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SCIENTIFIC METHOD IN ECONOMIC PLANNING

SCIENTIFIC workers, whatever their attitude to planning, will read the article by Prof. F. Hayek on "Planning, Science and Freedom", which appears on p. 580, with respect and some measure of appreciation. Whether or not his point of view is accepted, he has made an important contribution to clear thinking on a difficult and urgent problem. Even those who find his attitude negative and hold that he makes no constructive proposals, may none the less be grateful for his clear indications of some of the dangers that planning holds for science and freedom, if it is not inspired by creative thought and guided by sound and wise judgment.

Prof. Hayek's article appears to be directed particularly against economic planning. He is careful to dissociate himself from any argument about planning in the general sense of a rational design of human institutions, the desirability of which, by implication, he admits. He attacks the central direction of all economic life as against its direction by competition. His support of the competitive or price system is based on the view that a controlled economy is less efficient and that it leads direct to a totalitarian system, despotic control in every sphere of life, the repression of individuality and freedom, with all that is implied for scientific work by such repression.

No scientific worker can fail to recognize that such dangers exist and that under a totalitarian regime, whether in Germany or in Russia, scientific work of one kind or another has been impeded to greater or less degree. Prof. Hayek, however, does not advance convincing reasons as to why a totalitarian system should be the only outcome of even economic planning, and his whole argument loses verisimilitude to-day when he exempts from his attack the conception of rational planning of all human institutions in their mutual relations. It is this conception of planning for freedom that dominates the field to-day, as it inspired the whole conception of the recent Conference on Science and World Order.

The planning of the twentieth century rests its case, as Dr. Lewis L. Lerwin well said at the World Social Economic Congress in 1931, on a philosophical faith in the power of man to promote orderly economic and social change through scientific research and constructive imagination. Even at that time, Dr. Lerwin distinguished clearly between economic planning itself and technical and industrial planning and rationalization. Using the concept and mechanism of social price, economic planning attempts by new methods to co-ordinate and balance production and distribution, and while Dr. Lerwin admits that planning must be a national

function in method as well as in purpose and must possess a measure of Government authority, he sees alternatives to absolute socialist planning and to the partial State socialist planning of the U.S.S.R. in a voluntary business type of planning and a social progressive type of planning.

The ideas implicit in the latter type are in fact reflected in many of the proposals or developments which in the last few years have given a further impulse to the notion of planning, whether in regard, for example, to re-planning and re-building and the location of industry under the Ministry of Works and Buildings, or to those developments proceeding under the Leith-Ross Committee and in other ways for dealing with the disposal of surpluses and for commodity control. The realization of the waste and damage to national resources through uncorrelated individual action and private interests has been forced too vividly on the attention of the nation for it to contemplate a deliberate return to the pre-war chaos when war-time controls are relaxed. The choice to-day is not between planning and not planning, but rather of the type of planning to be adopted, and the purposes to be served. The peril of economic and political chaos after the War is too serious for no attempt to be made now to provide the institutions or policy for averting, or at least minimizing, these dangers for concerted effort.

It is equally clear that, in the post-war society, the price system will not be accepted as by itself a sufficient determinant. This is not because the idea of private property is likely to be rejected or that the ideal of service rather than profit will be a sufficient motive, but because the usual concept of price has no regard to the social effects of competition. It is this limitation that has had such untoward effects in the distressed areas as has been emphasized in one study after another, from the Barlow Commission's report to the various investigations of areas carried out by the University of Liverpool and similar bodies. In the absence of social control and definite planning, the price system and unrestricted competition will assuredly have equally or even more disastrous results for the community as a whole after the War.

A further tendency, which is also ignored by Prof. Hayek, is the new conception of the function of government as the nation's instrument for planning, and for action to safeguard and develop the collective inheritance and the social and economic welfare of the nation in peace and war. The old conception of government as a regulatory, policing and taxing mechanism is recognized as inadequate. The main weaknesses of our executive machinery of government to-day admittedly follow from failure definitely to adopt such a positive conception of government in all those spheres where individuals or private associations cannot achieve equally effective results.

If, however, the Spencerian concept that there is something inherently wicked and dangerous in government, and that the least government is the best government, should be rejected decisively to-day, there is in it, as in Prof. Hayek's views, a warning we disregard at our peril. As Cobban reminds us in "The Crisis of Civilization", while free association may be a good thing, government and organization can never be more than a necessary evil. The power of government is justifiable in accordance with its utility or the degree in which it promotes the rights of the individual. All absolute sovereignty is a usurpation.

Government, Cobban maintains, is a contrivance instituted by human wisdom for the better attainment of those ends which are laid down by the ethical intuitions of mankind, and which take the form of the natural rights of the individual of self-preservation, free association, the possibility of happiness and a certain field of free activity. The end of government should be to promote the realization of the rights of its subjects. Directly government ceases to be the instrument and in the personified State becomes the end in itself, individuality and freedom are imperilled or, as in the totalitarian State, destroyed.

At a time of flux and reconstruction, when men are seeking to mould instruments of government more effectively on an international as well as on a national scale to their social purposes, this warning, so firmly underlined by the events of the past two decades, needs to be kept clearly in mind. It is significant, moreover, that an essentially similar concept of economic planning inspired its leaders fully a decade ago, as is illustrated not only by Lerwin's paper already quoted but also by that of Mary Follett on "Individualism in a Planned Society" (recently reprinted in "Dynamic Administration"). Planning is to them an instrument for collective self-control, which can and should give scope to individual initiative by showing it the way to combine effectively with other individual initiatives. Individualism is regarded not as something apart but as something contributing to the whole, and freedom is not freedom from relation but freedom through organized relation.

The dynamic conception of planning and government as a collective instrument for co-ordination, based not on coercion from above, but on conference and agreement in accordance with ascertained facts and the changing needs of society, is fundamentally different from the conception attacked by Prof. Hayek and also that which finds concrete expression in the totalitarian regimes to-day. Planning, as Mannheim points out, does not mean rule by arbitrary forces over the living body of

society, nor the dictatorial attempt to supplant creative activity. It means, on the contrary, a conscious attack on the sources of maladjustment in the social order on the basis of a thorough knowledge of the whole mechanism of society and the way in which it works. It is not the treatment of symptoms but an attack on the strategic points.

Prof. Hayek's views must not be dismissed as entirely irrelevant because the type of planning which he attacks does not meet the criteria of such thinkers as Lerwin, Follett or Mannheim. They should rather be taken as endorsing Mannheim's contention that we should deliberately plan for freedom, and as a reminder of the dangers of partial attempts taking account of economic or political factors alone. Moreover, as Mannheim points out, we have still to elaborate much of the technique of social change. We have indeed to learn even from the totalitarian States how to use planned persuasion, not for stirring up strife, but for encouraging behaviour on which all our hopes of peace, co-operation and understanding depend.

The co-ordination of activities involved in this conception of planning is not incompatible with or inimical to freedom, provided these ideals are kept in mind. The elaboration of the necessary technique and social controls requires objective scientific research as well as the retention of such established democratic principles as equality of opportunity, the selection of the fittest and respect for human personality. It is a challenge to sociology and to psychology as much as to economics, and offers, as Mannheim points out, a real chance for sociology to make a creative contribution to the reconstruction of our society. While it may well be important, as both Cobban and Mannheim urge, to diminish the number of purely political issues and dissociate the national and international organs of welfare, health, education and economic co-operation from political and military control, a new experimental attitude in social, including economic, affairs holds the best promise of creative thought and constructive proposals.

It is the magnitude of this challenge to thought that captures the imagination to-day. Only by achieving on a larger scale and in new ways the co-ordination of his activities can man hope to retain real freedom. The new forms of organization must be evolved to serve clearly ascertained needs, and be recognized as instruments and not as ends in themselves. They must be so developed as to enlist the willing co-operation of the individuals and groups whose needs they are to serve.

Undoubtedly the dangers to which Prof. Hayek refers exist, but if humanity is deterred by dangers it is already doomed. Unless society is able to evolve further controls and organized relations while maintaining the individual capacity for adjustment, hope of a new order is a delusion. Separation and local autonomy can no longer be allowed to have the last word, but unless the democratic constitution of a planned society can avoid the bureaucratic absolutism, which is the main target of Prof. Hayek's attack, disaster is equally certain. The transfer of democratic, parliamentary control to a planned or co-ordinated society is a difficult and intricate task, and destruction of that control in the effort to establish a planned society means disaster. None the less, mankind must continue to run risks and to press forward. The study of history does not warrant pessimism as to the ability of society to throw up the men for the great occasions, or to evolve the institutions to serve its increasing and changing needs, so long as the fountain heads of knowledge and creative thought flow free and untainted.

AGRICULTURAL EDUCATION

THE appointment by the Minister of Agriculture of a Committee to review the position of agricultural education (see NATURE of August 9, p. 161) will be welcome to many who have long regarded a national committee or commission on agricultural education as being needed.

Agricultural education in Great Britain under Government ægis dates from 1888 and the passing of the Technical Instruction Act. In that year an agricultural committee of the Privy Council was formed, and given £5,000 with which to assist agricultural institutions. Agricultural education had, however, been operative in some measure before that, and its development can most usefully be considered from about 1840. At that time the basic process of all farming and all life—the process of photosynthesis—was first universally recognized, the Royal Agricultural Society came into being with its motto, "Practice with Science", and the first Rothamsted experiments were about to begin. During the century that has followed, the conspectus of the broad problem of agricultural education has altered in one very important respect. A hundred years ago there was much skilled craftsmanship in British farming and the limiting factor was lack of scientific knowledge. Since that time the development of scientific knowledge and the output of research has out-

stripped the development of the education and scientific training of the craftsman, and the limiting factor now is the trained ability of the husbandman to use the vast amount of knowledge and understanding of his materials and processes that have accrued. The major problem now is not more knowledge, but more personal education. It is therefore gratifying to note that the Committee appointed by the Minister is to consider the work of primary and secondary schools, and the subsequent personal training of the diverse categories of agriculturists.

To those engaged in programmes of agricultural education the foundations laid in the work of schools and in immediate post-school work is obviously of primary importance. Not that agricultural educationists would necessarily advocate vocational agricultural training in schools—they have, in fact, advocated a continuation of some general education in post-school work. What is commonly called rural science can be incorporated in a scheme of general education without being agriculturally vocational. The fact that scientific principles are illustrated by processes of farm and countryside gives no improper bias. Indeed, it may be regarded as a definite disadvantage to urban schools that such illustrations of scientific principles are not easily available to them, since it is a reasonable part of the educational demands of everyone, whatever his future occupation, to be given some understanding of the scientific basis of life.

The future agriculturist must get experience of practical farm work, normally after leaving school, and the continuity of his education in the year or years of apprenticeship, involving the establishment of appropriate day or evening classes, has been the most difficult part of the whole scheme of agricultural education. The service of elementary technical education to the farming initiate is far behind its service to apprentices in urban industries. Transport difficulties in bringing a highly dispersed rural people to a teaching centre, combined with inadequate public opinion on agricultural education, made the task impossible in the early days of technical education. The small but definite measure of success in recent years among the junior post-school agriculturists is probably due more to the work of young farmers' clubs than any other single factor. This suggests that other and less formal methods than the orthodox technical classes may be necessary to establish the continuity of the education of young agriculturists from the school-leaving age, but orderly and systematic study must necessarily be the main activity, and the discipline of education must remain in agricultural education as in all education. Alternatively, compulsory continuation classes as were contemplated in the Education Act of 1918 may have to be considered. Certainly, continuity at this critical stage in agricultural education is a major problem, and once such continuity can be established many more agriculturists will come on to whole-time courses in farm institute, college or university.

The present arrangements of agricultural education, in addition to providing diverse courses of systematic instruction, also provide the farmer with free facilities for obtaining technical advice on his many problems. There seems, however, to be scope and need for the co-ordination of these facilities. Every county has its agricultural and horticultural staff, who advise on general problems of husbandry, and each of twelve groups of counties—the advisory provinces—into which England and Wales is divided for the purpose, has a specialist staff with an agricultural chemist, bacteriologist, economist, entomologist, mycologist and veterinary officer at the service of the agricultural and horticultural community. There is, however, no official connexion (except in one province) between the county and provincial services, and that is a matter that seems to require attention. It is difficult to see that advisory work can attain its maximum efficiency if those who advise on general husbandry have no administrative connexion with those who advise on special problems of infertility, disease, and so forth. A diseased turnip may be a complex problem to the farmer, but it remains an indivisible problem while those who advise the farmer on the growing of turnips and those who investigate and advise on the disease are in independent services.

Besides the need for co-ordination within the whole advisory services, the association of advisory work with the teaching function of the agricultural educationist is a matter of some moment. The creation of universal public opinion in the farming community in favour of comprehensive courses of agricultural studies has still to be achieved, and there is no doubt that those who successfully advise farmers on technical problems are, over and above their services in solving the immediate problem of the day, doing much to develop a realization of the significance of agricultural education. The identity or intimate association of those who advise farmers and those who teach their sons and daughters in the agricultural classroom is very much needed for some time to come. This association of advisory and teaching function does exist in large measure, but its significance and importance need to be very clearly kept in mind.

Whether or not it comes within the terms of reference of the Committee appointed by the Minister, the agricultural education of the non-

agriculturist is a problem of great national importance. We live in days in which a realization of the basic significance of farming to all people is forced upon us. We realize to-day, as never before since the coming of the industrial age, that farming is the basis, not merely of all the material necessities, but also of all the material amenities of life, and indeed, that it alone among the industries provides the token whereby all men in all ages and in all lands express their mutual goodwill, their loyalties, and all that discriminates human life from animal existence. There should, therefore, be a place in the education of everyone for the development of an appreciation of the farming industry, for acquiring knowledge and understanding of the manifold aspects of the farmer's life. The life and problems of the farming community are still fundamentally the life and problems of all people. The modern industrialist has not left farming as if it did not matter to him : he has delegated it to those who still work on the land, and it should not be too much to ask that all boys and girls be given instruction in the significant position of farming, and that their education will enable them, whatever their own calling, to cultivate an informed opinion about agriculture and its problems.

MODERN PHYSICAL CHEMISTRY

Text-Book of Physical Chemistry

By Dr. Samuel Glasstone. Pp. xiii+1289. (London : Macmillan and Co., Ltd., 1940.) 42*s*. net.

PHYSICAL chemistry is a somewhat vague but useful term which serves to indicate those parts of chemistry and physics in which the two sciences overlap. There are few subjects in which greater and more rapid advances have been made in the last thirty years : the development of atomic and molecular theory has introduced a host of new topics, and the older parts of the subject have been much clarified and extended, particularly in the treatment of thermodynamics, the theory of solutions, and electro-chemistry. There are in existence a number of monographs dealing with the newer topics, and Dr. Glasstone's two volumes of "Recent Advances" and his "Electrochemistry of Solutions" have been very helpful to chemists in approaching some parts of the subject. It has, however, been evident for some time that a book was needed which would weld the old and the new together into a consistent and comprehensive whole. This gigantic task has now been completed by Dr. Glasstone in the volume under review ; it has been carried out with the competence and clarity which characterize his earlier writings.

The book opens with chapters on atomic structure and radioactivity which are largely physical in character, and which introduce the quantum theory and the fundamentals of wave-mechanics. This is followed by an introduction to thermodynamics, using the Gibbs analytical method and the standard symbols which are now almost universally adopted for the more important thermodynamical functions. Next comes a group of chapters which treat logically a number of new and old topics under the headings of the gaseous state, the solid state, change of state, and the liquid state. The chapter on physical properties and chemical constitution is also a refreshing blend of old and new, and includes discussions of dipole moments, molecular spectra, and magnetism. The chapter on dilute solutions which follows embodies *inter alia* a clear statement of the three definitions of activity coefficient which are to be found in the literature. Phase equilibria are next discussed in a long chapter ; this is largely classical in character, and includes a treatment of three-component systems. The discussion of chemical equilibria which follows embodies an account of statistical methods of calculating entropy changes and a discussion of the third law of thermodynamics. Electrochemistry and chemical kinetics are the next topics to be considered ; the chapter on chemical kinetics includes an account of the Eyring-Polanyi theory of the activated complex and a discussion of modern views on homogeneous and heterogeneous catalysis. The final chapter, on surface phenomena, completes a volume of more than 1200 pages.

