pleasing to note that industry, the universities, technical colleges and the professional organizations are alive to the problems involved in the training of young recruits for industry, and we may reasonably hope to see very substantial and beneficial modifications in the training of all scientific workers when the time is ripe. At the outbreak of war we were on the eve of great developments in technical education heralded by the establishment of a new type of college with ample provision for social and cultural interests in addition to the requirements of vocation. It is to be hoped that these developments are merely postponed, for there can be no doubt that they are calculated not only to ensure an adequate flow of enlightened technologists into industry but also to produce a supply of scientifically and socially minded men fit to be leaders in the great period of world reconstruction.

[1] Crowther, J. A., "The Training of Industrial Physicists" (*J. Sci. Inst.*, **13**, 141; 1936).

[2] Hardy, A. C., "The Physicist in Industry" (*Amer. J. Phys.*, October 1940).

[3] Owen, D., "The Teaching of Physics in Technical Institutions", Reports on Progress in Physics, **6**, 431 (Physical Society, 1939).

[4] Fleming and Pearce, "Research in Industry", p. 168 (1922).

[5] Bragg, W. L., "Some Views on the Teaching of Science" (*Mem. and Proc. Manchester Lit. and Phil. Soc.*, **72**, 119; 1927).

APPLIED BIOLOGY IN WAR-TIME

A WELL-ATTENDED and representative meeting of the Association of Applied Biologists was held at Harpenden on December 6 under the presidency of Mr. C. T. Gimingham to discuss the function of applied biology in war-time. In the opening paper, Sir John Russell dealt with the three general groups of problems to which applied biology can usefully contribute: maintenance of public health during the War; protection of food and other materials, for example, wood, flax, etc., both in the field and in store against deterioration by biological agents; and increase in the amount of food supplies.

While the maintenance of public health is primarily the business of the medical authorities, applied biologists can render valuable assistance in the adequate cleansing of shelters and of the persons and property of evacuated people. Much of the difficulty of finding accommodation in reception areas is due to the fear that insects and diseases may be brought from the cities into clean country homes, as actually happened in the first evacuation. It is, however, chiefly in connexion with food supplies that applied biologists are usually concerned, especially with food protection. The average dietary in Great Britain is both varied and attractive, but it cannot be maintained in war-time; a much simpler diet is necessary involving less meat, butter, eggs and sugar, but more potatoes, vegetables and bread. Of this new dietary we can produce far more than the 40 per cent of pre-war days: already the figure is well above this and will, it is hoped, be still higher. But the new programme necessitates the conversion of grass land to arable, and various members of the grass land population need controlling. Wireworms do much damage to wheat and other cereals. In the War of 1914–18 no adequate control measures were found, and unfortunately only a moderate amount of investigation was made in the peace period, so that we are still in much the same position as in 1918. Two fungi injurious to wheat have come into prominence since the War of 1914–18: *Ophiobolus graminis* and *Cercosporella herpotrichoides*: the former is harmful on light rather alkaline soils, and the latter is encouraged by the nitrogenous manuring now being enjoined on farmers. The potato crop is liable to a considerable number of pests and diseases, but some of the worst, for example Phytophthora blight and wart disease, can be dealt with. The virus diseases are now the most troublesome; fortunately they are now being vigorously studied. In the meantime they can be avoided only by the use of virus-free seed, but this is not always convenient.

For animals it is necessary to provide more protein equivalent, as the quantity produced on the farm tends to be reduced by ploughing out. Beans would furnish useful supplies, but are liable to attack by aphids. Marrow stem kale is an excellent transformer of simple and easily obtainable nitrogen compounds into protein equivalent, but it may suffer badly from the turnip flea beetle. Fuller control measures are desirable.

Considerable help has already been rendered, however, by applied biologists in saving crops and also the finished products milk and meat. Cleaner milk is now realizable in practice, and bacteriological control is understood and appreciated by many farmers; while valuable service has been rendered in regard to the control of the sheep blowfly and the tick *Ixodes ricinus*, which causes louping in sheep. The storage of food presents numerous problems now happily far better understood than in the War of 1914–18.

The investigation of war-time problems will necessitate numerous studies and surveys which, it it hoped, will be so planned that the results can be subjected to statistical analyses. Little more trouble is involved, and the value of the work is greatly enhanced.

