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ECONOMIC RECONSTRUCTION

THE report on the domestic economy of the United States, the third in a series prepared by a committee of the editors of *Time*, *Life* and *Fortune*, published in the last-mentioned journal, is striking evidence that American thought is running on similar lines to British thought on reconstruction. This evidence is the more welcome from a source so critical of President Roosevelt's views. Sir William Jowitt in his survey of reconstruction last December reminded the House of Commons that the solution of our problems depends largely on international co-operation. To avert large-scale unemployment of the kind from which we suffered after the War of 1914–18 is a major aim both in Great Britain and in the United States, and was one of the cardinal points made by Mr. Churchill in his historic address on reconstruction broadcast on March 21 (see also p. 359 of this issue).

The Atlantic Charter cannot be made effective without international action designed to raise the standard of life throughout the world, and the Beveridge Report, by insisting on the need for dealing simultaneously with the problem of mass unemployment in order to achieve social security, has given a fresh impetus to the study of the problem, as is evident in the recent statement issued by Unilever Limited and Lever Brothers and in recent articles in the daily Press on planning for full employment. The *Fortune* report facilitates an attempt, independent of the President's pronouncements, to assess the American approach to this problem, and the prospects of the indispensable co-operation on which no doubt Mr. J. G. Winant will be able to report authoritatively when he returns to Great Britain.

The report, it is true, in dealing with the economic system of the United States, ignores the relationship of that system with the rest of the world. None the less, it recognizes that the American system can never, except at outrageous cost, be a closed self-sufficient system, and that America's increasing participation in a unified world should be one of the chief outcomes of the War. That participation will be lame and even harmful to others, if America has not learnt to order her domestic affairs more successfully than in the past, and for this reason the *Fortune* report argues that the first duty of the United States to the world economy of the future is to bring to it an economy that is healthy and free inside itself.

No exception will be taken to that attitude : it is indeed one of the most urgent reasons for the formulation of a social security policy in Great Britain and for Government decision on questions of major reconstruction policy. Moreover, it is of interest to note the parallelism in lines of thought on domestic policy here and in the United States.

Accepting the conclusion that government fiscal policy can and should be used to influence the level of employment, the report proposes that the Government should underwrite permanent prosperity and that it be established government policy, whether Republican or Democratic, to maintain reasonably full employment in the United States. The first and

most important step is for the Government to see that private industry, which produces the bulk of goods and services and employs the greater part of the working population, has every chance to operate at capacity and to invest as much of the nation's savings as it can absorb. To-day, government is governing an industrial society, and the condition of private industry must be one of its primary concerns. The second way is to increase individual security by direct means, such as a greatly extended system of unemployment insurance and old age pensions, and greater government responsibility for public health, housing and nutrition.

By maintaining consumer income and effective demand, such a social security programme assists full employment. It sets a minimum standard of purchasing power on which industry can count, and industry is thus enabled to plan its own expansion with more assurance. The third weapon is a flexible programme of public works to be used by the Government whenever and wherever a part of the nation's productive resources is obviously going to waste. Such plans as, for example, urban development, river-valley development or the rationalization of transport, must be prepared well in advance, and it is noteworthy that the *Fortune* report recognizes that while some large public-works projects may appear to compete with private enterprise, on balance, if correctly chosen, they will create far more opportunities for new private enterprise than they destroy for old. This shows a wider vision than some British industrialists in the recent manifesto entitled "A National Policy for Industry".

It is significant that the *Fortune* report does not propose a return to *laisser-faire*. On the contrary, it advocates enlisting the power of government to restore the higher values of individualism, to enthrone the creative, risk-taking, profit-seeking, competitive individual in a sovereign-free market. A more rigorous policing by the Government of the free market is urged to supply the new combination of vigilance and judgment required to keep the market fundamentally free.

There are in this section of the report shrewd comments of exceptional interest on the place of the public utilities, the restraint of monopoly, patent law reform, tariffs and the stimulation of enterprise, which well merit careful consideration in Great Britain. The programme is an attempt at synthesis of the conflicting elements in the immediate past and towards restoring a free market and creative individualism. Its outlook is reflected both in the admirable paper on "The Problem of Unemployment" issued by Unilever, Ltd., and Lever Brothers, and in the recent debate on economic policy in the House of Commons. Sir Kingsley Wood's reference to the importance of Great Britain regaining her technical leadership, paying more and more attention to scientific research and to the steady development of new and more efficient processes, is in striking harmony with the *Fortune* report. Indeed, the final section of that report, on technology and post-war life, is of special interest to scientific workers and touches on some of the important changes at work, such as the chemistry of oil, the development of plastics, the increasing use of light alloys and new processing for foodstuffs.