The treatment in general is a judicious mingling of deduction and description. Clear and adequate accounts of experimental methods and numerous diagrams and tables of data illustrate and enrich the theoretical discussions. The more elementary theory is lucidly set out, but the author does not hesitate to say "it can be shown that" when approaching the more abstruse parts of the subject. This, in the reviewer's opinion, is the proper method to employ in a book of this character : those who wish to delve more deeply into chemical physics rather than physical chemistry will find adequate guidance in the bibliographies which are appended to each chapter.

In his preface Dr. Glasstone modestly states that his aim is "to take a student with a very elementary knowledge of the subject . . . and to lead him by

easy stages and with the simplest mathematical methods to such an understanding of physical chemistry as will permit him to appreciate the more advanced treatises". This aim is fully achieved, and the new "Glasstone" will soon become well known to honours students in chemistry. It should, however, appeal to a wider public, for there are many chemists outside the universities who will welcome an opportunity of making themselves acquainted with the newer work and its relationship to the old.

S. SUGDEN.

DECREASE OF WILDFOWL THROUGHOUT THE WORLD

International Wildfowl Inquiry

Vol. 1 : Factors affecting the General Status of Wild Geese and Wild Duck. Pp. x+123. (Cambridge : At the University Press, 1941.) 8*s*. 6*d*. net.

THE disquieting fact has to be faced that the world's stock of wild geese and wild duck is steadily decreasing. To obtain accurate information on this decrease, and to seek some method of checking it, the International Committee for Bird Preservation recently carried out an exhaustive inquiry, the results of which are recorded in the volume under notice.

The destruction of bird life has so often in the past been allowed to continue until some rare species has been exterminated—witness the fate of the sea eagle, osprey and goshawk in Scotland —that it is good to know that some at least of European countries are alive to the potential danger in this decrease of their stock of geese and duck. Sweden, for example (p. 4), has afforded protection throughout the year for five years to all wildfowl in the large province of Jamtland. Contrast this with the state of affairs in Holland (p. 4) where it is estimated that a million wild duck are taken annually in decoys. It is satisfactory to know that few duck decoys are working in Britain. At one of these decoys—Orielton in Pembrokeshire—the duck are not killed, but after being caught and ringed are released. In the year 1935, 1,350 duck were caught and ringed here, and interesting light on their migrations has been shed. It is stated that in Eire and in Denmark duck decoys are illegal, but one wonders what the result of the present War will be as regards the praiseworthy efforts of European nations to conserve their stock of birds. Will Denmark continue such protection, and will Sweden continue to keep the great province of Jamtland a sanctuary ? One fears that in the present bitter warfare, birds everywhere are bound to suffer.

This book contains interesting information on the destruction of the eggs of duck and geese in the High North. Captain J. H. MacNeile (p. 23) describes the raids made by Norwegian sealing sloops on the eggs of the eiderduck, which nest in large colonies in Spitsbergen. On the low islands off the Spitsbergen coast brent geese nest in the eider colonies, and the egg hunters make no distinction between the eggs of geese and eiders. Captain MacNeile mentions that in 1935, in early July, hundreds of eggs of eiders and brent geese were taken on one island group alone. The eggs were then hard set and, it might have been thought, useless as food. Captain MacNeile writes :

"How long can the brent geese survive such treatment ? It seemed more than doubtful whether one single gosling could have been reared that year on any of the Liefde Bay islands, the principal stronghold of the species in northern Spitsbergen."

In Iceland the raven sucks great numbers of duck eggs. Major W. M. Congreve writes (p. 15) :

"Freme was responsible for shooting over fifty ravens on their morning and evening flights to Myvatn, from their distant mountain breeding homes. On the evening flight they were gorged with egg, and it was running from their beaks. Now one can say that this has always gone on. I suppose it has, but what has not gone on until, say, 50 years ago, is the invention of the breech-loading gun, with the everlasting shooting by every Tom, Dick and Harry all over Europe and North Africa."

Chapter 3 of the book deals with another possible cause for the diminution of wildfowl in Britain—the undoubted decrease of the wigeon grass (Zostera) during the past fifteen years. This decrease was specially noticeable in the years 1931 and 1932.

Chapter 7 gives many interesting results of wildfowl ringing. The earliest ringing of duck was by H. C. C. Mortensen in Denmark, who published reports on the teal (in 1908) and on the pintail (1914). Since then, duck have been ringed in large numbers in Iceland, Holland, Germany, Sweden, Finland, and Russia. An unusually interesting ringing record is (p. 98) of a young wigeon ringed in Kinross, and recovered far to the north-west, in Iceland, during its first winter.

INFLUENCE OF WAR UPON SURGERY*

By V. Zachary Cope

SURGERY or chirurgery is the handicraft of healing. It has always been an art, but only during the past hundred years has it become a science. In pre-historic and early historic times the craft must have been almost exclusively exercised upon the victims of inter-tribal war. The earliest crude knowledge of anatomy may have come from skulls cleft by the battle-axe, or chests or abdomens ripped open by spear or sword; and in like manner from the time of earliest combat primitive man must have learned various ways of dressing wounds, extracting arrows or spear-heads from wounds, or applying some form of crude splint to a broken limb. By the time of Hippocrates various methods of practical value had been learnt by experience and were generally taught, but for more than two thousand years little definite advance was made in the art of surgery. Garrison states that through even the sixteenth and seventeenth centuries surgical instruction was so poor that all authorities agreed that war was the only field in which surgery could be learned. The knowledge thus gained was crude, ill co-ordinated, and only advanced by the rough method of trial and error.

Scientific surgery was not possible until there was a knowledge of anatomy, physiology and pathology, and no great extension of surgery was possible before the discovery of anæsthesia. From the time of Hippocrates until Vesalius published his monumental work on anatomy, surgery made few advances. The foundation of physiology, made possible by Harvey's discovery of the circulation of the blood, brought little immediate change apart from the interesting but abortive attempts at blood transfusion by Wren and Lower. Right up to the nineteenth century there were few changes in the methods of treating wounds, apart from those necessitated by the type of missile used. When bullets were round and propelled with only low velocity they did less damage and were often allowed to remain in the body, but when the velocity became higher more damage was done and surgeons such as Larrey used to open up (débrider) the wound and if possible remove the bullet. The usual course of wounds of the limbs was, however, so serious that many surgeons used to recommend primary amputation, and as Garrison remarks, this was often done with reckless profusion by the half-instructed surgeons of the time. The middle of the nineteenth century saw light dawn upon this dark scene, and some of the light was reflected from the battlefield.

In 1846 ether was first used as an anæsthetic, and in 1847 Simpson discovered the value of chloroform for the same purpose. In the next year, 1848, occurred the civil disturbances in Paris and there were many wounded. The value of chloroform was immediately confirmed by Roux, who stated that he had employed it in all his operations with "very marked advantage and without the slightest inconvenience". Thus was shown for the first time how warfare may provide a favourable opportunity for trying out a new scientific remedy. Soon after this the relation of microbes to suppuration was shown by Pasteur, and in 1867 Lister demonstrated how the intelligent use of antiseptics could prevent suppuration in wounds. Though Lister's work was not everywhere received with an open mind, war provided the first great trial of the method. In the Franco-Prussian War of 1870–1871 the German surgeons were very ready to try any method which might give relief to the wounded, and many of them treated the wounds with antiseptics, particularly carbolic acid. But the strength of the solution used was not constant, the methods of using it in different hospitals were various, and the results so conflicting that, though its use became general before the end of the War, the conclusions as to its merit gained no general acceptance. Indeed, in the German history of that War the conclusion is reached "the campaign of 1870–1871 belongs to the pre-antiseptic era". Yet the account given in the history makes it plain that by this War the use of carbolic acid as an antiseptic for general use in operating became widely known among the rising German surgeons.

Though now largely replaced by the aseptic method, there is no doubt that the antiseptic method opened the way for the rapid and great advances which took place in general surgery during the latter half of the nineteenth century. By the beginning of this century surgery had advanced to such an extent that an almost complacent mood came over many who thought that it had attained the limit of its possibilities. To any who thought like this the last thirty years must have caused a rude awakening, for the titanic struggles of the nations—the War of 1914–18, the Spanish Civil War, and the present War—have shown the great limitations of surgery, and at the

* Substance of the Chadwick Public Lecture delivered on October 7.

same time have provided the most valuable opportunities for research.

It is true that little of surgical value came to us from the Boer War—in fact some of the deductions made from that war have been proved to be misleading. The chief result of value was the discovery of the value of inoculation against typhoid fever—a triumph with which the name of Almroth Wright will always be associated.

Surgery in the War of 1914-18

The war of 1914–1918 had a very great influence on surgery in all its branches, and it will be necessary to limit ourselves to some of the most striking advances either initiated or rapidly developed during the course of that War.

It has been well said that "in former wars tetanus was a calamity to be recorded and deplored; the war of 1914–1918 has shown that it is one which can largely be prevented". At the beginning of that War the incidence of tetanus was high, but when once prophylaxis was introduced the number of cases greatly diminished and remained so during the remainder of the War.

The War of 1914–18 helped largely to make of blood-transfusion an immediately available life-saving measure. So far as can be ascertained it was not until the seventeenth century that the transferring of blood to man, either from an animal or from another man, was considered a practicable proposition. But in spite of the many investigators who experimented with blood-transfusion, there were two great obstacles to the general adoption of the method; one was the clotting of the blood, the other the incompatability of one blood with another, leading to serious or fatal consequences. In the first decade of this century Landsteiner detected the agglutinins in blood, and Jansky and Moss were thereafter able to classify bloods into four groups and to say which were compatible. Just before the War of 1914–18 the method of preventing clotting by using paraffin-coated tubes was discovered, and actually in 1914 several observers noted that sodium citrate when added to blood prevented its coagulation and caused no harm when injected intravenously. It was after the War had already begun that the first transfusion with citrated blood was made by Agnote in Buenos Aires. There was a delay of two years before the great value of transfusion was realized by the contending armies, but when the American surgeons came across to Europe transfusion was rapidly developed and soon became a recognized measure for saving life. Banks of stored blood are available during the present War for the immediate treatment of shocked or exsanguinated patients, and a further advance has been the use of stored serum or plasma. There have indeed been some who say that there is at present too free a use of this method.

The treatment of wounds underwent great developments during the course of the War of 1914–18. At the beginning many surgeons had a blind faith in the efficacy of antiseptics to prevent or stop sepsis in a wound—a faith which they would scarcely have entertained if they had carefully studied the original writings of Lister. This simple faith was shattered by the work of Wright, Fleming and others, who showed that the antiseptics commonly used, for example, carbolic acid and perchloride of mercury, did more damage to the tissues than to the microbes hidden within them. This led to the use of other antiseptics such as flavine and the hypochlorites, which were more efficacious and did little damage to the tissues. Good results were also claimed for a mixture of bismuth, iodoform and paraffin (BIPP), using a technique introduced by Rutherford Morison. (Readers of Lister's papers will recall with interest that iodoform was the only antiseptic substance that he ever recommended to be introduced into the interior of a wound for its antiseptic effect.) But in order to apply any antiseptic the wound had to be opened up (débridement), and when it was opened up the difficulty of reaching all the damaged parts became evident. So by logical necessity surgeons were brought to see that the best method of avoiding septic wounds was thoroughly to excise the damaged tissues along the edges of the wound, and this ultimately became the routine treatment whenever possible. This excision of damaged tissues (wrongly called débridement) became standard treatment and constituted a wonderful advance in surgical technique. (It is only fair to state that this method had been advocated in the time of the Napoleonic wars by Desault and by Larrey, but they considered that it was only applicable to wounds of the soft parts of the face.)

During the War of 1914–18, thoracic surgery underwent considerable modifications and improvements, which have continued progressively to the present time. The free opening of the thorax, which before that War was a dreaded procedure, is now a daily occurrence.

A branch of surgery which may almost be said to have owed its origin to the War of 1914–18 is that of plastic work. In previous wars gunshot wounds had usually or frequently been made by bullets discharged from a distance, but in the terrible bombardments and close fighting of that War the character of the wounds by shells and bombs became more mutilating. Moreover, in trench warfare and with the wearing of metal

helmets the face was the only part left exposed and was therefore very frequently injured. Such injuries, if the patient survived and the wounds healed, produced terrible caricatures of the human face, and such revolting sights stimulated surgeons to devise methods of repair which should, so far as possible, restore parts to their original appearance. Thus arose the modern art of plastic surgery, in which patience, skill and ingenuity are more needed than in any other branch of surgery. It would take me too long to tell of the marvellous and ingenious turns of technique called into play in this art, how skin is made to travel caterpillar fashion from one part of the body to another, how noses are made from skin borrowed from one part and bone or cartilage taken from another area of the body, how large gaps in the jaw are made good by bone transferred from another bone and grafted on to the remnants of the broken jaw-bone, and many other marvels which are now of daily occurrence.

At the beginning of the War of 1914–18 gunshot injuries of joints were usually treated by incision into the joint, irrigation by antiseptic solutions and drainage by rubber tubes inserted into the cavity of the joint. As the War proceeded, however, it was found that to put a drain into a joint was bad technique, that incision of the infected parts of the wound and removal of foreign bodies with closure or almost complete closure of the joint-cavity led to much better results. After three years of war the improvement was so great that more than four-fifths of joint-wounds were healing by first intention without suppuration, and the amputation-rate at the base hospitals was down to 7 per cent. This was indeed a notable surgical advance directly due to the War.

The loss of a limb is not uncommon in peace-time, but in war it is a very frequent occurrence and it would not be surprising if the great experience of war-time should lead to improvements in the technique of amputation. As a matter of fact during the War of 1914–18 the terrible injuries and the frequent occurrence of gas gangrene frequently made formal amputation inadvisable, so that little technical advance was made in that direction. Ingenious advances were, however, made in the prosthetic apparatus to replace those limbs which were removed, for as the late Mr. Elmslie remarked, "progress in the design and manufacture of artificial limbs has usually occurred as a direct result of great wars".

Though the War of 1914–18 advanced surgery it did not greatly help surgical education. War surgery is very different from civil surgery. In that War, by force of circumstances or by the absence of proper grading, many men of little experience were compelled to do much operating. After the War it was soon evident that such operative experience did not constitute a full or adequate surgical training to cope with the great variety of civilian surgical work. In the present War a much better system has been used for choosing and grading surgeons for responsible work, and the benefit of this has already been observed.

Surgery in the Spanish Civil War

The statement that war provides the opportunity of trying out any new method of treatment needs to be qualified by the remark that the opportunity furnished is not always seized. During the Spanish Civil War, however, we had an example of man and opportunity meeting at the appropriate time. I have mentioned that in the War of 1914–18 excision of contaminated wounds proved the best treatment, but with very extensive wounds complicated by fractures and injury to joints, suppuration often could not be prevented, and the consequent frequent after-dressing, either by Carrell-Dakin technique or other means, proved very tedious and prolonged. Similar prolonged and inconvenient treatment had been necessary at one time in those cases of inflammation of bone in which the bone had been widely opened to let out the pus. Twenty years ago, Winnett-Orr proposed that it would be a better proceeding to give complete rest to the part by immobilizing it in plaster of Paris casing and letting the wound heal underneath the plaster. Though, *a priori*, this appeared a dirty and unsurgical method, yet it proved an unqualified success and saved much time and trouble to the surgeon and much discomfort and pain to the patient. It is quite possible that this method may have been applied to gunshot wounds of the limbs before the Spanish War—in fact a similar method is stated to have been used by some surgeons in the last century—but there is no manner of doubt that the credit for making this technique applicable to severe gunshot wounds of the limbs attended by fractures mainly belongs to Trueta.