Two food production activities come within the scope of applied biologists. Honey production is capable of much expansion in Great Britain: already about one million pounds' worth is produced annually, but bees render even greater service than this in the pollination of fruit trees and certain other plants. The other problem is not so well advanced. During the War of 1914–18 the Germans were said to be using a yeast for the production of protein and fat for human consumption. It is hoped we shall not need to do this; but it would be of the greatest value if some process could be worked out for synthesizing protein for animals. Suitable nitrogen compounds are available, but the substrate presents difficulties; various wastes might be used, but the ideal source of carbohydrate would be straw, which is available in particularly large quantities on most farms.

These are the main problems: the question is how best to organize the activities of applied biologists so as to ensure finding some solution now, and continuing the work after the present war is over.

In the discussion Prof. J. W. Munro, Mr. J. C. F. Fryer and others emphasized the fact that the war-time biological problems of to-day include many of those of the War of 1914–18, and if we had continued work on them during the past twenty years with the same impetus we should now have been in a much happier position. There was also the old difficulty of ensuring that existing knowledge should be fully applied in practice. Mr. Fryer instanced leather jackets, which had damaged thousands of acres of crops, and the white cabbage butterfly, which last year caused much loss, both of which could have been controlled. It was, however, more difficult to forecast outbreaks in Great Britain than on a Continental area. Mr. Findlay spoke of the serious wastage of sandbags because certain known precautions had not been taken.

It was strongly urged by Drs. Blackman, Ainsworth, Barnes and others that biological experts are not being fully drawn upon at the present time, and on the motion of Dr. Goodey and Mr. Fox-Wilson the Council of the Association of Applied Biologists was asked to bring to the notice of the appropriate bodies the pressing problems which exist to-day in applied biology and to discuss with them the means of utilizing to the best advantage the services of applied biologists.

COSTS OF ELECTRICAL HEATING

IN *Electrical Industries* of November, Mr. F. D. Parker criticizes methods of measuring the running costs of electricity when used for heating and cooking installations. If the estimates given are too high, the company loses a valuable load; and if too low, there is often dissatisfaction and complaints. In particular, the estimating of 'space heating' loads is especially difficult owing to the fact that so much depends on many undeterminable factors.

Weather conditions are very closely related to energy consumption in much the same way as the amount of hot water used determines electric water-heating consumption. The main difficulty is that whereas the latter can in some measure be computed, the former is always conjectural. It has also to be remembered that running costs of heating installations in the south of England cannot be considered representative of those in the north, where more severe weather conditions are experienced. This emphasizes that data obtained from other installations, when not in the same locality, must be employed with caution.

Further factors influencing space-heating consumption are: type of building, position, heat-loss characteristics, hours of use, time of use and thermostat setting. The provision of revolving doors, springs on doors to exclude draughts and the system of ventilation adopted, if any, all appreciably affect operation costs. It follows that the estimating of space-heating consumption is a much easier matter when dealing with existing buildings than from plans of buildings to be erected. In the latter case, allowance has necessarily to be made for the drying out of buildings during the first year.

In the domestic sphere, estimating space-heating consumption is very conjectural, as the element of careless usage is always present. This, coupled with variations in consumers' habits and ideas as to the amount of heat required, usually prevent space-heating consumption of one consumer being considered representative of other consumers even of identical characteristics. Apart from all-electric houses, etc., the majority of domestic space-heating consumers may be considered intermittent users. No difficulty therefore is likely to arise if consumers are advised of the consumption of the apparatus on various 'heats'—which should be done when appliances are purchased, especially from supply authorities.

With new all-electric consumers the position is somewhat different. Apart from thermostatic control and continuous heating, running costs are proportional to hours of usage, which often cannot be determined. If consumers therefore require some idea of annual space-heating costs, then the only arrangement is to obtain from them details as to probable usage and build up estimates accordingly, assuming $\frac{1}{2}$–$\frac{2}{3}$ of the total loading of the heating apparatus is in use per hour. In regard to the heating of corridors, halls, etc., much depends on the type of apparatus installed and the method of control. It is advisable to eliminate hand control as much as possible, as apparatus employed for such purposes is apt to be neglected.