The Unilever paper shows clearly that there is a similar approach to the problems of post-war economy in Great Britain and that we have leaders who see the difficulties clearly and are equally capable of creative thought. Its comments on planning and on social security are in refreshing contrast to some of the weak criticism of the Beveridge Report. There is nothing to encourage initiative and a sense of responsibility if a man and his family are standing at the end of an unemployment queue, or when he is afraid of unemployment at the end of the week. The minimum benefits of the Beveridge Report are intended to ensure the minimum income which scientific research has established as required, assuming a given price-level, to keep a family in health and vigour.

That position is accepted in the Unilever paper, which concentrates its attention on the means by which such a social security policy is to be achieved. Social security cannot be attained only by legislation fixing minimum wages, unemployment pay and old-age pensions. It can only be solved by an adequate part of the nation's productive capacity being used for the extension of that capacity, leaving a sufficient part available for the production of consumer goods.

Next the paper insists on freedom of choice. The abolition of privilege and the establishment of minimum social conditions do not ask for general uniformity, which would certainly hamper any general improvement of those conditions and the utmost use of the world's possibilities of production. While the profit motive has proved an untrustworthy guide to the extension of productive capacity, the fundamental identity of interest between industry on one hand and the community on the other, whether considered as workers or as consumers, should be remembered. Economic policy should aim at economic development, and freedom from want should be accompanied by freedom from idleness.

There are other observations in the paper on the function of government and that of private enterprise which should be noted. Industry's role is to endeavour to produce as cheaply and efficiently as possible, but it should show its sense of social responsibility, for example, in planning for development with as long a view as feasible, adopting a scheme of guaranteed earnings and training during interrupted employment, widening the possibilities of advancement to higher responsibilities, improving the contacts and mutual understanding between management and workers. Industry, voluntarily organized, should help government to the full, facilitating contact between them for furthering the government's economy policy and providing government with accurate and up-to-date information on production and marketing. Modern methods of market research should be developed to enlighten both government and industry on changes in the trend of economic life. Collaboration on these, leaving to government and industry each its own work in its own field, and not the direction of industry

by a reorganized Civil Service or the delegation to industry of part of the duty of government, will ensure a regular and progressive development of economic life. Similarly, the responsibility for the social well-being of the population which obliges governments to take a guiding part in framing economic life makes it incumbent on government to safeguard economic policy from those influences that would make it haphazard or failing in international spirit.

The general similarity in outlook of the two documents is clear from what has already been said, but the Unilever paper is much more specific in its conclusions and proposals. The thesis that the main task in fostering regular capital investment and through it regular employment lies with the central government, leads to proposals not for direct government control over production but for the exercise by government of the powerful means of indirect control it possesses. The chief proposal to co-ordinate these influences on a systematic plan for dealing with the trade-cycle is the system of two budgets—an ordinary budget balanced annually for meeting standing expenditure out of current income, and an extraordinary budget to meet normal capital expenditure and such emergency measures as should be taken in times of depression to fight unemployment or stimulate trade. This extraordinary budget would be covered or over-covered only in times of prosperity.

Provided it is used solely for the purpose of regularizing economic life, the two-budget system is claimed to be the most efficacious means of controlling the trade-cycle and is the one that needs most study; this study should be undertaken now. No progression of productive activity, however, can be kept regular that leaves no reserve available in manpower or machines. A part of the working population will, under conditions of normal industrial activity, always be temporarily unemployed. They should not be without sufficient income, nor should they be idle, and the fluctuations of this labour reserve, in both numbers and the way it is made up, will be the signal to the government to apply its anti-boom or anti-slump measures, all of which should be planned well in advance.

In addition to the general monetary and budgetary measures suggested for the checking of a boom or a slump, supplementary special measures are suggested, such as public works of a special kind, as distinguished from normal government capital expenditure; the special training of younger people who cannot find a job; re-training of workpeople whose unemployment is due to structural, local or seasonal causes; and occupation in temporary work such as afforestation, and preparing uncultivated ground for tillage or pasture. It is assumed that, in addition to these measures to be applied intermittently as required, government and industry will apply continuously measures for achieving social security, and a number of specific industrial measures are suggested, including the planning of development with as long a view as possible, voluntary schemes for training workpeople for other work and for guaranteeing earnings during sickness, accident, short-time, or unemployment that is temporary only, and the institution of works councils or similar bodies.