Trueta practised excision of the damaged tissues of the wound and immediate encasement of the affected limb in plaster of Paris which, unless some complication became evident, was left on for five or six weeks before being changed. It was found that severe infection seldom ensued, that what infection was present usually subsided within a few days, that virulent streptococci which were often present at the beginning gradually disappeared, and the wound took on a healthy appearance so that when the plaster was removed it revealed a granulating surface and a uniting or united fracture. This simple method, which perhaps largely depends upon the perfect rest to the part,

has proved efficient in this present War and must be accounted one of the most remarkable advances in wound treatment of late years.

SURGERY IN THE PRESENT WAR

The present War has been raging for more than two years. Realizing the need and opportunities for research on certain problems the authorities have already arranged for special research units, and some useful information has resulted.

The bugbear of the surgeon is the streptococcus, deadly to human beings, often persistent and latent in wounds and sinuses and difficult to dislodge. A few years ago mankind was blessed by the discovery of a drug which, given internally, was able to diminish and often destroy the streptococcus wherever it might be in the body, except on the surface of wounds. Recently Colebrook has found that this drug, sulphonilamide, when put on to the surface of an infected wound, has a direct inhibitory or destructive effect on the streptococcus, and this discovery is full of promise.

The other discovery deals with the effect of blast upon the human body. Everyone is now aware of the terrible effect of the blast due to the bursting of a large high-explosive bomb. A person may be killed by this blast without any external mark of injury being apparent. How this lethal effect is produced and how it may be prevented has been the subject of a research by Zuckerman and by others who have already obtained results which are full of promise for the successful prevention of injury from the terrible injuring force.

INDIRECT RESULTS OF WAR UPON SURGERY

War affects a nation otherwise than by direct physical damage. Food-supplies are often diminished to a level which is incompatible with health, and various diseases may find a chance to flourish which could not gain a footing in normal times. This was shown by the statistics of surgical diseases as they occurred in one of the large Russian hospitals during the time of the War of 1914–18 and the subsequent revolution. The whole social framework of the country was broken for a time and disease of every kind was rife. Starvation and undernourishment were prevalent. In these circumstances it was noteworthy that the number of cases of appendicitis and cholecystitis diminished almost to vanishing point, while ulceration of the stomach and duodenum increased altogether out of proportion. It is certainly significant that the most common surgical disease of the abdomen should almost disappear when war compelled drastic reduction in the diet scheme. It may well be that many other factors were concerned in this reduction, but on the face of it there may be some indication as to the pathology of appendicitis.

Every wise practitioner is taught by time and experience that to prevent is better than to cure, or to speak paradoxically, prophylaxis is the better part of treatment. The best cure of wounds is to prevent them. So we may hope that future generations may profit by the terrible experiences of the present time and there may develop the perfect prophylaxis of the war disease—that for which all of us are longing—peace.

PLANNING, SCIENCE AND FREEDOM

BY PROF. F. A. HAYEK
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THE last ten years have witnessed in Great Britain a strong revival of a movement that for at least three generations has been a decisive force in the formation of opinion and the trend of social affairs in Europe: the movement for 'economic planning'. As in other countries—first in France and then particularly in Germany—this movement has been strongly supported and even led by men of science and engineers. It has now so far succeeded in capturing public opinion that what little opposition there is comes almost solely from a small group of economists. To these economists this movement seems not only to propose unsuitable means for the ends at which it aims; it also appears to them as the main cause of that destruction of individual liberty and spiritual freedom which is the great threat of our age. If these economists are right, a large number of men of science are unwittingly striving to create a state of affairs which they have most reason to fear. It is the purpose of the following sketch to outline the argument on which that view is based.

Any brief discussion of 'economic planning' is handicapped by the necessity of first explaining what precisely is meant by 'planning'. If the term were taken in its most general sense of a rational design of human institutions, there could be no room for argument about its desirability. But

although the popularity of 'planning' is at least partly due to this wider connotation of the word, it is now generally used in a narrower, more specific sense. It describes one only among the different principles which might be deliberately chosen for the organization of economic life : that of central direction of all economic effort as against its direction by competition. Planning, in other words, now means that not only the kind of economic system which we want to adopt should be rationally chosen, but that we should chose one that rests on 'conscious' or central control of all economic activity. It is evidently in this sense that, for example, Professor P. M. S. Blackett uses the term when he explains that "the object of planning is largely to overcome the results of competition"[1]. This narrow use of the term is of course meant to suggest that only this kind of economic organization is rational, and that therefore it alone deserves to be called planning. It is this contention which economists deny.

The full argument which leads to the conclusion that planning in the sense of central direction is in fact an inefficient system cannot be reproduced in a few sentences. But the gist of it is simple enough. It is that the competitive or price system makes possible the utilization of an amount of concrete knowledge which could never be achieved or approached without it. It is true, of course, that the director of any centrally planned system is likely to know more than any single entrepreneur under competition. But the former could not possibly use in his single plan all the combined knowledge of all the individual entrepreneurs that is used under competition. The knowledge which is significant here is not so much knowledge of general laws, but knowledge of particular facts and the ever-changing circumstances of the moment—a knowledge which only the man on the spot can possess. The problem of the maximum utilization of knowledge can therefore be solved only by some system which decentralizes the decisions. There is no possibility of a division between the general outline of the plan and the detail of the execution—or at least no way for such a division has yet been shown. The reason for this is that the general features are just the result of an infinity of detail, and there are no principles which, without harm, can be laid down irrespective of the detail. Yet, in order that in a decentralized system the individual decisions should be mutually adjusted to each other, it is of course essential that the individual entrepreneur should learn as promptly as possible about any relevant change in the conditions affecting the factors of production and the commodities with which he is concerned. Now this is precisely what the price system brings about *if* competition is functioning. It is in effect a system under which every change in conditions and opportunities is promptly and automatically registered so that the individual entrepreneur can read off, as it were, from a few gauges and in simple figures, the relevant results of everything which happens anywhere in the system with respect to the factors and commodities with which he is concerned.

This method of solving by an automatic decentralization a task which, if it had to be solved consciously, would exceed the powers of any human mind, would have been hailed as one of the most marvellous inventions—if it has been invented deliberately. Compared with it the more obvious method of solving the problem by central direction appears incredibly clumsy, primitive, and limited in scope. It is very significant that those socialist economists who have most carefully studied the practical problems of a socialist economy have more than once re-discovered competition and the price system as the best solution—only that unfortunately this system cannot work without private property[2]. For the general attitude towards the price system it has, however, been most unfortunate that it has not been deliberately invented, but that it has spontaneously grown up long before we had learnt to understand its operation. It seems to offend a deep instinct of the man of science and particularly the engineer to be asked to believe that anything which has not been deliberately constructed but is the result of a more or less accidental historical growth should be the best method for a human end. Yet the contention is of course not that by some miracle just that system has spontaneously developed which is best suited to modern civilization, but rather that the division of labour, which forms the basis of modern civilization, has been able to develop on a large scale only because man happened to tumble on the method which made this possible.

It is now sometimes argued—often by the same type of people who by their propaganda against competition have contributed largely towards its progressive suppression—that although all this is quite true, and although it would be desirable to have competition if it were still possible, technological facts prevent this, and that therefore central planning has become inevitable. This, however, is just one of the many myths which, like that of the 'potential plenty', are taken over by one propagandist work from another until they come to be regarded as established facts, although they have little relation to reality. There is no space here to discuss this point at any length, and it must suffice to quote the conclusion at which the most comprehensive recent investigaton of the facts has arrived. This is what the final report of

the investigation on the "Concentration of Economic Power", by the American Temporary National Economic Committee, has to say on the point: "It is sometimes asserted, or assumed, that large scale production, under the conditions of modern technology, is so much more efficient than small-scale production that competition must inevitably give way to monopoly as large establishments drive their smaller rivals from the field. But such generalization finds scant support in any evidence that is now at hand"[3]. Indeed few people who have watched economic development during the last twenty years or so can have much doubt that the progressive tendency towards monopoly is not the result of any spontaneous or inevitable force, but the effect of a deliberate policy of the Governments, inspired by the ideology of 'planning'. The really remarkable fact is the vitality of competition, which in spite of the persistent attempts towards its suppression is ever again raising its head—only to encounter new measures designed to stifle it.

It is a serious thing that in this situation men of science and engineers should so frequently be found leading a movement which in effect merely serves to support the unholy alliance between the monopolistic organizations of capital and labour, and that for a hundred men of science who attack competition and 'capitalism' scarcely one can be found who criticizes the restrictionist and protectionist policies which masquerade as 'planning' and which are the true cause of the 'frustration of science'. That this attitude should be so common among natural scientists can scarcely be fully explained by that characteristic bias for anything consciously constructed and against anything which has merely grown up, to which I have already alluded. It is at least as much due to the antagonism of so many natural scientists towards the teaching of economics, whose methods appear to them unfamiliar and strange, and whose results they often either disregard or, like Prof. L. Hogben, even violently attack as "the medieval rubbish taught as economics at our Universities"[4]. This conflict over the methods proper to the pursuit of the study of society is an old one and raises exceedingly complex and difficult problems. But as the prestige which the natural scientists enjoy with the public is so often used to discredit the results of the only systematic and sustained effort to increase our understanding of social phenomena, this dispute is a matter of sufficient importance to make in this context a few words of comment necessary.

If there were reason to suspect that the economists persist in their ways merely from the force of habit and in ignorance of the methods and techniques which in other fields have proved so eminently successful, there could indeed be grave doubt about the validity of their arguments. But attempts to advance the social sciences by a more or less close imitation of the methods of the natural sciences, far from being new, have been a constant feature for more than a century. The same objections against 'deductive' economics, the same proposals to make it at last 'scientific', and, it must be added, the same characteristic errors and primitive mistakes to which natural scientists approaching this field seem to be prone, have been repeated and discussed over and over again by successive generations of economists and sociologists and have led precisely nowhere. All the progress in the understanding of the phenomena which has been achieved has come from the economists patiently developing the technique which has grown out of their peculiar problems. But in their efforts they have constantly been embarrassed by famous physicists or biologists pronouncing in the name of science in favour of schemes or proposals which do not deserve serious consideration. It was expressing a common experience of all students of social problems when an American sociologist recently complained that "one of the most terrible examples of unscientific-mindedness is frequently an eminent natural, i.e., physical or biological scientist speaking on societal matters"[5].

As the dispute on central planning has become so closely connected with the dispute on the scientific validity of economics, it has been necessary briefly to refer to these matters. But this must not draw us away from our main theme. The technical inferiority or superiority of central planning over competition is not the sole or even the main problem. If the degree of economic efficiency were all that is at stake in this controversy, the dangers of a mistake would still be small compared with what they really are. But just as the alleged greater efficiency of central planning is not the only argument used in its favour, so the objections do not rest solely on its real inefficiency. It must indeed be admitted that if we wanted to make the distribution of incomes between individuals and groups conform to any predetermined absolute standard, central planning would be the only way in which this could be achieved. It could be argued—and has been argued—that it would be worth putting up with less efficiency if thereby greater distributive justice could be obtained. But unfortunately the same factors which make it possible in such a system to control the distribution of income also make it necessary to impose an arbitrary hierarchical order comprising the status of every individual and the place of practically all values of human life. In short, as is now being more and more generally recognized, economic planning inevitably leads to, and is the

cause of, the suppression of individual liberty and spiritual freedom which we know as the 'totalitarian' system. As has recently been said in NATURE by two eminent American engineers, "the State founded on dictatorial authority . . .and the planned economy are essentially one and the same thing"[6].

The reasons why the adoption of a system of central planning necessarily produces a totalitarian system are fairly simple. Whoever controls the means must decide which ends they are to serve. As under modern conditions control of economic activity means control of the material means for practically all our ends, it means control over nearly all our activities. The nature of the detailed scale of values which must guide the planning makes it impossible that it should be determined by anything like democratic means. The director of the planned system would have to impose his scale of values, his hierarchy of ends, which, if it is to be sufficient to determine the plan, must include a definite order of rank in which the status of each person is laid down. If the plan is to succeed or the planner to appear successful, the people must be made to believe that the objectives chosen are the right ones. Every criticism of the plan or the ideology underlying it must be treated as sabotage. There can be no freedom of thought, no freedom of the Press, where it is necessary that everything should be governed by a single system of thought. In theory Socialism may wish to enhance freedom, but in practice every kind of collectivism consistently carried through must produce the characteristic features which Fascism, Nazism and Communism have in common. Totalitarianism is nothing but consistent collectivism, the ruthless execution of the principle that 'the whole comes before the individual' and the direction of all members of society by a single will supposed to represent the 'whole'.

It would need much more space than can be given to it here to show in detail how such a system produces a despotic control in every sphere of life, and how in particular in Germany two generations of planners have prepared the soil for Nazism. This has been demonstrated elsewhere[7]. Nor is it possible here to show why planning tends to produce intense nationalism and international conflict[8], or why, as the editors of one of the most ambitious co-operative volumes on planning discovered to his sorrow, "most 'planners' are militant nationalists"[9]. We must turn here to a more immediate danger which the present trend in Great Britain creates. It is that of a growing divergence between the economic systems here and in the United States which threatens to make impossible any real economic collaboration between the two countries after the War. In the United States the present development is well described by the programme for restoring competition developed by President Roosevelt in the message to Congress of April 1938, which, in the President's words, is based on the thesis "not that the system of free private enterprise for profit has failed in this generation, but that it has not yet been tried"[10]. Of Great Britain, on the other hand, it could be rightly said about the same time that "there are many signs that British leaders are growing accustomed to thinking in terms of national development by controlled monopolies"[11]. This means that we are following the paths on which Germany has led and which the United States is abandoning because, as states the report on the "Concentration of Economic Power" to which the President's message gave rise, "the rise of political centralism is largely the result of economic centralism"[12]. The alternative is, of course, not *laisser-faire*, as this misleading and vague term is usually understood. Much needs to be done to ensure the effectiveness of competition; and a great deal can be done *outside* the market to supplement the results. But by the attempts to supplant it we deprive ourselves not only of an instrument which we cannot replace, but also of an institution without which there can be no freedom for the individual.

Nothing in this situation deserves to be studied and pondered so much as the intellectual history of Germany during the last two generations. What has to be realized is that the features which made her what she is are largely the same as those which made her admired and which still exert their fascination; and that the corruption of the German mind came largely from the top, the intellectual and scientific leaders. Men, undoubtedly great in their way, made Germany an artificially constructed State—'organized through and through', as the Germans prided themselves. This provided the soil in which Nazism grew and in which representatives of State-organized science were found among its most enthusiastic supporters. It was the 'scientific' organization of industry which deliberately created the giant monopolies and represented them as inevitable growths fifty years before it happened in Great Britain. The very type of social doctrine which is now so popular among some British men of science began to be preached by their German counterparts in the seventies and eighties of last century. The subservience of the men of science to whatever became official doctrine began with the great development of State-organized science which is the subject of so much eulogy in Great Britain. It was the State in which everyone tended to become a State employee and in which all pursuits

for profit were held in contempt which produced the disregard and final destruction of liberty which we now witness.