The calculation of operation costs on a heat loss basis for direct heating, assuming, for example, minimum outside temperatures of, say, 25–30° F., to maintain 60° F. internally, to obtain the required loading, and then assume average winter temperatures of, say, 40–44° F. and arrive at the consumption accordingly, relatively to the hours of usage, heating-up times, etc., should provide reasonable estimates. The trouble is that theoretical heat-loss calculations of buildings seldom hold good in practice, owing to faulty construction, badly fitting windows and doors. Weather conditions such as effects of sun and wind should be taken into account.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Museum (Natural History). Economic Leaflets, No. 6: Plaster Beetles. Pp. 4. (London: British Museum (Natural History).) 1*d*. [1811

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 3, No. 23: An Analysis of the Influence of Weather upon a Migratory Movement of Birds. By Prof. James Ritchie. Pp. 299–321. 2*s*. Vol. 60, Part 3, No. 24: Early Glacial Remains of Reindeer from the Glasgow District. By Dr. M. Macgregor and Prof. James Ritchie. Pp. 322–332. 1*s*. 3*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [2011

Lecture on "The Mechanism of Enzyme Action". By Dr. J. H. Quastel. Pp. 28. (London: Institute of Chemistry.) [2111

Other Countries

Scientific Publications of the Cleveland Society of Natural History. Vol. 8, No. 3: On One of the Least Known of the Cleveland Shale Arthrodira. By David H. Dunkle and Peter A. Bungart. Pp. 29–48+plates 4–5. (Cleveland, Ohio: Cleveland Society of Natural History.) [1511

Records of the Geological Survey of India. Vol. 75, Professional Paper No. 3: Studies on some Characteristics of Indian Coking Coals. By Dr. R. K. Dutta Roy. Pp. 28. (Calcutta: Geological Survey of India.) 7 annas; 8*d*. [1811

Field Museum of Natural History. Botanical Series, Vol. 22, No. 4: Studies of American Plants, I. By Paul C. Standley and Julian A. Steyermark. (Publication 480.) Pp. 219–322. (Chicago: Field Museum of Natural History.) 75 cents. [1911

Contributions to Embryology. Vol. 28, Nos. 170 to 178. (Publication No. 518.) Pp. iii+451+34 plates. (Washington, D.C.: Carnegie Institution of Washington.) [2011

U.S. Office of Education: Federal Security Agency. Bulletin, 1938, No. 14: Teaching Conservation in Elementary Schools. By Effie G. Bathurst. Pp. v+125. (Washington, D.C.: Government Printing Office.) 20 cents. [2011

Catalogues

Prokayvit and Prokayvit Oral. Pp. 2. (London: The British Drug Houses, Ltd.)

The Hilger Photometric Colour Comparator (an "Abridged Spectrophotometer") with a description of the Hilger Photometric Amplifier. (SB. 289.) Pp. 8. (London: Adam Hilger, Ltd.)

Various Books, also a Complete Set of Gould's Birds. (Catalogue No. 652.) Pp. 68. (London: Francis Edwards, Ltd.)

Early Botany and Herbals, Old Medicine and Science. (Catalogue 60.) Pp. 54. (London: E. P. Goldschmidt and Co., Ltd.)

Diary for 1941. Pp. 16+32 maps+Diary. (Bonnybridge: John G. Stein and Co., Ltd.)

For your

Information

The address of the Editorial and Publishing Offices of "NATURE" is

MACMILLAN & CO., LTD.,
St. Martin's Street, London, W.C.2.

Telephone Number: Whitehall 8831
Telegrams: Phusis, Lesquare, London.

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance. Volumes begin in January and July of each year, but subscriptions may commence with any issue. Payment from abroad should be made by International Money Order or by Cheque payable at a London Bank, and Cheques, Money Orders and Postal Orders should be made payable to Macmillan & Co., Ltd.

All editorial communications, books for review, etc., should be sent to the above address.

Advertisements only should be addressed to T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4. Telephone Number: City 4211.

Free Copies of "NATURE".

Each of the signatories of a letter published in the Correspondence columns will be sent, free of charge, on publication, 1 copy of the issue of "NATURE" containing the letter.

If more than 1 copy is desired, written application must be made to the Manager of "NATURE", stating the number of copies that is required. Not more than 6 free copies in all can be presented in connexion with any letter published.

This offer of free copies does not refer to articles and similar contributions to "NATURE".

If any contribution includes illustrations, the blocks used for their reproduction may be obtained by the author, after publication, at half the cost price. Application for the blocks should be made to the Manager of "NATURE".

Proofs will not usually be sent to authors living outside Great Britain. Orders for reprints should, therefore, accompany MSS. All communications regarding reprints should be sent direct to the printers:

FISHER, KNIGHT & CO., LTD.,
Gainsborough Press, St. Albans, Herts.

Printed in Great Britain by Fisher, Knight & Co., Ltd., The Gainsborough Press, St. Albans, and Published by Macmillan & Co., Limited, at St. Martin's Street, London, W.C.2, and The Macmillan Co., 60-62 Fifth Avenue, New York, Saturday, December 21, 1940.