Any wide plan for social security in one country, however well devised, is at the mercy of events in other countries, and it is of vital importance to the success of any such scheme that similar measures are taken in all major industrial countries. The necessary contacts in the field of commercial policy and of social security, which in the international monetary field have been a conspicuous success, would, it is suggested, be best obtained through international councils or similar institutions having permanent international secretariats on which the governments of the various countries would be permanently represented. These organizations would negotiate, conclude and expedite international agreements on such matters as the adaptation of productive capacity dislocated by the War to allow the various countries to produce and consume according to their abilities; positive measures for encouraging the expansion of international trade; the protection of countries that embark on anti-unemployment measures and plans for social security against unfair competition from other countries; regulation of the production of stocks and prices of raw materials; and raising the standard of living in undeveloped countries.

Schemes so comprehensive as the Beveridge plan and that of Unilever Ltd. and Lever Brothers assume the existence in the world of a strong consciousness of the fundamental community of interests that binds all classes of society and all nations, for their success depends on the existence of similar schemes in the principal industrial countries. Moreover, much has to be learned from experience, and the technique required for their handling will only be developed gradually. Such conditions demand not only courage in the conception of schemes but also foresight to protect society against partial failure. It is a hopeful sign that the challenge of the Beveridge Report has been taken up so unhesitatingly in the United States.

The references to the Unilever paper in the debate in the House of Commons on economic policy indicate that its proposals are already receiving serious consideration and have attracted widespread attention. Sir Kingsley Wood's speech, like that of Mr. Dalton, showed that constructive lines of policy at home are being mapped out.

Much that the Chancellor said needs to be kept in mind in considering the Beveridge Report and other schemes for reconstruction and the transfer of our resources as quickly as possible back to peace-time purposes, to promote employment and to revive export. He insisted, for example, that we would need to maintain, in any event for a time, a considerable measure of control of our economic life. It might also be desirable to continue the policy of the stabilization of the cost of living and the prices of goods in common use along our present lines. Controls relating to the demand for scarce materials or manufacturing capacity would require careful co-ordination with such a stabilization policy. The control of the release of raw materials and of issues of capital might also continue to be necessary.

Certain of the proposals outlined by Sir Kingsley Wood indicate that proposals in the Unilever paper are very much in line with the mind of the Government. The Chancellor stressed the great contribution which the Government could make by its general policy in foreign affairs, by its interest in the promotion of export trade, by its internal financial policy and the economic development of general social policy. The Government could also stimulate directly the provision of capital equipment, and the Chancellor referred specifically to the effect of a well-considered building programme planned several years ahead. Besides the restoration of trade and business and active employment, he stressed the importance of an adequate defence programme for international security to prevent a repetition of the present disaster, and his reference to the Government's intention to see that up-to-date statistical information should be available to the maximum extent after the War will be particularly welcome to those scientific workers who are aware not only of the importance of adequate knowledge of economic facts and tendencies for reasonable direction of our economic activities, but also of the backwardness of Great Britain in the collection and publication of economic and financial statistics—a statement clearly intended to remedy a defect to which Mr. Herbert Morrison directed attention recently.

The Chancellor closed his speech with an important statement as to the main directions in which it was generally agreed we could advance. First, he said, we shall need a policy of expansion so that employment is maintained and production serves the end of consumption, coupled with an expansion in international trade and the orderly reduction of unnecessary barriers and other practices interfering with the flow of goods from one country to another. Secondly, we shall need a strong effort to prevent disastrous swings in the prices of the raw materials and primary products of the world. Thirdly, we shall need an international monetary mechanism which will serve the requirements of international trade and avoid any need for unilateral action in competitive exchange depreciation. Fourthly, the work of the International Labour Office, with its interest in the standard of working conditions in all countries, has a great bearing on the orderly development of international trade; and, fifthly, when the world begins to settle down and each country has a clearer picture of its own resources, we shall need some international organization for assisting the direction of international investments for development.

Replying on the debate on February 3, the President of the Board of Trade stated that he has recently made arrangements for an intensified study of post-war problems, and after the consultations which are proceeding with national bodies and particular interests he hoped to be able to draw up a plan embodying points which are common ground, and to pursue closer study of the national plan. He reiterated the Government's intention to attack the problem of mass unemployment and to seek to bring about an expansion in international trade by international agreement. We need also an expansion in the home market and in the standards of production and consumption among our own people.