I shall conclude with an illustration of what I have said about the role of some of the great men of science of Imperial Germany. The famous physiologist Emil du Bois-Reymond was one of the leaders of the movement anxious to extend the methods of natural sciences to social phenomena and one of the first and most effective advocates of the now so fashionable view that "the history of natural science is the real history of mankind"[13]. It was also he who uttered what is perhaps the most shameful statement ever made by a man of science on behalf of his fellows. "We, the University of Berlin," he proclaimed in 1870 in a public oration as rector of the University, "quartered opposite the King's palace, are, by the deed of our foundation, the intellectual bodyguard of the house of Hohenzollern"[14]. The allegiance of the German scientist-politicians has since changed, but their respect for freedom has not increased. And the phenomenon is not confined to Germany. Has not Mr. J. G. Crowther recently, in a book which develops views so similar to du Bois-Reymond's, undertaken to defend even inquisition because, in his view, it "is beneficial to science when it protects a rising class"[15] ? On this view clearly all the persecutions of men of science by the Nazis after they came to power could be justified—for were not the latter then a "rising class" ?

[1] P. M. S. Blackett and others, "The Frustration of Science", Allen and Unwin (1935), p. 142.
[2] H. D. Dickinson, "Economics of Socialism", Oxford University Press (1939); O. Lange and F. M. Taylor, "On the Economic Theory of Socialism", University of Minnesota Press (1938); F. A. Hayek, *Economica*, N.S., 7 (1940).
[3] Final Report of the Temporary National Economic Committee ("T.N.E.C."), U.S.A., 77th Congress, 1st Session, Senate Document No. 35, 89.
[4] L. Hogben, "Education for an Age of Plenty", British Institute of Adult Education (1937), p. 10.
[5] R. Bain, *Social Philosophy*, 230 (April, 1939).
[6] F. B. Jewett and W. R. King, NATURE, 146, 826 (1940).
[7] W. Lippmann, "The Good Society", Little, Brown and Co. (1937); M. Polanyi, "The Contempt of Freedom", Watts and Co. (1940); W. Sulzbach, *Ethics*, 50 (April, 1940); F. A. Hayek, "Freedom and the Economic System", University of Chicago Press (1939).
[8] L. Robbins, "Economic Planning and International Order", Macmillan (1937).
[9] F. Mackenzie (ed.), "Planned Society", Prentice Hall (1937), p. xx.
[10] Final Report of the T.N.E.C., p. 20.
[11] *Spectator*, 337 (March 3, 1939).
[12] Final Report of the T.N.E.C., p. 5.
[13] Emil du Bois-Reymond, "Kulturwissenschaft und Naturwissenschaft" (1879).
[14] "A Speech on the German War", Delivered on August 3, 1870, before the University of Berlin, by Emil du Bois-Reymond, at that time Rector. London, Rd. Bentley (1870), p. 31.
[15] J. G. Crowther, "The Social Relations of Science", Macmillan (1940), p. 333.

THE SCIENTIFIC APPROACH TO COLONIAL DEVELOPMENT*

BY THE RIGHT HON. LORD HAILEY, G.C.S.I., G.C.M.G., G.C.I.E.

IN discussing colonial conditions, I shall in the main limit myself to those prevailing in the British Colonies. The character of the British colonial empire was modified as a result of the expansionist policy of the latter part of the last century. The Indian Empire and Burma have, of course, never been ranked as colonies. Up to about the eighties of last century, therefore, the Colonies comprised mainly Ceylon and a small part of Malaya in the eastern hemisphere, a number of trading settlements on the coasts of Africa, and in the western hemisphere, the old British possessions in the West Indies. The period of expansion added in Africa alone an area roughly equal to that of British India, together with parts of Borneo, an extended area in Malaya, and some of the Southern Pacific islands. The new territories were largely tropical in character; but, what is more important, the majority of their populations were at a stage at which they had needs, both material and social, far greater than those of some of the older dependencies. Judged in terms of approach to our own type of civilization, they were far more backward. On the other hand, we had then available to us the result of much previous experience of colonial development; above all, we had by this time at our service an amount of knowledge regarding the employment of the applied sciences in social development which was far in advance of that possessed by our predecessors. We had another advantage. Earlier in the last century, tropical products (excluding, of course, certain of the minerals, and the precious metals) were in demand only in the luxury market of the more highly developed countries. But the rapid growth of standards of living in those countries has made the luxuries of our grandfathers the necessities of whole populations to-day. Such things as cocoa, the great range of vegetable oils, coffee or bananas are typical of the tropical products which have become essential to the general population of Europe and America, and thus can assist the tropical peoples in financing the social services needed to improve their standards of life.

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* Substance of a paper read at the Conference on Science and World Order on September 27.

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knowledge about the social customs of primitive peoples. It may be that the existing customs of these people in such matters as the holding of property, the regulation of conduct by tribal or community ties, and the like, has had its analogy in the past history of our own and other highly organized peoples. But we are now divided from the primitive peoples by a gulf which makes the process of their adjustment to modern civilization far more difficult than that of many of the Eastern peoples. Our anthropological study may, at the period of which I am speaking, have been interested in the form rather than in the function of custom. But we had the means of appreciating the fact that the gulf could not be suddenly closed by a hasty substitution of our own social conceptions and practices, but must be bridged by a studied adaptation of existing custom to modern uses.

I can best illustrate the character of the problem with which I have set out to deal, if I ask how far we have actually availed ourselves of these opportunities in planning the development of the new areas which the events of the latter half of the last century brought into our possession. We need not concern ourselves here with the preliminary stage through which all colonial development must pass, I mean the introduction of law and order, and the provision of those more elementary requirements, in the form of communications and the like, which will enable the population to begin building up its material existence. We are concerned here with the secondary stage, of which the chief feature is, or should be, the conscious planning of the improvement of its standards of life.

We can afford to avoid at this point any discussion as to the nature of the ultimate objective of this development—whether, for example, we desire to Europeanize the dependent peoples, or what is the nature of the synthesis between the indigenous culture and our own culture which we seek to attain. These are no doubt questions which must have their answer at some stage, but the answer is one which is in the end more likely to be provided by the dependent peoples themselves than by us. I confine myself here to matters which we cannot doubt to be within our grasp, given a due attention to careful planning and systematic execution.

We must see that the colonial peoples have that type of nutrition which will establish the necessary measure of resistance to disease. We must secure for them a subsistence adequate to provide the strength necessary for sustained effort in cultivation or industry. They must have access to medical facilities for dealing with physical disorders, epidemic or otherwise ; and access to such measure of popular instruction as will enable the mass of people to adjust themselves to the needs of new economic and cultural conditions. These are fundamentals, and precondition all further social progress.

But planning, even at this early stage, cannot halt there. We interpret economics to-day in terms of welfare, not of wealth ; but it is a condition of welfare that the Government should itself have the means of raising finance for capital works or for the provision of social services, and that the population should be furnished with the means of acquiring articles which a non-industrialized country must necessarily import. All the exportable assets of the territory, whether in the form of metals or of exportable crops, must therefore be turned to the best account. But this must at the same time be effected on terms which will avoid prejudice to the primary claims of subsistence production or undue disturbance to a social economy not yet adjusted to the needs of industrial life.

How far have we planned scientifically for development on the lines which I have just described ? For I take it that the use of science in colonial development means just this, that we start by surveying the whole field in order to get the problems which it presents into proper alignment, and afterwards proceed systematically to their solution, using the most expert agencies available for advice as to the methods to be employed, and expending the resources at our command in the order which the relative importance of our problems indicates.

It is doubtless unduly idealistic to suggest that we could ever have proceeded on lines involving so much prevision and systematic procedure as this involves. It is at all events clear that we did not do so. We have, for example, in many instances allowed concentration on the cultivation of export crops to outweigh the needs of subsistence production, with results no doubt less disastrous than those which at one time attended the use of the culture system in the Netherlands East Indies, but sufficiently grave to require legislation compelling a minimum subsistence cultivation, in order to prevent famine. It is only in the last few years that we have inaugurated a general survey of nutritional conditions in the Colonies. It required the revelations regarding the ravages of sleeping sickness in the neighbourhood of Lake Victoria during the years 1901–1905, where we owed much to inquiries initiated by the Royal Society, to bring home to our administrations the deplorable health conditions prevailing in many parts of Africa, and there are still many areas in which no general survey of these conditions has yet been made. The extent of popular education was for long dependent on missionary initiative, and the State did not control

the curriculum. It is only of very recent years that we have realized the widespread menace of soil erosion and the need for special measures for conserving soil fertility.

Passing to another field, there are many territories where geological survey has been very superficial, and the discovery of mineral deposits has been left to the initiative of individual prospectors, who have been primarily interested only in the precious metals. Land survey has in some cases been so exiguous that railways have had to be realigned at great cost owing to the lack of accurate maps. Or take yet another field. Native land tenure systems have in Africa still to come under comprehensive survey, though agricultural progress must largely depend on the evolution of a definite and easily recognizable system of land rights. Recruitment of labour for industrial enterprises has not until lately been regulated by any programme based on the capacity of different areas to provide man-power without undue social disturbance or interference with subsistence cultivation. It has been left to the management of these enterprises to investigate the most suitable dietary for labour and to apply it at their own discretion.

We must readily admit the obstacles which have stood in the way of a systematic planning of development. No one can justly overlook these, just as no one should underestimate the vast improvement which we have actually made in the life of the dependent peoples, or the services which the high sense of duty of the administrative staff has rendered to them. Nor must one overlook the many contributions which have been made, especially of late years, by our scientific bodies and the labours of individual men of science. It is sometimes said, that if we have failed to be more systematic in our policy of development, it is because we are not ourselves either a very logical or a scientifically minded people. In our own national life we prefer to act on a sense of expedience rather than on principle; we trust to improvisation rather than to logical scheming, holding that this is more flexible and more readily adjustable to the complexities of actual situations than are the results of more abstract thinking.

Our colonial policy has in the past been dominated by certain traditions derived from our own political instincts, and by the conditions in which we originally acquired jurisdiction over our dependent peoples. We saw our first duty in protecting them from exploitation and misrule and in fitting them to maintain, in a political sense, their own position in the world. That tradition was far from unworthy, but it may be that it unduly diverted our attention from the need of pursuing a constructive policy of improvement in the physical conditions and the standards of life of these people. In the second place, we have in the past tended in our own domestic life to look on the State chiefly as a political organization, and not as one of which the primary function is the promotion of the social welfare, the health and the standards of life of its citizens. This generation has seen a radical change in our conception of the functions of the State, and with it has come a new and more constructive outlook on the activities which should engage the attention of a colonial administration.

This changed conception of the functions of the State has had a marked influence on the attitude of the British public itself towards its colonial obligations. It was in the past usual to make an appeal to a sense of trusteeship, a trusteeship which, in a well-known phrase, ought to be exercised alike in the interests of dependent peoples and those of civilization. But that form of appeal had its limitations. It was capable of a great variety of interpretations, and it supplied no standard for action. It left it open to the public to feel that it could satisfy its sense of obligation by the maintenance of a humane system of administration and by taking a liberal view of the political future of its dependants. But the new conception of the functions of the State puts our colonial obligations on a concrete plane, and one with which the public is not unfamiliar.

It is the general acceptance of this new conception of the State in relation to the provision of social services which rendered it relatively easy to secure the liberal provision of funds guaranteed by the Colonial Welfare Act passed in 1940. We started at the outset with the feeling that a Colony should be self-supporting. We advanced a further stage when the Colonial Development Fund Act of 1929 made it possible to spend up to a million pounds a year on assistance to certain of the social services, or on types of inquiry which the Colonies were not able to finance. The Act of 1940, however, is a final recognition that further development cannot be achieved without more far-reaching and more consistent assistance.

It is now the task of the administrator to make a full use, and at the same time a more scientific use, of this position. Let me indicate some of the directions which the more scientific use of the opportunities now presented might profitably take. I will begin with some of our more fundamental needs. In the first place, we need to place our demographic information on a more satisfactory basis. Even the total population of some of our territories is a matter of assumption and dependable vital statistics are generally unobtainable. The extension of land survey is essential, at all events so far as regards geodetic triangulation, in order to

provide the network within which cadastral survey can be conducted as it becomes necessary. We must not repeat the experience of South Africa, which paid heavily for its delay in carrying out the scheme of triangulation put forward by Sir David Gill in the seventies of last century. Again, the fuller knowledge of our colonial assets demands an expanded service of geological survey; the discoveries made by the Government geological staff in the Gold Coast and Sierra Leone, show how ample a return the Government revenues can secure for the small outlay involved. To-day much of the energy of our small geological staff is diverted in some areas to the provision of water supplies or the regulation of mining licences. I have referred to the inauguration of a nutrition survey, a movement largely stimulated by the work of Sir John Orr and his colleagues in Kenya, but the specialist staff engaged is relatively small, and in only one or two cases has the survey been associated with the sociological survey which must be an essential part of a study of this nature. It is not enough to know if a dietary is inadequate or ill-balanced; we must know also the social habit which determines its selection or hinders the use of available substitutes.

As regards health work I have already pointed out the absence in many territories of a complete survey of health conditions. There have been studies carried out of particular localities which have proved of the highest value, but much has still to be done in this direction. Thus, to take an example from Africa, we know as yet very little about the exact range of the 'dormant' or 'silent' stage of yellow fever, and we should indeed know less but for the aid given by the Rockefeller Foundation. The incidence of tuberculosis is still unexplored, and there is reason for believing that previous assumptions on the incidence of leprosy are largely incorrect. It is essential again that we should have a more precise knowledge of the effects of tropical and particularly equatorial climates on the physical condition of Europeans. It is equally necessary that we should know whether there are any such fundamental differences in the physical constitution of tropical peoples as will effect the application to them of the European system of curative medicine.

Our work of survey must necessarily include also studies on the social side. One such is that into land tenures, to which I have already referred. Another is the study of the procedure of native marketing, on the improvement of which depends the expansion of the internal economy of the Colonies. A third is the investigation of the extent to which indigenous customary law affords a basis for the formulation of a uniform legal system which will adjust the procedure of European law to the requirements of the more primitive populations.

It is to be hoped that much of this work will become practicable when the special fund for research provided by the Act of 1940 becomes available after the War. The provision which Parliament has thus made for colonial research is in itself significant of the new order of ideas, and I know of no parallel to such a measure in other countries. But survey, though essential to systematic planning, is only part of a scientific approach to colonial development. There still remains the need for research into the wide range of specific problems arising in the field both of the applied and social sciences, which require local investigation either because they are peculiar to colonial conditions or because, though more general in character, they present features which can only be studied within the Colonies themselves.

Here I suggest that there are certain guiding considerations. It is advisable that the facilities afforded by our great imperial institutions of research should be utilized to the fullest extent and that the energies of colonial research workers should be strictly limited to problems requiring local inquiry. One is struck by the limitations imposed on the research worker by isolation alike from the assistance and the criticism of professional colleagues. The well-known study into the alleged mental deficiency of Africans made a few years ago at Nairobi would have taken a very different form if it had been made in the more critical atmosphere of a European intellectual centre. Secondly, we should seek to group colonial research workers into suitable centres and to bring their work under some form of professional direction. At present the staff engaged in research is liable to have its energies diverted to routine work, and when it undertakes longer range inquiries the subject is often dictated by its own choice or pressed on it by the local interests which are in a position to influence its services.

There arises a further problem for which I have some difficulty in suggesting a solution. It is possible to envisage group centres for agricultural, medical or similar research, each under its own professional direction. But how are the efforts of these different departments of inquiry to be co-ordinated? Few of the major problems of the Colonies can be solved by specialists in one branch of inquiry alone. What agency is there which can exercise joint direction over these different interests in research, or at all events decide the relative importance of their application in practice? That is a question to which the lay administrator would certainly welcome an answer.