Mr. Dalton's insistence on expansion rather than restriction—expansion but not inflation—stability of prices but not stagnation, order in our schemes but not undue rigidity, is the more important as passages in his speech lend colour to the belief that the Government countenances the restrictive policies advocated by some of the reconstruction schemes put forward by the trade associations. That is indeed one of the great dangers. The emphasis must be on expansion, and all restrictions on trade and industry which do not contribute to the national purpose and serve merely sectional ends must be set firmly on one side. The dangers of such restrictive policies are clearly recognized in the *Fortune* report as well as in the Unilever paper, but such policies are firmly embedded in some of the reports issued by bodies with which Mr. Dalton stated that he has been consulting.

This is one of the reasons why it is imperative that the Government should announce its plans and policy in greater detail. A central plan is essential if a firm hand is to be taken with the sectionalism and the ideas of restriction which are still current in some quarters. An energetic and coherent policy framed to meet the new conditions which the Government clearly has in mind, and recognizing a broadly conceived national interest which stands above considerations of individual or sectional profit or privilege, is as essential to Anglo-American understanding and co-operation as it is in fortifying the nation for the supreme effort to which it is now being called in the present struggle. Furthermore, it is the first step to the formulation of a policy for the re-organization or reconstruction of world trade—a matter in which, though its importance was recognized in the debate, the Government spokesmen did little to dispel confusion and anxiety. Without a firm break from those policies of restricted consumption and hence of restricted production and mass unemployment which led the world into chaos and to war, we have no hope of securing the whole-hearted co-operation of the United States or the other United Nations in the attack on this fundamental problem.

Consumption is the only effective starting point of a programme of expansion, and by making full employment and rising standards of living the effective aim of domestic policy and neglecting no steps calculated to achieve them, Great Britain could enter the councils of the United Nations with the promise of an expanding British market for foreign as well as for domestic production on the sole condition that the means of payment in British exports be not denied to her. There can no longer be doubt as to the support which would be forthcoming in Great Britain for such a policy which would place the initiative in British hands. The close parallel between the speeches of British and American statesmen, no less than the trend of the *Fortune* report, justify the belief that the United States and others of the United Nations would not lightly refuse the wholehearted co-operation which would ensure the success of such a policy, with its benefits, not to one country alone, but to the whole post-war world.

EVOLUTION IN ACTION

Systematics and the Origin of Species: from the Viewpoint of a Zoologist

By Ernst Mayr. (Columbia Biological Series, No. 13.) Pp. xiv+334. (New York: Columbia University Press; London: Oxford University Press, 1942.) 27*s*. net.

DURING the last decade taxonomy has not merely experienced a revival but has also become one of the active growing points of biology. It is the focus round which genetics, ecology, field natural history and other biological disciplines have concentrated to illuminate the study of evolution in action.

Until now, the comprehensive studies in this new joint field have been undertaken by general biologists —preponderatingly, as in the compilation entitled "The New Systematics", or solely, as in the recent books by Haldane, Waddington or myself; or geneticists, as in Dobzhansky's interesting "Genetics and the Origin of Species", now in its second edition. The only exceptions to this have been the studies of the German systematist Rensch, but these were largely in the nature of pioneer work.

Now at last Dr. Mayr has approached the problem from the other side of the fence, from that of the practising systematist, familiar with the most modern taxonomic methods, but also in close touch with some of the world's leading geneticists.

This is the first work on 'evolution in action' to be written by a specialist in the taxonomy of a single major group of animals. What is more, it is improbable that anyone save a specialist in the systematics of birds could have written such a satisfactory work; for, as Dr. Mayr points out, the class Aves is better known systematically than any other group above the rank of sub-order, and general taxonomic principles of various sorts only emerge clearly from the comparative survey of well analysed material.

The result is a book of high value for the taxonomist, for the geneticist, and for the general biologist and the student of evolution. The degree of intensive study which the avian systematist has been able to give to his study, thanks to the relatively small number of species in the group, and the thorough collecting that has gone on in all parts of the world, has enabled him to perfect taxonomic methods and to draw general conclusions to an extent which has scarcely been attempted in most groups. Mayr estimates that less than 2 per cent of the total number of bird species in existence remain to be discovered. Of those which have been described the great majority are known from long series, which enable us to pronounce with considerable accuracy as to their infraspecific constitution; we know what a bird subspecies is, we know how subspecific and specific differentiation proceed in different circumstances and in different regions.

The geneticist is presented with a vast array of natural experiments which provide material of the greatest value for his theoretical or experimental analysis. The general biologist is given a fascinating picture (which much extends the basic outline already provided by palæontology) of how evolution actually works, how it is related to the geographical environment, to violent climatic changes like those of the Ice Age, and to the peculiarities of the evolving stock and the biological competition to which it is exposed.

Space will not permit mention of more than a few of the main conclusions. Perhaps most important, Mayr has given convincing reasons (certainly they have convinced me to change my views in the matter) that in higher animals all speciation, except the small fraction which begins by the differentiation of true 'biological races' in parasites, parasitoids, and monophagous food specialists, depends in the first instance on geographical isolation; ecological and genetical differentiation can never bring about the requisite degree of isolation between groups, though they can accelerate and amplify the process of divergence, once it has been initiated (and to an extent which is perhaps a little under-estimated by Mayr).

In clearing up this position, Mayr has a valuable section on "sibling species", a purely descriptive term which he introduces for closely related forms with overlapping geographical ranges, which must be classed as species because they exhibit complete reproductive isolation, but which are so similar in appearance that the systematist brought up in morphological methods is reluctant to separate them taxonomically. Under this head he puts the well-known case of the so-called "biological races" of the malaria mosquito, the puzzling cases in ants which myrmecologists usually call "varieties" or "subspecies", and various birds, of which the cave-swifts, the minivets, and the babblers provide some striking examples, which have deceived all systematists until very recent times.

This phenomenon would seem to demand a good deal more analysis. Mayr tends to dismiss it as "not surprising", once one has rid oneself of morphological preconceptions. The fact remains that most speciation, even in animals of "non-optical" groups, does involve considerable morphological (visible) divergence; and sometimes, as where distinctive form and pattern provide the basis for preventing species-crossing, we can understand why such visible divergence should be striking. The fact that sibling species are in a small minority, but that they exist even in "optical" groups like birds, demands explanation.

Then Mayr emphasizes the need for studying speciation in all types of regions before drawing general conclusions about the process. He gives quantitative evidence that whereas the majority of species in old tropical archipelagoes are in the later stages of the speciation process, the reverse is the case in continental areas, especially those where large-range changes have recently occurred, as in the north temperate zone since the close of the Glacial period. He writes: "so far as I know, all workers who minimize the importance of geographic formation for species formation base their opinion on work done in the Holarctic region. On the other hand, von Buch, Darwin, Wallace and others derived their clear ideas on evolution from a study of both continental and insular species".

As might be expected, the author has something of value to say on taxonomic categories. The genus, for example, is "based on a natural phenomenon", namely, the fact that species are not evenly distinct from each other, but diverge so as to form smaller or larger groups, separated by smaller or larger gaps. But genera do not have "objective reality", because, unlike species, they do not constitute groups with definable limits—in other words, it is an arbitrary matter whether we make our genera large or small, whereas the definition of the size and limits of a species is in principle never arbitrary, though there

may be borderline cases. The size of a genus is, therefore, a matter of practical convenience, and Mayr enters a cogent plea against the retention of "giant" genera, and still more against the undue creation of monotypic genera.

We should also mention that Mayr gives what would appear to be a definitive refutation of Goldschmidt's heterodox views on speciation.

Among the few points of criticism to be made are Mayr's curious neglect (though this is in common with many other evolutionists) of the organic selection principle of Baldwin and Lloyd-Morgan, which deserves the most careful consideration as an auxiliary method of evolution. Another is his failure to give full consideration to the case of groups of subspecies inhabiting large continental areas, and with zones of intergradation at the margins of their ranges. He appears (if I understand him aright) to consider that all such subspecies are likely to differentiate into full species with time, owing to the introduction of geographical, climatic, or biological discontinuities. However, the alternative thesis may be maintained that partial discontinuity of this sort may in such areas constitute an equilibrium phase in the speciation process, and that such groups of subspecies may, therefore, continue to maintain themselves and to evolve without further increase of taxonomic divergence. It would be of extreme interest to be given a discussion of this problem by someone like Mayr, who is familiar with the taxonomic data. However, as I have already said, Mayr's book invites few criticisms and much gratitude. It is a distinctive and valuable contribution to modern evolutionary studies. JULIAN HUXLEY.

THE PHYSICAL BASIS OF MEDICAL RADIOLOGY

Radiologic Physics

By Charles Weyl, S. Reid Warren, Jr., and Dallett B. O'Neill. Pp. xvii+459. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1941.) 5.50 dollars.

THE period between the War of 1914–18 and the present War has been marked by outstanding advances in every branch of scientific, medical and industrial radiology. At the beginning of this era, the induction coil was probably the most favoured apparatus for the production of the high potentials required to excite an X-ray tube; the Coolidge tube had just been invented; the measurement of radiation for biological purposes was in a chaotic condition, since there were neither agreed units nor standards of measurement; and hospital X-ray departments were frequently located in ill-ventilated basements or other inaccessible parts of buildings, in which devices for the protection of the operating personnel against the injurious effects of scattered and direct radiation and high-tension discharge were in the majority of cases either non-existent or utterly inadequate.