Let me add one final consideration. I have purposely refrained from instituting comparisons which might suggest that other colonial powers have given either greater or less attention to

scientific planning than we have ourselves. I have therefore made no reference to the extensive study of the economics of production made by the Dutch in their East Indies, or the use made in the French Colonies of their metropolitan research institutions, such as the Pasteur Institute, of the scientific approach made by the Belgians to certain aspects of medical work and to the problems of labour supply, or the unusually extensive programme of scientific inquiries with which Italy inaugurated its regime in Ethiopia. But if any lesson would seem likely to emerge from such a comparison it is this. Admitting a certain difference in policy and ideals, there is a very striking resemblance in our concrete problems. That we should seek for every means of co-operation in solving them is so obvious as to be commonplace. But how far does this co-operation extend at present? In one sense, of course, all scientific inquiry is co-operative in so far as its published results are the common possession of all men of science. We have again had instances, though not as many as might be expected, of international conferences on scientific subjects which have a bearing on colonial development. But there are not many instances of combined planning for dealing with specific problems in the field of the applied or social sciences. An outstanding instance to the contrary is that of anti-locust research, which has become largely international in character. There are perhaps other instances, but they must be few. Their restricted scope justifies, at all events, the suggestion that a modern world which can combine to control the production of tea or rubber, or tin, or copper, in the interests of an investing public, might well find the means of exhibiting a greater solidarity in dealing with issues vital to the welfare of the colonial peoples.

OBITUARIES

Prof. N. K. Koltzov

ON December 2, 1940, science suffered a severe loss in the death of Nicolai K. Koltzov, the great Russian biologist. Born in Moscow in 1872 and educated at the University of Moscow, Koltzov began research as a comparative anatomist and his first paper was on the development of the amphibian pelvis. Other early work of his was in the direction of the development of the head, especially in cyclostomes.

When Koltzov turned his attention, however, to the structure of spermatozoa, beginning with those of the decapod Crustacea, which are extremely elaborate, he found himself entering a line of work which was to continue throughout his life. From 1905 onwards he was more and more fascinated by the structures in cells which seem to maintain their morphological shape. While others arrived at the conception of fibre-molecules, anisometric polymerized particles, etc., from the study of mammalian muscle fibres, Koltzov approached it from the study of cells such as crustacean spermatozoa and contractile fibres such as the stalks of Vorticella. Already in 1912, long before any X-ray analysis had been applied to fibres of biological origin, Koltzov proposed in *Priroda* that much of the morphology of cells is due to the actual shape of the molecules within them. Even in 1928, when he elaborated these views in a classical paper in the *Biologisches Centralblatt*, he had little more to go upon than the polypeptide chain conceptions of Emil Fischer. The establishment of the anisometric character of myosin particles by optical and viscosimetric methods did not come to confirm him until after 1930. In Russia the view that the shape of cells is determined largely by "solid" protoplasmic "skeletal" elements immersed in more liquid or semi-liquid protoplasm, is known as "Koltzov's Principle", and as time goes on this term may come to be more widely used. In 1928, too, Koltzov suggested that the chromosome might perhaps be regarded as a protein giant-molecule, of which genes might be side-chains; a conception which has since been found stimulating and fruitful.

Koltzov's papers, not very numerous, but all on fundamental problems, were collected into a book "Organisatsia Kletke" ("The Organization of the Cell"; Moscow, 1936) but he also published two excellent monographs, "Physiologie du Développement et Génétique" (Paris, 1935) and "Les Molécules Héréditaires" (Paris, 1939). Besides his researches, he founded in 1917 in Moscow the first Institute of Experimental Biology in Russia, of which for the rest of his life he was the loved and respected leader. He also founded and edited, until his death, the *Biologicheskij Zhurnal*, known to many British biologists. Among his students and colleagues were names so well known internationally as Zavadovsky, Serebrovsky, Efimov, Astaurov, Dubinin, Epstein, Filatov, Lopaschov and Manuilova.

I had the great pleasure of visiting Prof. Koltzov and his wife (also a research worker) in their laboratory and institute in 1935, and of appreciating the admirable atmosphere of collaborative work which reigned there among all its members. On November 27, 1940, Koltzov was interrupted in his work by a sudden heart attack. He was preparing a lecture which he would have delivered at the February, 1941, meeting of the Moscow Society of Naturalists. Its title was "Morphology and Chemistry". It was typical of him, this choice of a fundamental subject,

and it summarized the aim to which his whole life had been devoted. Had it not been for the fact that he remained primarily a biologist to the end, thus lessening somewhat the parallelism between their lives, we might well have come to think of him as the Russian W. B. Hardy. JOSEPH NEEDHAM.

Mr. I. O. Griffith

BY the sudden death of Mr. I. O. Griffith on September 22, the day before his sixty-first birthday, the University of Oxford, and especially the science faculties, have lost more than can be easily measured. As member of the Hebdomadal Council, vice-chairman of the General Board, chairman of the Board of Faculty, treasurer of the Natural Science Club, he held a key position in the scientific administration in the University. Whatever the branch of science and however remote from his own special loves, mathematics and physics, he could always be counted upon to make every effort to help to bring a project to fruition. He will be indeed difficult to replace in the councils of the University.

After his distinguished flying work, mainly on the navigational side, in the R.A.F., during 1914–18, which earned him the Air Force Cross, he returned to Oxford as senior demonstrator in the Clarendon Laboratory. Always keenly interested in teaching he was mainly responsible for building up the advanced course and organizing the expansion of the Department which trebled or quadrupled its activities during his period of office. His work on the measurement of temperature in the high-pressure arc led on to the well-known monograph on photographic photometry published by himself and Dr. Dobson. But his conscientious devotion to his students' interest left him scant time for research, and it is in their activities and records that his main contributions to physics will be discerned.

The departure of many of his younger colleagues since the outbreak of war left him with more teaching than ever to do. Always ready to help, he had one task after another thrust upon him. True to his old service, he accepted the important and onerous duty of looking after the Air Force cadets in the University and organizing their teaching. No better choice could have been made, and the immediate success of the scheme is evidence of his tireless work and administrative ability.

It is impossible to describe Griffith's peculiar personal charm in words. Invariably cheerful and friendly, he could be relied on to face an acrimonious debate on the Board of Faculty or a critical situation in a crucial golf match with equal adequacy. Free from any thought of self, he devoted all his efforts to the advantage of his pupils and his colleagues. A keen member of his College, he never allowed parochial patriotism to over-ride his devotion to the interests of the University. His balanced judgment confuted those who delight to paint the average don as a creature of moods and foibles with an outlook bounded by curricula and examinations. Void of the glitter and clash of more metallic personalities he did great work for his University and his country which will bear fruit long after the more strident voices, which so easily gain popular acclaim, have died away.

Prof. R. B. Wild

IT is with regret that we record the death on October 7 of Prof. R. B. Wild, emeritus professor of materia medica and therapeutics in the University of Manchester.

Educated at Owens College, Prof. Wild was associated with Manchester throughout his active career. After serving for a time as an assistant lecturer in the Department of Pathology he transferred his affection to the subjects of pharmacology and therapeutics and joined the staff of the late Prof. D. J. Leech. The two men developed an active Department in which important work in experimental pharmacology was done, the most significant being a study of the effects of the nitrites upon the circulatory system. One of the results of their researches was the recognition of amyl nitrite as an official preparation.

On the death of Leech in 1900, Wild was elected to the chair and in 1919 became the first whole-time Leech professor of materia medica and therapeutics. When in consulting practice, Wild was recognized as an authority on dermatology and he wrote a number of papers on diseases of the skin. For many years he was intimately associated with the Christie Cancer Pavilion and Home; he was responsible for the medical side of the work and played a leading part in the administration of the institution. Throughout his teaching career he was untiring in his efforts to develop and improve the Faculty of Medicine and his contributions to medical education were of the greatest value. For a time he was dean of the Medical School and the representative of the University on the General Medical Council. As a member of Senate he took a prominent part in general University affairs and acted for a period as one of the pro-vice-chancellors. He retired in 1927, when he ceased to live in Manchester, but still kept in touch with the University and city which he served so conscientiously and well. J. S. B. STOPFORD.

WE regret to announce the following deaths:

Mr. W. A. Bailey, chief conservator of forests, Indian Forest Service, on July 14.

Mr. Norman de Garis Davies, the well-known Egyptologist, on November 5, aged seventy-six.

Dr. Walter Granger, curator of fossil mammals in the American Museum of Natural History, on September 6, aged sixty-eight.

Prof. C. M. Sparrow, professor of physics in the University of Virginia, on August 30, aged sixty-one.

Prof. T. H. Taliaferro, professor of mathematics in the University of Maryland, on September 25, aged seventy.

NEWS AND VIEWS

Science Clubs of America

A NATIONAL science activity, Science Clubs of America, is being sponsored by Science Service, the American science news service. In every locality throughout the country there will be groups active in various fields of science. Science clubs in high schools will be encouraged and given the opportunity of joining in the national movement and entering into national activities. Groups of enthusiastic amateurs in science—grinding telescope mirrors, collecting insects, breeding new plants, collecting minerals, or pursuing scores of other interesting avocations—will join in this important development. As the nucleus of Science Clubs of America, there are more than eight hundred junior clubs which have been organized during the past fourteen years by the American Institute of the City of New York. These clubs exist not only in the United States but also in Puerto Rico, Hawaii, the Philippines, British West Indies, Alaska, Canada, and even Portugal. An advisory committee on Science Clubs of America, representing jointly the American Institute and Science Service, is being formed.

Excavations in Alaska

Dr. H. L. Shapiro and Dr. F. G. Rainey, of the American Museum of Natural History, have been excavating five hundred arctic tombs at Point Hope, Alaska. The five hundred skeletons are said to form one of the largest collections of the sort ever found at a site in America. The two anthropologists sought remains of an ancient and unknown people, whom Dr. Rainey first discovered in expeditions of 1939 and 1940. Also they sought later Eskimo burials which would aid in showing what relationship the lost ancients had to the later Eskimos. The mysterious unknown people had a remarkably big town with well-planned streets, more than a hundred miles north of the Arctic Circle; and about two thousand years ago they abandoned this settlement. They are looked upon as a lost race, because their ivory arts are unlike those of known Alaskan Eskimos, ancient or modern. Also, it is explained, they lacked many typical Eskimo implements, and were more dependent on land than on the sea for their resources.

Dr. Shapiro plans to examine the physical traits of the forgotten northerners, to place them more definitely in the story of prehistoric America. The Ipiutaks, as they are now called from the Eskimo name of a spit of land near their old home, may have come from as far away in Asia as north China, according to one suggestion. A new glimpse into curious burial customs of the Ipiutaks is revealed by a carved ivory mask with staring inset ivory eyes, which was found covering the body of a little child. The child lay resting on the knees of a man, and a woman also accompanies it. Masks with ivory eyes have been found before in the graves of these mystery people, but what their significance was for a future life remains one of the unsolved puzzles of the arctic.

Koalas in Australia

A CENSUS of koalas on Phillip Island, Victoria, was taken this year with the aid of school-children, and, we are informed by Sir James Barrett, the count shows a record population of 590, a natural increase of thirty-nine over the number shown after the census of July 1939. Many *Eucalyptus viminalis* and red gum, on which the animals feed, are being planted. The koalas are now confined to the eastern fringe of the Australian mainland, from southern Queensland to Victoria. They used to be present in South Australia, but, apart from some imported from Victoria and maintained in sanctuaries, it is doubtful if there are any there now. According to *Wild Life*, the Australian nature magazine, the combined Victorian population is somewhere between 900 and 1,100 individuals. This compares very unfavourably with the number of koala pelts marketed during 1920 and 1921, namely, 205,679.

The koala fur is remarkably warm and is practically indestructible, a jacket made of it often being passed down from father to son for several generations. This, no doubt, accounts for the dwindling of the koala. Other factors have been deforestation, disease, and, above all, bush fires. The last-named is the prevalent danger. Steps are being taken to combat this, expecially on Phillip Island, where efforts are also being made to supply an abundance of natural food and shelter in open sanctuary conditions. Two large areas have been set aside for the purpose, one of 256 acres and the other of 160 acres. Money is still required for this conservation. It is estimated that a preliminary grant in Victoria of £500 a year would enable the work to be carried on satisfactorily; and it is to be hoped that such a comparatively small sum will soon be assured, preferably from the various Australian Governments, or from the natural history societies or private individuals.

Trees and their Care

IN the July–September issue of *Trees*, the journal of the Men of the Trees, it is stated that the money already received in connexion with the Million Shilling Fund has enabled about 90,000 trees, hardwoods and softwoods, to be planted in Great Britain. Exception appears to have been taken to the fact that some of these trees have been presented to landowners who have already been paid for timber supplied for war purposes. It is said in defence that since these people have trained foresters and planters, the trees will be better looked after; but surely the man who can afford to maintain a trained forester can afford the mere price of the plants necessary to replant felled areas. It is difficult to

see any justification in supplying him from a fund of small subscriptions given, presumably, by a tree-loving public.

In a brief note elsewhere "To Intending Planters", by H. E. Seaton, the sound advice is given, in deciding upon planting schemes, to remember that "pure woods of alien trees are not modern practice; but that mixed woods of trees which do well locally are likely to succeed and are fairly fool-proof". How often has this been forgotten, even by those professing forestry knowledge. "Tree Shelter for Cattle", by S. F. B. Lane, is a much-needed reminder to farmers of the dangers being introduced in many parts of Britain by the indiscriminate tree felling which is taking place. Not only cattle, but also crops will suffer from the resultant exposure. An interesting article by H. E. Seaton on "Sewage and Civilization" (reprinted from the Rotary Service, Nov. 1940) sums up research work carried out by, among others, Dr. McCarrison and Sir Albert Howard in connexion with obtaining the present food for man and beast by a future suitable treatment of soils.

The British Empire Naturalists' Association

THE twentieth issue of the quarterly bulletin of the British Empire Naturalists' Association contains its usual summary of current field records and also the interesting announcement of the revival in octavo form, as in the War of 1914–18, of its well-known journal *Country-Side*, which had to be suspended at the outbreak of war. This decision is made possible with the very considerable—perhaps unexpected—interest in field natural history that has been maintained in Great Britain despite the War, and often in the most heavily raided centres like London and Merseyside. The first issue of the new abbreviated form of this journal is expected in December.

Among botanical records in the autumn issue of the bulletin are creeping bellflower (*C. ranunculoides*) and willow-leaved spiræa (*S. salicifolia*) in the Cotswolds, thorn-apple (Datura) spreading over bomb craters in Kent and greater spearwort at Chippenham, Wiltshire. Entomological records show a very wide distribution of the clouded yellow butterfly during its immigration from the Continent this summer, records extending into Scotland. The pale clouded yellow is recorded from Cheshire, several white admirals from the Borough Green area of Kent and the Ruislip area of Middlesex, high brown fritillaries from the west Lancashire dunes, and the marbled white at Chippenham, Wiltshire. Ornithological reports include the black-necked grebe, white wagtail and shoveler nesting in Cheshire, and little gull, spotted redshank, greenshank, and sandwich tern on migration; grasshopper warbler nesting in Lancashire, and the little gull and red-necked phalarope on migration.

Future of Telecommunications

IN an address before the London Students' Section of the Institution of Electrical Engineers on October 15, Dr. W. G. Radley, of the Post Office Research Station at Dollis Hill, spoke on Telecommunications of the future. He pointed out that in 1914, although wire telephony had been in use for about forty years and had become an important factor in the social and business life of urban communities, the loss in speech power during transmission imposed definite limits to long-distance conversations. These limits disappeared as a result of the general introduction of thermionic valve amplifiers. Later on, the long-distance circuits which became possible were made cheaper by the development of systems of carrier-current telephony, culminating in a standard system providing twelve speech channels over one pair of wires. A novel form of co-axial cable followed. This was capable of transmitting television or providing several hundred speech channels over two conductors. In the meantime, the transmission of speech by radio had made world-wide telephony possible. Each of these developments was the result of a long period of experimental work.

From the position of research work in 1939, it is possible to hazard a guess at the nature of the telephone system during the post-war period. The disappearance of metallic conductors, and the development of long-distance speech transmission by means of what is virtually guided radio waves, is a future possibility. Research into the nature of speech sounds has made it possible recently to construct a machine which will speak under the control of an operator at a keyboard. An extension of this idea suggests the possibility of analysing speech in a local circuit, transmitting signals over the long-distance line corresponding to the results of the analysis and at the distant end automatically reconstructing the speech. The frequency band necessary for transmission of the signals over the long-distance line is very much narrower than that necessary for ordinary telephony, and this would enable more circuits to be obtained from long expensive submarine telephone cables. Improvements during the post-war period would probably lead eventually to the disappearance of telephone operators, except for special services. Improved fidelity of response of microphones and telephone receivers was foreshadowed, but no immediate change in principle.

The Royal Observatory, Cape of Good Hope

THE report for 1940 of H.M. Astronomer at the Cape of Good Hope illustrates how astronomical work in the belligerent countries is being affected even though they may be far removed from the present scene of hostilities. Half the observing staff at the Cape is now engaged on non-astronomical duties, this at a time when so many observatories in Europe have perforce suspended work. Nevertheless the depleted staff is doing its best to secure such observations as cannot be replaced by any made at a later date. Meridian observations of the moon have been started in view of the possible loss of European observations, and volunteers have come to the rescue in observing occultations. Photographic work has been somewhat precarious owing to delays in the delivery of plates, but few photographs have been lost, and the position has been eased by a modification of the programme of routine

solar observations which supplements that still being carried on at Greenwich. Work on the Reversible Transit Circle continues on a somewhat reduced scale, and the photometric observations are now sufficiently far advanced to make possible the construction of a framework of stars of magnitudes between 7 and 10 to which the magnitudes of the zone stars can be referred. With the 1940 batch of parallaxes the Observatory now enters the very restricted list of stations at which the distances of more than a thousand stars have been determined trigonometrically.

The section of the report which will be read with perhaps the greatest interest concerns the total solar eclipse of October 1, 1940. The main part of the programme was to measure the gravitational deflexion of light in the sun's field—the Einstein effect. The Greenwich expedition which was to have co-operated in this work was cancelled at the outbreak of war, and the entire programme was carried through, as planned, by the Cape staff. It is disappointing to have to record total failure in this part of the work. The field of stars close to the eclipsed sun was known beforehand to be a poor one; but eclipses are so few and far between that the attempt seemed justified. In fact, the lessened exposure time and reduced aperture necessary to prevent fogging of the plates by the rather bright sky, combined with the poor daytime 'seeing' on the Karroo to prevent any stars showing on the negatives at all. Astronomers all over the world will sympathize with H.M. Astronomer and his staff in this disappointment, particularly as observing conditions were otherwise good. Their sole compensation was in securing the only large-scale photographs of the corona obtained during this eclipse—photographs which, though interesting and indeed important, represent a most inadequate reward for months of work.

Prevention of Blindness

IN its annual report for 1940 the United States National Society for the Prevention of Blindness stresses the increase in eye accidents brought about by extension of industrial production made necessary by national defence. Many firms are now using the industrial film known as "The Eyes Have It", which has been made available to the Society without cost by the Pullman Society. The Society is now planning an evaluation of vision-testing procedure used with school children and pre-school children in the hope of establishing a uniform procedure. During 1940 the National League for Nursing Education began a study of nursing education in sight conservation in co-operation with the Society. The Society has also arranged to co-operate with similar organizations in Latin America, has prepared an exhibition on glaucoma, and has continued its campaign to reduce blindness caused by venereal disease and fireworks.

Earthquake in the Argentine

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the provisional epicentre of the earthquake of July 3 at 7h. 11·7m. U.T. as being at lat. 33° S., long. 68° W. The calculations have been based on reports from eleven seismograph stations. The epicentre is situated near the railway line about midway between Mendoza and San Luis. Activity in this region has been much less severe and more infrequent than between 1750 and 1910. There was a strong earthquake at Mendoza on May 22, 1782, though this was surpassed by the terrific shock in the same area which caused widespread destruction on March 20, 1861. Prior to this latter shock, San Luis was destroyed on April 9, 1849. Further intense shocks were experienced in both places up to about 1910. It may be that, following the catastrophic shock of January 24, 1939, at Chillan in Chile (NATURE, Feb. 11, 1939, p. 230), the centre of activity has moved eastwards. The earthquake of July 11, 1941, at 1h. 16·6m. U.T. had its epicentre in the Pacific Ocean between the Galapagos Islands and the Isthmus of Panama.

University of Cambridge

UNDER the will of Mr. Alfred Corner, of Staverton Road, Brondesbury Park, London, who died in 1934, the University has received £1,440 for the sole purposes of the Cambridge University Biochemical Laboratory. The full value of the bequest of which this is an instalment may approach £1,800.

The professorship of animal pathology will be vacated on December 31 by the resignation of Prof. T. Dalling.

Announcements

SIR HENRY DALE, president of the Royal Society, has been awarded the Gold Medal for 1941 of the Royal Society of Medicine. The Medal is given triennially for "valuable contributions to the science and art of medicine".

THE RIGHT HON. LORD CHATFIELD, recently Minister for the Co-ordination of Defence, has been elected president of the Institution of Naval Architects in succession to the late Lord Stonehaven.

MR. R. A. WATSON WATT, scientific adviser on telecommunications to the Air Ministry, has been elected president of the Association of Scientific Workers in succession to Prof. F. G. Donnan.

IN connexion with the fiftieth anniversary of the University of Chicago which was celebrated a short time ago, the sum of 9,200,000 dollars has already been subscribed by the citizens of Chicago towards an anniversary fund of 12,000,000 dollars. It is planned to raise the balance over a period of five years.

Dr. P. C. Koller and C. Auerbach, of the Institute of Animal Genetics, University of Edinburgh, writing with reference to their letter "Chromosome Breakage and Sterility in the Mouse" which appeared in NATURE of October 25, p. 501, wish to withdraw the last two sentences in the first paragraph of column 2 beginning with "We can confirm . . ."

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.*

Non-precipitating Protein Antigens

WHEN some protein antigens are heated with serologically unspecific proteins they cease to be precipitated by their antisera, and their behaviour *in vitro* approximates to that of non-precipitating haptens[1]. Evidence from different sources suggests that this change in behaviour is brought about by the antigens combining with the other protein during the early stages of heat denaturation to form complexes, which after combination with antibodies still remain soluble.

We have now studied such complexes *in vivo* and find that they differ from haptens in being active as producers of antibodies. The antigens we used were tomato bushy stunt virus and whole globulin from human serum. These were turned into non-precipitating complexes by heating them in the presence of rabbit serum albumin in physiological saline at *p*H 7·0. 0·1 per cent solutions of bushy stunt virus were heated for 10 minutes at 83° C. in the presence of 0·5 per cent rabbit albumin, and 0·1 per cent solutions of human globulin were heated for 5 minutes at 100° C. in the presence of 0·2 per cent rabbit albumin. None of the sera produced by injecting rabbits with solutions of these complexes precipitated the materials used for immunization. The serum produced against the virus-albumin complex, however, precipitated solutions of both unheated virus and virus heated in the absence of rabbit albumin; indeed, no differences have been detected between this serum and those produced by injecting rabbits with virus only. The serum produced against the globulin-albumin complex precipitated solutions of the globulin heated in the absence of the albumin. In other words, although the immunizing systems were active in producing precipitating antibodies, these could be demonstrated only when one component of the system free from the other was used as a test antigen.

It is possible that these complexes are split in the rabbit before acting immunologically, so that the antigenic component is liberated and acts alone in the production of antibodies. Whether this is so or not, it should be realized that failure to obtain a positive precipitin test between an antiserum and the material used for its preparation cannot be regarded as proof that no precipitating antibodies have been formed, for complexes behaving like those we have produced by heating may occur naturally.

Complement fixation provides a suitable test for the antigenicity of such non-precipitating complexes. With antisera prepared against either the virus or against the virus-albumin complex, solutions of the virus-albumin complex fix complement as strongly as solutions of the virus alone. Similarly, the globulin-albumin complex fixes complement with antisera to the unheated globulin and with those prepared against the complex itself. This fixation of complement equally by an antiserum with antigens with which precipitation does and does not occur is evidence for the independence of the two reactions, and strongly supports the view that complement is fixed by the union of antigen and antibody and not by the formation of a precipitate.

F. C. BAWDEN.
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Harpenden, Herts.
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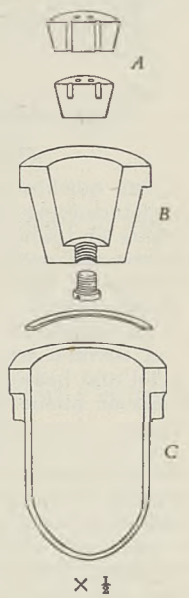
[1] Bawden, F. C., and Kleczkowski, A., *Brit. J. Exp. Path.*, **22**, 208 (1941).

A New Capillary Cell for Measuring the Rate of Sedimentation of Virus Particles in a Centrifugal Field

ELFORD[1] has developed a method of particle size determination by centrifuging solutions in inverted capillaries. The sedimentation within the capillaries fulfils Stokes's law, that is, there is a uniform movement of the particles until the boundary approaches the lower open end of the capillary. At this point the boundary comes in contact with disturbing effects such as vibrations and heat convection currents in the outer fluid. These effects tend to reduce the true rate of sedimentation.

In order to eliminate these disturbing effects on the sedimentation in the capillaries I have constructed a new type of capillary cell as illustrated in the accompanying figure.



A is a cone made of M.V.C. alloy in which a series of capillaries are drilled in such a way that those of the upper section coincide accurately with those of the lower section, into which they extend a few millimetres. The two sections of the cone fit in a conical cup *B* made of the same metal. The cup is provided with a screw at the bottom which enables the cone to be forced out without disturbance after centrifugation. Four vertical grooves are cut into the inner surface of the cups. The cup, together with the conical cell, is supported by means of a rubber washer on the rim of the centrifuge cup.

The method of using this cell is as follows:

The surface between the two sections of the cone is smeared with a thin layer of a paste made of a mixture of beeswax and wool grease, and the two sections pushed together. Care should be taken to ensure that the capillaries of the two sections coincide accurately. Some of the fluid to be centrifuged is then placed in the cup, and the cone with

the capillaries carefully dropped in to replace this fluid. The thin layer of fluid between the conical cup and the cone and in the grooves counteracts the hydrostatic pressure inside the capillaries. This effect eliminates the movement of the fluid during centrifugation. At this stage the capillaries are filled with the help of a fine pipette with the solution to be centrifuged, and the open ends are sealed off with molten paraffin wax.

After centrifugation for the required length of time the cone in the metal cup is removed by pressing it out from below by means of a metal rod. The capillaries in the top section are then cut off from those in the lower section by turning the two sections in opposite directions. This enables the fluid in the capillaries to be removed by means of a fine pipette and analysed.

Test runs with horse sickness virus (diameter 46 mμ. Polson, in press) have shown that the titre can be reduced from 10,000 m.i.d. to almost zero in the required length of time. The remaining trace of virus is probably left behind through adsorption on the sides of the capillaries, or due to the capillaries not being sector shaped. However, when virus solutions low in titre, that is, 100 m.i.d., were centrifuged, the titres were reduced to zero, which proves that the disturbing effects occurring in Elford's inverted capillary method were eliminated.

This method of centrifugation has also been applied to a study of blue tongue virus. The size determined for the virus of blue tongue, 87–105$m\mu$, compared well with that determined by ultrafiltration through Elford's gradacol membranes, namely, 100–132$m\mu$.

ALFRED POLSON.

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Onderstepoort,
South Africa.
Sept. 11.

[1] "Handbuch der Virusforschung." Erste Hälfte. Doerr und Hallauer. Wien, Julius Springer. p. 195 (1938).

Rapid Determination of Water in Animals and Plants

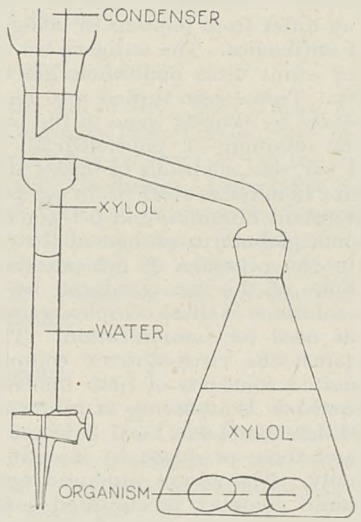
THE quickest and also the most accurate method of determining the percentage of water in animals or plants or tissues in general is a simple modification of the recognized method of determining the percentage of water in oils by means of a Dean and Stark's tube.

The animal or plant is placed in the distilling flask and covered with several times its own volume of xylol and heated over an electric heater. The xylol boils at about 135° C. and hence steam and xylol vapour distil off and are condensed. The water and xylol fall into the graduated tube and since the water is heavier than the xylol and is not miscible with it, it sinks to the bottom of the tube and for ordinary purposes its volume can be read off directly.

The same thing can be accomplished with an ordinary Soxhlet extractor provided with an outlet tap, and thus much larger quantities of water can be dealt with. The siphon tube is blocked with a little mercury. Steam and xylol are driven off as before and the water collects under the xylol.

After distillation, and when the apparatus is cold, the mercury, water and xylol are run off through the tap into a suitable graduated cylinder and the volume of water read as so many grams, but for really accurate work the height of the water is read and then the water and xylol are thrown away but the mercury is dried and returned to the same cylinder after it is clean and dry. A little xylol is added and distilled water is run in from a standard burette to the proper graduation mark. Then the same volume of distilled water is run in from the same burette into a flask and weighed. Distillation is complete when clear xylol settles in the extractor, for so long as water is coming off the xylol is cloudy.

The percentage error, which should certainly be below 0·5, is easily ascertained by distilling a known weight of distilled water under xylol and ascertaining the weight of water recovered. Paraffin cannot be substituted for xylol as its boiling point steadily rises. The percentage of distilled water in the Plymouth sea-water has been determined in this way and found to be 96·8 per cent (actually 96·796 per cent).



The great advantage of this method is its quickness and accuracy. Recently I determined the percentage of water in an ordinary hen's egg by this method and found it to be 65·4 per cent, which agrees closely with the figure given by Lebbin (65·16 per cent)[1]. The distillation took just an hour.

The alternative method of driving off the water in an oven has many disadvantages. If the material is not heated up to 110° C. all the water will not be driven off, while if it is, a good deal besides water will be driven off.

In the distillation method volatile products other than water are absorbed by the xylol; thus no difference is made to the result and so one can heat up to 135° C. without danger of decomposing the tissues. Cane sugar is charred at this temperature with prolonged distillation, but so far as I have been able to ascertain nothing else is affected. The method has been used at Plymouth for the last two years for determining the percentage of water in marine animals after they have been weighed by the displacement method[2].

Glass-ground jointing is essential and the complete apparatus with interchangeable parts is supplied by W. and J. George, Ltd., Birmingham. Fish livers are investigated as follows. They are weighed and

placed in a Soxhlet extraction thimble. This is placed in the distillation flask and the water estimated. Then the thimble with the residue is transferred to a clean extractor and the xylol removed by extraction with acetone. The remaining extract is dried and weighed and ashed if necessary. Thus at practically one distillation one can get the water, non-soluble residue, and the fat by difference. The percentage of water in mice has been found by this method. Of course it varies slightly but is always very close to 64 per cent.

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Oct. 19.

[1] Needham, J., "Chemical Embryology" (Cambridge, 1931).
[2] Lowndes, A. G., NATURE, **141**, 239 (1938).