The situation to-day is vastly different from this. The induction coil has been almost entirely supplanted in X-ray sets by transformer-plus-rectifier units which, together with elaborate controlling mechanisms, ensure a constancy and reproducibility of output in intensity and duration previously unobtainable. Thanks to the pioneer work of Sir William Bragg and the labours of standardizing laboratories in many countries, ionization instruments have been developed which enable medical radiologists throughout the world to administer identical prescribed doses of X-rays to their patients. At the same time, the problems of protection have been so thoroughly explored that we may confidently anticipate there will be no more X-ray martyrs. The recent discoveries in the field of nuclear physics and the contemporary development of apparatus capable of producing current at pressures of millions of volts foreshadow further great advances in the treatment of disease by means of X-rays and radioactive substances. Recently, Dr. Coolidge has stated that the fortieth *portable* million-volt X-ray generator was being completed in the G.E.C. works at Schenectady. Further, he announced that the promising results of tests carried out with an X-ray generator based on the "betatron" principle and functioning at 20 million volts have encouraged his Company to build a larger model on the same principle designed to operate at 100 million volts.

Diplomas in medical radiology have been instituted by universities and other examining bodies in Great Britain and other countries, and the training of candidates for these now forms one of the regular post-graduate courses of instruction. Against the background of continuous scientific and technical progress increasing demands are made on the knowledge of physics and electro-technics possessed by the candidates. Not only must they be familiar with the construction and mode of action of the complicated apparatus they employ, but also they must be equipped to appreciate fully and take advantage of future discoveries and developments useful in their speciality.

The present book has been written with this dual object in view, and embodies a course of instruction which the authors have given for several years in the department of radiology of the Hospital of the University of Pennsylvania. It can at once be said that the book fulfils its purpose admirably and is probably the best of its kind available in the English language. Beginning with the fundamental physical principles of electricity and magnetism including electronics, the authors then describe the construction and mode of action of measuring instruments, transformers, generators, motors, rectifiers and electromedical apparatus. Succeeding chapters discuss radiant energy and its interactions with matter. Those physical properties of X-rays and radioactive substances useful for diagnosis or medical treatment are explained both adequately and lucidly. Special chapters deal with the measurement and control of X-rays and of gamma-rays for therapy, and with the physical aspects of X-ray fluoroscopic and diagnostic techniques.

In a book of uniformly high standard, we would select for especial commendation the chapters dealing with the physical principles underlying diagnostic radiology—a subject much neglected in other textbooks in English. The book is well produced and appears to be free from misprints and errors. The description of electrons, neutrons, protons, etc., as "atomic" entities (p. 254) is perhaps scarcely justifiable, and some American words sound strange to English readers; for example, "retention" for "persistence" of vision (p. 154), "laminagraphy" for "tomography", etc. One misses, too, any reference in the text to the names of people associated with some outstanding contributions to the subject, such as Bouwers, Coolidge, Greinacher, Rutherford,

Villard; although in general full justice is done to the subject-matter of their contributions. The inclusion of a description and diagram of a *mechanical* rectifier (pp. 183, 184) is somewhat surprising. The authors have shown great skill in the selection and discussion of the matter included in the book. They have met in advance any possible objection which might be raised to the restricted treatment or rejection of any topic by including a good bibliography of references. The book should be found in all radiological libraries, and is certain to achieve a well-deserved popularity among medical students and those who desire to become qualified radiologists, whether medical or industrial.

F. L. HOPWOOD.

ELECTRIC POWER CONTROL

Electric Power System Control

By H. P. Young. (Monographs on Electrical Engineering, Vol. 11.) Pp. xii+319+22 plates. (London: Chapman and Hall, Ltd., 1942.) 25*s*. net.

JUST as ordered control is the keynote of success of the individual and of the organization, so is it when applied to the harnessing of the forces of Nature, either in their pristine state or as manifested in the workings of man-made mechanisms. In the electrical field of endeavour, intelligent control is a vital necessity, and it finds its highest expression in the various forms of automatic apparatus and systems which are so largely responsible for the modern reliability of electric power supply. It is no exaggeration to say that the extensive interconnected high-voltage power systems of to-day with their hundreds of thousands of rated kilowatts and millions of potential fault kilowatts owe their operational success and, indeed, their very being, to automatic control and protection. A book such as this, which brings the subject before the reader as a co-ordinated whole, is, therefore, a valuable addition to electrical engineering literature and is welcome accordingly.