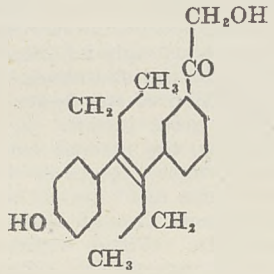
Synthetic Compounds Possessing Biological Activity Similar to that of Deoxycorticosterone

IN 1938, Dodds, Goldberg, Lawson, and Robinson[1] compared the carbon skeleton of 4 : 4′-dihydroxy-α : β-diethylstilbene (stilbœstrol) with those of œstrone and chrysene. The similarities in molecular architecture may be significant. If this be so, the possibility arises that the α : β-diethylstilbene molecule might have a similar significance in the realm of synthetic, as the condensed ring system has in the natural, sex hormones.

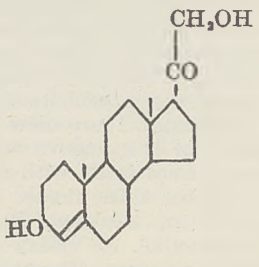
Three years ago it was decided to test the validity of this contention by applying it to the production of substances which might exhibit a similar action to deoxycorticosterone. It was first necessary to establish the importance of the -CO.CH_2OH radical, and hence a series of substances possessing the general formula R.CO.CH_2OH was prepared[2]. When R was aliphatic (CH_3 to C_6H_{13}), the compounds yielded osazones with 2 : 4-dinitrophenylhydrazine, but when R was cyclic (phenyl, p-hydroxyphenyl, cyclohexyl), hydrazones alone were formed. All the compounds reduced ammoniacal silver nitrate solution and Fehling's solution in the cold. Preliminary trials showed that of all the compounds prepared, benzoyl carbinol alone showed the desired biological activity.

The activity of this simple molecule stimulated endeavours to obtain a stilbene derivative (1) which showed a similar relationship to deoxycorticosterone (2) as stilbœstrol does to œstradiol.

Compound (1) has been obtained in the following way: m-nitrophenylacetyl chloride was condensed with anisol to yield 3-nitro-4′-methoxydeoxybenzoin, which was converted into the 3-carboxy derivative *via* the amine and cyanide. Ethylation of this acid, followed by treatment of the product with ethyl magnesium iodide, gave a product that lost water on warming with iodine, yielding 3-carboxy-4′-methoxy-α : β-diethylstilbene. This compound was demethylated and the acid chloride of the acetate was converted into (1) by treatment with diazomethane followed by hydrolysis.



(1)



(2)

3′(Hydroxyaccto) 4 - hydroxy - α : β - diethylstilbene was obtained as a white solid melting at 65-67° C. It possessed chemical properties similar to the other examples of R.CO.CH_2OH. We are indebted to Prof. J. H. Gaddum (vice Dr. K. Coward) for the biological tests of these substances. The substances were examined for their ability to increase the survival time of young adrenalectomized rats. Comparison was made with the effect of deoxycorticosterone acetate and also with a group of negative control rats which received a daily injection of the diluent, arachis oil. Of the compounds examined, only benzoyl carbinol and 3′-hydroxyaceto-4-hydroxy-α : β-diethylstilbene showed activity, the former possessing 1/2500 and the latter something less than 1/200 of that of deoxycorticosterone. The figure obtained for benzoyl carbinol was obtained on more than one occasion, but that for the stilbene derivative is less definite. We believe that this is the first instance of purely synthetic substances showing activity similar to deoxycorticosterone. It is interesting to note that p-hydroxybenzoyl carbinol and cyclohexyl carbinol were inactive.

The possession of 3′-carboxy-4-hydroxy-α : β-diethylstilbene, a necessary intermediate in this work, afforded the opportunity of preparing 3′-aceto-4-hydroxy-α : β-diethylstilbene—a substance which may be regarded as the diethylstilbene analogue of progesterone. This substance has been obtained, but the reports on its examination for progesterone-like activity are not yet to hand.

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Oct. 22.

[1] Dodds, E. C., Goldberg, L., Lawson, W., and Robinson, R., NATURE, **141**, 247 (1938).
[2] Linnell, W. H., and Roushdi, I. M., *Quart. J. Pharm. Pharmacol.*, **12**, 252 (1939).

An Iron-Copper-Nucleoprotein Complex in Animal Tissue

IN the course of investigations on the availability of iron in fish and other animal tissues, it appears that a more correct figure for the nutritionally available iron would be obtained if the tissue is treated with 10 per cent acetic acid or digested with pepsin before the material is assayed by Hill's dipyridyl method. Further work has shown that 30–40 per cent of the total non-hæmin iron of several animal tissues consists of an iron-copper-nucleoprotein complex, which has been obtained in a fairly pure state. The copper seems to be loosely combined; it

is easily split off by trichloroacetic acid and also by alkali. The iron is also split off by alkali. Controlled experiments with anæmic rats on hæmoglobin-building indicate that this complex (or rather its breakdown products, after absorption) may be a precursor for the formation of hæmoglobin. Previous elimination of copper from this complex has been found to diminish its hæmopoietic power. Quantities of iron and copper corresponding to a given quantity of the complex, when fed to animals, have considerably less potency regarding hæmoglobin formation than the original complex, which would indicate the importance of the organic moiety for hæmoglobin building.

Further work is in progress and the results are being published in the *Annals of Biochemistry and Experimental Medicine*.

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Sept. 6.

Decreased Ovarian Response to Chorionic Gonadotropin following Hysterectomy in the Mouse

MANY attempts have been made to demonstrate a possible endocrine influence of the uterus upon the ovaries of animals. The most recent report dealing with this subject[1] describes degenerative changes in the ovaries of hysterectomized rabbits. An extract of rabbit endometrium appeared to retard the process of ovarian atrophy in another group of hysterectomized rabbits. The authors suggest that a protective influence upon the ovary is exerted by the uterus. Some clinical reports support the observation that conservation of some endometrium at the time of hysterectomy in the human lessens the severity of the menopausal syndrome following such an operation[2]. Other investigators leave the subject an open question.

That ovarian activity may be influenced by the uterus is suggested by the results of the following experiment in mice. Six 21-day-old female albino mice (litter mates) were hysterectomized through a small supra-pubic incision. Both cervices were carefully removed. No intra-abdominal clamping or tying was done save for a single black silk ligature placed about the top of the vaginal stump. The incision was closed with a single skin clip. Four female mice from another litter of the same age were used as controls. At 22 days of age each mouse was injected subcutaneously with 0·5 c.c. (5 I.U.) of an aqueous solution of chorionic gonadotropin. The solution was prepared from the international standard preparation of this hormone, to contain 1·0 mgm. per c.c.

The animals were sacrificed 96 hours after injection. Vaginal introitus had been established in all the controls and all but one of the hysterectomized animals. Œstrous and metœstrous smears were present in the controls and mucus and leukocytes only were seen in the smears from the hysterectomized mice the vaginæ of which were open. The ovaries from three of the four control animals contained corpora lutea while those from the hysterectomized animals contained none.

The experiment was repeated using ten more mice (five controls and five hysterectomized) of the same age. The amount of chorionic gonadotropin was doubled, that is, each mouse received 0·5 c.c. of an aqueous solution containing 2 mgm. of the standard hormone per c.c., or 10 I.U. The animals were sacrificed 96 hours after injection. Again, vaginal introitus had been established in all the controls and all but one of the hysterectomized mice. The controls exhibited œstrous and diœstrous vaginal smears and marked uterine growth and circulatory congestion. The vaginal smear from one of the hysterectomized animals was œstrous but the others contained leukocytes. Corpora lutea were present in all the ovaries of the controls but none was found in the ovaries of the hysterectomized animals. The ovaries of the hysterectomized mouse exhibiting full œstrus were enclosed in hæmorrhagic capsules. The ovarian tissue itself, however, appeared quite normal and contained no corpora lutea upon histological examination. With this exception none of the ovaries of the hysterectomized mice in either group showed any evidence of surgical trauma or degeneration.

The mouse unit of chorionic gonadotropin in this laboratory has been found to be approximately equivalent to 4 I.U. The experiment described above was carried out according to the bio-assay procedure by which our mouse unit of chorionic gonadotropin was ascertained: namely, a single subcutaneous injection of 0·5 c.c. of aqueous solution. The results of the experiment suggest that the absence of the uterus decreases the gonadotropic effect of threshold doses of chorionic gonadotropin on the ovaries of 20-day-old mice.

This study was made possible by the Christine Breon Fund for Medical Research.

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LEE FULTON.

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[1] Mishell, D. R., and Molytoff, L., *Endocrinology*, **28**, 436 (1941).
[2] Marx, R., Catchpole, H. R., and McKennon, B. J., *Surg. Gynec. and Obstet.*, **63**, 170 (1936).

Evolution of the Fleece of the Sheep

RECENT comparative studies of fibre-type arrays, mostly in the New Zealand Romney, have thrown new light on the probable course of evolution in the coat of the sheep from wild type to the most 'improved' domesticated fleece. Fibre type arrays[1] are distinguished essentially by differences attributed to the lesser or greater power of the pre-natal check. The effect of this check stands out most clearly when, as in Ravine and Valley arrays, among fibres beginning their development before birth, it causes some starting to grow earlier to be finer than some starting to grow later. Fibre-type array is strongly inherited[2] and this fact gives confidence in the soundness of this new approach to the evolution of the fleece.

Although I am now finding great interest in a study of the coat of wild lambs, the present communication deals with more advanced stages in the evolution of the fleece. The course of evolution has run, I am satisfied, from Plateau, through Saddle and Ravine, to Valley and Plain. Within a given fibre-type array there are mostly quantitative differences which make it possible to arrange arrays in a

graded series according to their 'toughness', and between the several arrays, which differ from one another qualitatively rather than quantitatively, there are links.

The series of arrays named reveal the increasing power of the pre-natal check of Dry, which is responsible for the fineness of fine sickle-fibres and checked curly-tip fibres. This check it seems convenient to call the 'head check' to distinguish it from a check occurring a little later, recognized by Dr. Nancy Galpin[3], which may be called the 'tail check'. 'Tail' has reference, of course, not to the caudal appendage of the animal, but to fibres starting to grow comparatively late. These fibres are well removed in position in the array from pre-curly-tip fibres, and so constitute the tail of the array.

Fibre types are classified in three groups, namely, pre-curly-tip, curly-tip and post-curly-tip. The first comprises halo-hairs, super-sickle-fibres and sickle-fibres; the second hairy-tip-curly-tip fibres and ordinary curly-tip fibres; the last histerotrichs. The first two groups constitute the birth-coat; the first fibres of the third pierce the skin about the time of birth. From the evidence in hand it is concluded that halo-hairs in the pre-curly-tip group, hairy-tip-curly-tip fibres in the curly-tip group, and histerotrichs in the post-curly-tip group are phylogenetically the oldest fibre types. In the course of evolution halo-hairs have undergone a series of changes, becoming transformed step by step to super-sickle-fibres[2] of, successively, the three types, *A*, A^1 and *B*, to chalky sickle-fibres, and eventually to fine sickle-fibres. The table serves to illustrate what has happened. Apart from an exceptional situation, to be mentioned later, the percentage of pre-curly-tip fibres (computed on total fibres in an array) is similar in all arrays.

RELATIVE ABUNDANCE OF THE SEVERAL FIBRE-TYPES IN DIFFERENT ARRAYS.

(Based on six regions of seventeen lambs. Means expressed as percentage of total pre-curly-tip group. The last two columns computed on total sickle-fibres.)

Array	Halo-hairs %	Super-sickle a %	Super-sickle a^1 %	Super-sickle b %	Sickles %	Sickles	
						Chalky %	Fine %
Plateau	31·7	41·5	11·1	15·0	0·7	100·0	0·0
Saddle	0·2	4·0	8·3	26·5	61·0	100·0	0·0
Ravine	0·9	1·9	4·0	14·4	78·8	57·9	42·1
Valley	0·2	0·5	1·2	13·0	85·1	10·6	89·7
Plain	0·0	0·0	0·0	0·0	100·0	0·0	100·0

As evolution has proceeded the centre of gravity in the pre-curly-tip group has been shifted from halo-hairs and super-sickle *A* in Plateau to fine sickle-fibres in Plain. Hairy-tip-curly-tip fibres are abundant in Plateau, rare in other arrays, and I would elevate them to a position of high ancestral importance. Indeed, in the curly-tip group of non-Plateau I conclude that four-fifths of the curly-tip fibres have evolved from hairy-tip-curly-tip fibres.

In the evolution of histerotrichs I would emphasize what I believe to be the 'promotion' of the earliest histerotrichs to become the latest curly-tip fibres. In Plateau about half of the fibres are histerotrichs, in Valley and Plain about one fifth. The trend of evolution is seen to be towards the goal of a coat composed entirely of curly-tip fibres. In very 'improved' fleeces of Plain array the reduction of both pre- and post-curly-tip groups is very marked indeed. In a plain array, it is to be noted, the effects of the head and tail checks overlap. In arrays lacking hairy pre-curly-tip fibres, with all the fibres of this group fine sickle-fibres, the numbers of the pre-curly-tip fibres may be reduced, and quite frequently in Wensleydale arrays[4] and once in a Romney array, no sickle-fibres at all have been found. To my thinking, the pre-curly-tip fibres have undergone, not loss, but extreme change.

The covering of the wild sheep has long been recognized as consisting of a hairy outer coat and an inner coat that is fine and not hairy. In Plateau I take the outer coat to be represented by the pre-curly-tip group and many fibres of the curly-tip group. In the course of evolution the trend has been for both outer coat fibres and inner coat fibres to become non-hairy curly-tip fibres. It may be added that there is a correlation between the percentage of hairiness determined by the medullometer (McMahon[5]) and the array. The contrast is most marked between extreme arrays, Plateau being grossly hairy, whereas Plain shows scarcely any trace of hairiness. The same relation holds for the average abundance of secondary kemp.

In the Romney the Plateau array is common on the britch, but *N*-type having the Plateau array on all or most of the main area of the body is rare, save in Dry's experimental stocks. The fleece characterization of *N*-type—whatever be the genetic basis—is atavistic, and links the Romney with some other breeds of sheep situated lower on the ladder of evolution, notably Blackface Mountain sheep. On the other hand, Valley and Plain arrays were found not only in the Romney but also in the Ryeland, Southdown[3], Wensleydale and Merino[4]. Thus we deal with a transitional series of arrays, from Plateau through Saddle and Ravine to Valley and Plain. In this series we trace the path of the evolution of the fleece. The genetic basis of these evolutionary changes probably resides in small mutations.

This note is based on a thesis recently presented to the University of New Zealand. It is hoped shortly to publish a full account of this investigation.

H. GOOT.

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Palmerston North,
New Zealand.
June 5.

[1] *N.Z. J. Agric.*, 48, 6 (1934).
[2] *N.Z. J. Sci. Tech.*, 22, 4A (1940).
[3] *Emp. J. Exp. Agric.*, 4 (1936).
[4] Sutherland, J. A., Unpublished thesis, University of New Zealand (1939).
[5] *J. Text.Inst.*, 28, 12 (1937).

Aphid Transmission of Strawberry Viruses

BRITISH workers with strawberry viruses have so far failed to obtain transmission of Fragaria virus 1 (yellow edge) or Fragaria virus 2 (crinkle) by aphides other than the 'delicate strawberry aphis', *Pentatrichopus* (*Capitophorus*) *fragariæ* Theob., a species possibly identical with the American vector *Capitophorus fragæfolii* Ckll.

In experiments at this College the following species of aphides, recorded on strawberries in North Wales, consistently failed to transmit any virus from severely diseased plants of the variety Royal Sovereign: *Macrosiphum solanifolii* Ashm., *Aula-*

corthum solani Kalt (= *Myzus pseudosolani* Theob.), *Myzus persicæ* Sulz., *Myzus circumflexus* Buckt. (a single specimen only—possibly a stray from a glass-house—was taken on strawberry), *Myzus ornatus* Laing (tested only in the case of crinkle).