The opening chapter is of an introductory nature and discusses the parallel operation of generators and the characteristics of exciters. Two chapters follow, on the automatic regulation of both voltage and power factor of synchronous machines, stress being laid upon the importance of the subject from the point of view of system stability. The succeeding chapter is devoted to the synchronizing of alternators, an operation which it is essential should be carried out accurately to avoid high-magnitude current surges.

Power control by reactance is a technique which has been adopted for many years on large systems in respect of machines, busbars and feeders, and Chapter 5 describes the principles and application of the different methods and apparatus. Chapters 6 and 7 deal with circuit breakers, circuit interruption, power station switchgear arrangements, and short-circuit calculations, and they form a reliable guide to modern practice and developments in these important branches of power control.

The last three chapters relate respectively to the interconnexion of power stations, interconnector control, and automatic supervisory control. These are all features of power system operation which are rather imperfectly understood by most engineers apart from the control specialists and hence are valuable additions to the book.

It would be easy to suggest additional studies which the author might have included, but nothing which might have been omitted. Within the confines which have been laid down, the book is an eminently suitable guide to electrical engineers interested in both the design and operation of power system networks.

ENGINEERING DATA

The Engineer's Year-Book of Formulæ, Rules, Tables, Data and Memoranda for 1943

A Compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas, Aero, Mine and Metallurgical Engineering. Originally compiled by H. R. Kempe and W. Hanneford-Smith. 49th annual issue, revised under the direction of L. St. L. Pendred. Pp. xii+2854+lxxxi. (London: Morgan Brothers (Publishers), Ltd., 1943.) 40*s*. net.

DESPITE the difficulties associated with war conditions, "Kempe" has once more appeared in a new edition—the forty-ninth—and, certainly as regards its external appearance and form, is but little different from its more recent predecessors. Internally, too, there is little change from last year's issue, which was made the occasion of one of those periodical revisions by which from time to time it renews its youth.

In the present issue, then, one would expect to find a number of minor corrections rather than any alterations in the body of the work. As it happens, however, very little correction proved to be necessary, and the principal change is found in the sub-section devoted to fire extinction and prevention, which has been revised and amplified by Hubert B. Graham, president of the Fire Extinguisher Trades Association. This forms Part IV of Section XXXVI and, in the space available, deals in considerable detail, though necessarily succinctly, with first-aid precautions and appliances, mobile secondary-aid and major appliances, fixed installations, fire hose, pressures to give various ranges of fire streams with different sizes of nozzle, fire-resisting buildings and materials, fire prevention at sea and oil fires. The collated information regarding the different types of extincteurs, their charges, their capacity and their applications should prove most valuable.

It is difficult to present the scope of "Kempe" to anyone who has not handled the book itself in recent years. The bibliography shows a number of 'continents' into which its world can be divided, but in each of these there are major and minor subdivisions almost beyond enumeration or description. Its 2,751 pages, exclusive of the index, which occupies 72 pages—a fact which, in itself, is illuminating as to the variety of items dealt with—are allocated to no fewer than forty-seven main sections. These are very largely devoted to the practical side of engineering, and include such representative titles as surveying, reinforced concrete, aircraft and aero-engines, radio communication and electric traction, to name but a few. In contrast with these a fair proportion deal with more fundamental subjects such as mechanics, heat, and acoustics. A third group includes those giving information on patents, designs and trade marks, depreciation of plant and machinery, income tax allowances, and legal notes for engineers. Thus it can be seen that "Kempe" is eminently a book for every engineer's desk, and one capable of informing him on many points requiring confirmation or elucidation.

SIR WILLIAM CHANDLER ROBERTS-AUSTEN*

By DR. S. W. SMITH, C.B.E.

IT is now more than forty years since Roberts-Austen was a familiar figure at scientific and technological gatherings. Born on March 3, 1843, in Kennington, his whole life coincided with a period of intense scientific and metallurgical activity, and, living as he did in the Metropolis, and for the greater part of that time at the Royal Mint (where he died on November 22, 1902), he had exceptional opportunities of participating in the proceedings of the numerous scientific and technical societies having their headquarters in London, and of being closely associated with those who were concerned with their various activities.

The name by which he is known was added in middle life for family reasons, when, as William Chandler Roberts, he was granted license to add the name of Austen. It is this name which has been perpetuated by the distinguished French metallurgist, Floris Osmond, who dedicated to him the discovery of the constituent of steel to which he gave the name 'austenite', and which, with its derivative 'austenitic', have become terms in daily use.