Other aphides tested as possible vectors of crinkle included *Pentatrichopus potentillæ* Walk. and *Pentatrichopus tetrarhodus* Walk. All attempts to achieve transmission by means of the former species were unsuccessful, but transmission from Royal Sovereign to *Fragaria vesca* L. was obtained with *P. tetrarhodus* both in 1940 and 1941, the resultant symptoms being indistinguishable from those induced by means of *P. fragariæ*. This discovery is of academic interest in that it suggests a specificity of relationship between strawberry viruses and the genus Pentatrichopus. The host-ranges of British members of this genus were described in a recent paper by Thomas and Jacob[1], who stated that *P. potentillæ* appears to occur only on *Potentilla anserina* L., and fails to survive on strawberries; while *P. tetrarhodus*, although capable of living for a rather longer period on strawberries under glass, occurs naturally only on species of Rosa. Further work is contemplated to discover if *P. potentillæ* is invariably a non-vector of crinkle and, if so, whether this is due to some metabolic cause operating within the insect or to the feeble extent to which the species is able to feed on strawberry.

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Oct. 15.

[1] Thomas, I., and Jacob, F. H., *Ann. App. Biol.*, 27, 234 (1940).

Frequency of Occurrence of Wars and other Fatal Quarrels

IN order to investigate the causes of wars by counting occurrences, let the magnitude of any war be defined to be the logarithm, to the base ten, of the number of persons who died because of that quarrel. This definition has the advantage that it applies, not only to what are ordinarily called wars, but also to all kinds of fatal quarrels, including insurrections, frontier incidents, riots and murders.

The numbers of wars of various magnitudes, which ended from 1820 to 1929 A.D. inclusive, have been counted, after laborious search in works on history. The number of murders is an estimate from the statistics of crime. Between the wars and the murders, in the range between magnitudes 2·5 and 0·5, there were certainly many fatal quarrels; but statistics of them are scanty, presumably because such incidents are mostly too small to be history and too large to be crime. The results are:

Ends of range of magnitude	$7\pm\frac{1}{2}$	$6\pm\frac{1}{2}$	$5\pm\frac{1}{2}$	$4\pm\frac{1}{2}$	. . . .	$0\pm\frac{1}{2}$
Observed number of fatal quarrels	1	3	16	62	. . . .	10^7

It is seen that the numbers of wars in successive equal ranges of magnitude are nearly in agreement with the geometrical progression 1, 4, 16, 64; but that when this progression is continued, it gives 16,384 for the number of murders instead of the observed 10^7.

These remarkable relations call for explanation. A full account of this and cognate matters is nearly ready for publication elsewhere.

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Science in the U.S.S.R.

IN NATURE of October 25, p. 497, M. Maisky's statement that "there is no place in the U.S.S.R. for pure science" is described as "rather unfortunate". In 1646 Robert Boyle stated that he was studying natural philosophy "according to the principles of our new philosophical college, that values no knowledge, but as it hath a tendency to use". I think the two statements are equivalent. Sprat, the first historian of the Royal Society, into which the Invisible College metamorphosed, went even farther towards the theory held in the Soviet Union, in postulating a class basis for science. "Their mechanics and artificers (for whom the true natural philosophy should be principally intended)", he wrote, "were so far from being assisted by those abstruse doctrines, that perhaps scarce any one of these professions, and trades, has well understood Aristotle's *Principles of Bodies*, from his own time down to ours." I think these quotations will show that the Soviet practice and theory on this important matter, whether or not we approve of them, are in the great tradition of British science.

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TAKING the above quotations from two British men of science of three hundred years ago on their face value, one must allow that the Soviet practice and theory are compatible with their views, though it is possible that the *general* views of Boyle and of Sprat may be considered to be not quite so dogmatic as these single quotations would imply. In any event, we cannot agree that the views of these two men alone thus put the present-day Soviet practice and theory in the great tradition of British Science.

More important still, the main point at issue, surely, is the attitude of the general body of *present-day* British men of science. It is to be hoped that the time will never come when it can truthfully be said that there is no place in Great Britain for pure science. Prof. Haldane should, we think, have concluded the sentence in quoting from NATURE, which ran as follows: "since we do not believe that pure science has been altogether taboo in the U.S.S.R."

There seems to be a dangerous tendency to make too prominent a distinction between pure and applied science, for it may easily involve the risk that the protagonists for a *planned* scientific policy will be accused of wishing to oust pure science altogether. This is far from the truth. Scientific planning involves pure as well as applied science, especially when taking the long view; and that is why we consider M. Maisky's statement unfortunate, because we have no doubt that though there may be more *conscious* planning of science in the U.S.S.R., that country has not expunged pure science from its programmes merely because it is pure.—EDITORS.

CEREALS AS FOOD

THE fourth of the series of symposia on the nation's food arranged by the Society of Chemical Industry took place on October 29. The subject was "Cereals as Food".

The first paper, contributed by R. G. Booth, R. H. Carter, C. R. Jones and T. Moran, dealt with the "Chemistry of Wheat and Wheat Products". It consisted of a review of the literature, supplemented by estimations carried out by the authors on analyses of the wheat 'berry' as a whole and its separate constituents. The paper showed the wide variations that exist, depending upon the variety and cultural conditions of the wheat, but it is equally clear that many of the figures quoted in the literature are based on unsatisfactory analytical methods. Figures were given for the phytin and vitamin contents of wheat and flours of different extraction, and a large section of the paper dealt with the separation of the different fractions of wheat during milling.

This led logically to an analysis of high-extraction flours including National Wheatmeal. According to the authors, wheatmeal can be classified as rational or irrational meals depending upon how far the proportions of the different offal stocks in the meal are equal to, or are in excess of, the amounts present in whole wheat. National Wheatmeal is a rational meal, but the authors showed that, provided white flour continues to be milled, an 85 per cent extraction meal superior to National Wheatmeal could be produced. This is clearly a question to be considered after the War.

A. L. Bacharach and D. W. Kent-Jones followed with a paper on "The Nutrient Analysis of Bread". They first pointed out that flour as bread alone contributes something like 20 per cent of our total intake of calories and 20 per cent of our intake of proteins ; in all forms, including cakes, puddings, etc., these figures are increased to about 35 per cent. Incidentally, they showed that, in terms of calories and protein combined, bread is far and away the cheapest foodstuff. The authors then considered the effects of phytin in immobilizing calcium, and attempted a calculation of the available calcium in white flour and National Wheatmeal, on the basis that the salts formed are either the tri- or hexa-calcium phytates. They pointed out, however, that this at best could only be a rough guide because of the complicating effects of magnesium on the precipitation of phytate. Their figures gave a quantitative justification for the 7 oz. and 14 oz. of calcium carbonate per sack of white flour and National Wheatmeal that the Medical Research Council recently recommended. It should be pointed out, however, that recent work has shown that most of the phytin can be hydrolysed by suitable conditions of baking, so that the higher amount for National Wheatmeal may not be necessary.

The authors also outlined the proposals in the United States for the fortification of white flour which would make B_1, nicotinic acid, riboflavin and iron compulsory, with calcium and vitamin D optional. The maximum amounts proposed for the first four factors would make the flour the equivalent of wholemeal bread. Mr. Bacharach and Dr. Kent-Jones suggested that the fortification of white flour should be extended to include iron as well as B_1 and calcium.

H. C. Moir had a difficult task in his paper on "The Composition and Nutritive Value of Oats and Oatmeal". The literature on this particular cereal is scattered and scanty, but the author succeeded in assembling data which should be of great value as a source of reference ; there would, however, appear to be many anomalies ; for example, the fact that the contents of tryptophase, lysine and histidine are greater in flaked oats as against whole oats. Mr. Moir emphasized that in view of the high protein, fat, iron and B_1 of oats, it is clearly an important human food. In the preparation of porridge the loss of B_1 is only 5–10 per cent, but with oatcakes the loss is 35 per cent, due presumably to the added sodium bicarbonate reducing the acidity. The question of phytin in oatmeal was also discussed, and it was pointed out that when porridge is properly prepared, that is, by soaking overnight, the inorganic phosphorus would be increased. The suggestion that oatmeal aggravates gout and rheumatic conditions was summarily dismissed.

The final paper, by W. P. Ford, "The Composition and Nutritive Value of Cereals other than Wheat and Oats", dealt with the remaining cereals—maize, rice, rye and barley. Maize contains 8–10 per cent of germ with a fat content in the germ of about 30 per cent. It is deficient in calcium, magnesium, iron and phosphorus as compared with wheat, but the protein contents of whole-maize and wheat are apparently equal.

The author described the changes in vitamin B_1 consequent upon de-husking, winnowing and polishing rice and showed why, except as a source of easily digestible carbohydrate, polished rice is the least valuable of all the cereals. He also mentioned the interesting fact that in the middle of the eighteenth century up to 42 per cent of rye was included in bread flour in Great Britain. German rye often contains 20–30 per cent of white flour, while American bread of the same name never contains less than 66 per cent.

In the discussion that followed, Dr. Green emphasized the importance, in cereal research, particularly in its nutritional aspects, of using material of known history and origin. This was supported by Mr. Bacharach, who, after pointing out the wide variations in individual chemical characteristics found in cereals, suggested that after the War at least, an organized attack should be made on all food stuffs, in order to collect precise and comprehensive analytical data.

Mr. Bacharach also stressed the need for further work on the availability of the different elements including calcium and iron, and went so far as to suggest that instead of protein figures for foods the individual amino-acids might be estimated.

In the papers and the discussion two points stood out : (1) the frequent references made to the analytical tables of McCance and Widdowson ; (2) the unanimous view that much work has still to be carried out before we have anything like a factual picture of the chemistry of cereals, even wheat. Perhaps for this reason the excursions into the nutritional field were generally extremely tentative. The chemist does not dogmatize without the facts. This alone is a guarantee of the value of these discussions on the nation's food.

MODERN CAST IRON

FEW metallurgical products have shown such a marked improvement in quality during the last two decades as have the cast irons. So rapid has this advance been, that few, except those in immediate contact with the industry, can have kept abreast of the work done; and the engineer user has perforce lagged behind in his knowledge of the new materials thus placed at his disposal. It was presumably in appreciation of this fact that the Institution of Mechanical Engineers formed a Research Committee on High Duty Cast Irons for General Engineering Purposes, the first report of which was published in 1938. This was concerned with a general outline of the development of both the "high-duty" irons used on account of their enhanced strength, and of the special-duty irons employed in the main as a result of their possession of unusual physical or chemical properties.

On the outbreak of war, the attentions of the Committee were necessarily somewhat diverted to those matters within their province which would most immediately assist in the national effort. Of these, one of the most important was the question of making the fullest use of Great Britain's own iron ores, the most abundant of which are phosphoric. From these ores, irons containing up to around 1·5 per cent are produced, and the second report of the Committee, recently published by the Institution, is an excellent account, prepared by J. G. Pearce, director of the British Cast Iron Research Association, of the phosphoric grey irons used by the foundryman and engineer. The mechanical properties of these materials, both at ordinary and at elevated temperatures, are discussed, and curves are provided showing what type of properties may be expected from an iron of given carbon, silicon and phosphorus contents.

A third report, also prepared by Mr. Pearce, is devoted to a consideration of the newest forms of alloyed irons. As a consequence of the War, a demand has arisen among engineers for fuller information regarding the special irons which are being used, both for their own sakes and as substitutes for other materials in urgent demand.

This report is divided into separate sections dealing respectively with the austenitic and the martensitic irons, and well fulfils its purpose. The former type of iron bears to ordinary ones a relationship not dissimilar from that borne by the stainless steels to plain carbon material. Their characteristic properties include softness, ductility, and high resistance to wear, erosion, corrosion and heat. In addition, they are non-magnetic, of high electrical resistance and thermal expansion and low thermal conductivity. These materials have passed far beyond the field of research, and an appendix contains a list of many scores of examples of typical applications of such irons in actual engineering practice.

Where resistance to wear or erosion is the factor of prime importance, the martensitic irons, on account of their great hardness, find many important uses, some sixty or seventy specific examples of which are cited.

These reports, of which others are promised, contain select but adequate references to original sources of information, and should be of great value to makers and users alike. The author, the Committee and the Institution, in preparing and publishing this information, are performing a service of immediate national importance. F. C. T.

FORTHCOMING EVENTS

MONDAY, NOVEMBER 17

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Miss L. E. Cheesman: "The Border Mountains and Torricelli Range of Northern New Guinea".

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. A. J. Curtin Cosbie: "Brewing, the Story of a National Industry" 1: Brewing Materials. (Cantor Lectures, I).

WEDNESDAY, NOVEMBER 19

SOCIETY OF GLASS TECHNOLOGY (at Elmfield, Northumberland Road, Sheffield, 10). Twenty-fifth Anniversary Meeting. 10 a.m.—Symposium on Glass Furnace Problems, I. 2.35 p.m.—Symposium on Glass Furnace Problems, II.

THURSDAY, NOVEMBER 20

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. W. T. Astbury, F.R.S.: "X-Rays and the Stoichiochemistry of the Proteins".

ROYAL INSTITUTION OF GREAT BRITAIN (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir James Jeans, O.M., F.R.S.: "Is there Life on Other Worlds?"

FRIDAY, NOVEMBER 21

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 2.30 p.m.—Mr. W. T. Halcrow: "A Century of Tunnelling" (Thomas Hawksley Lecture).

APPOINTMENTS VACANT

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

DIRECTOR OF EDUCATION—The Town Clerk and Clerk to the Local Education Authority, Town Hall, Brighouse, Yorks. (endorsed 'Director of Education') (November 19).

BOROUGH ANALYST—The Town Clerk, Town Hall, Burnley (November 24).

SENIOR ASSISTANT to the Principal of the Barrow-in-Furness Technical College and Junior Technical School (will be required to take Evening Classes in MECHANICAL ENGINEERING)—The Director of Education, Town Hall, Barrow-in-Furness (November 29).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Hull Bulletins of Marine Ecology. Vol. 1, Nos. 4 and 5: Ecological Investigations with the Continuous Plankton Recorder—The Copepoda of the Southern North Sea, 1932–37, by K. M. Rae and J. H. Fraser; Ecological Relations between the Herring and the Plankton off the North-East Coast of England, by C. Cheng. Pp. 171–254+plates 65–125. 10*s*. Vol. 2, Nos. 7 and 8: Continuous Plankton Records—General Introduction to the 1938–39 Survey, by Dr. A. C. Hardy; Continuous Plankton Records—Phytoplankton in the North Sea, 1938–39, Part 1: Diatoms, by C. E. Lucas (assisted by W. Macnae). Pp. 46+plates 1–38. 8*s*. (Hull: University College.) [2210

Other Countries

U.S. Office of Education: Federal Security Agency. Vocational Division, Monograph No. 22: Farm-Family Living: contributing to Satisfying Farm-Family Living through Cooperative Educational Programs in Vocational Agriculture and Home Economics. Pp. iii+12. (Washington, D.C.: Government Printing Office.) 5 cents. [2010

National Research Council of Canada. N.R.C. No. 1011: Abstracts on Storage of Grain. By Muriel E. Whalley. Pp. 180. (Ottawa: National Research Council of Canada.) 3 dollars. [2210

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1941. Pp. 50. (Wellington: Government Printer.) 1*s*. 3*d*. [2210

New Zealand. Fifteenth Annual Report of the Department of Scientific and Industrial Research. Pp. 92. (Wellington: Government Printer.) 9*d*. [2210

Report on the Department of Agriculture, St. Lucia, 1940. Pp. ii+12. (St. Lucia: Government Printing Office.) 6*d*. [2210

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