Early Influences

It is of interest, I think, that we should take a glance at the background of Roberts-Austen's earlier professional career and consider for a moment the extent to which his bent for scientific investigation was influenced by those with whom he became associated and under whose inspiring influence his aspirations were no doubt stimulated. Of these I would mention two to whom he paid generous tributes in later years.

First of all, Dr. John Percy, professor at the Royal School of Mines—then at Jermyn Street, London. Roberts-Austen entered in 1861, at the age of eighteen, with the intention of pursuing mining as a career; it was undoubtedly due to Percy that his interests were deflected to metallurgy.

Having completed the course at the School of Mines, Roberts-Austen, no doubt on the recommendation of Percy, went to the Royal Mint in 1865 as personal assistant to Thomas Graham, and for four years—that is, until Graham's death in 1869—continued to assist him in his private laboratory at the Mint, but in no direct way associated with the operations of coinage. During this time Graham was pursuing his researches on the diffusion of gases in metals and, in particular, the classical work on the occlusion of hydrogen by palladium, in which Roberts-Austen felt justifiable pride in having participated.

At the death of Graham, the office and title of 'Master of the Mint' was in future to be held, *ex officio*, by the Chancellor of the Exchequer, while the actual administration of the Department was entrusted to a 'Deputy Master and Comptroller'. Roberts-Austen was retained in an official capacity as 'Chemist to the Mint' and was entrusted with the responsibility, as an assayer, and still occupying Graham's laboratory, of ascertaining and certifying the legal composition of all standardized alloys and finished coins.

A further reorganization of the work of the Assay Department occurred in 1882 on the retirement of Mr. E. L. J. Ridsdale, the officer responsible for the valuation of all gold and silver bullion imported into the Mint. Roberts-Austen was given full charge of the valuation of bullion at all stages with the title of 'Chemist and Assayer of the Mint'. This office he continued to hold, never releasing himself from a share in the daily responsibilities of routine work, until, on the death of the then Deputy Master (Sir Horace Seymour), early in 1902, he was called upon to add the duties of that office to those of his own.

Early Work at the Mint

The earlier years of Roberts-Austen's official career were devoted almost exclusively to matters directly related to the operations of minting, and the thoroughness with which he explored the historical records of the art is shown by the admirable series of Cantor Lectures which he delivered before the Royal Society of Arts in 1884, on "Alloys Used for Coinage".

One is tempted to dwell longer on the variety of interests which Roberts-Austen found to attract his attention in those earlier years, such, for example, as the repetition of some of Spring's work, of 1878 and 1880, on the compression of metallic powders, which we now call 'powder metallurgy'; but one must keep steadily in mind the lines along which he developed his main contributions to metallurgical progress. An important milestone is, undoubtedly, a remarkable paper which he contributed to the *Proceedings of the Royal Society* so early as 1875, "On the Liquation, Fusibility, and Density of Certain Alloys of Silver and Copper".

Roberts-Austen set himself the task of determining, in the first place, the temperatures at which the alloys of these metals solidify when the composition ranges from pure silver to pure copper. At that time the only course open to him was to adopt a laborious calorimetric method of temperature measurement based on a modification of a procedure employed by Pouillet in determining the specific heat of platinum at high temperatures. The fifty or so observations of freezing points were plotted graphically and constitute the first recorded 'freezing-point curve' of a series of alloys which solidify beyond the range of the glass thermometer.

Although Roberts-Austen's original intention in undertaking this work was to find an explanation of the segregation which occurs when alloys of the precious metals solidify from the molten state, a behaviour which, following the train of thought which he had inherited from Graham, he spoke of as "molecular mobility", the actual outcome of this work was the direction it gave to a search for more accurate methods of measuring and recording high temperatures and to the means which these would afford of studying the constitution of other series of alloys. From then onwards for many years he sought to make available a means of recording autographically those changes in the rates of heating and cooling of metals and alloys which accompany changes of phase below and above their melting points. For this purpose he followed the lines which had been initiated by Henri Le Chatelier, who had shown the possibilities of making use of thermo-couples of platinum and platinum-rhodium for this purpose.

The recording pyrometer continued to be his chief implement of research until he adopted the methods of photomicrography in 1895, which became comple-

* Substance of the centenary address arranged by the Institution of Mechanical Engineers, the Iron and Steel Institute and the Institute of Metals, delivered on March 3.

mentary to it. He made effective use of these two lines of approach in revealing the molecular changes taking place in metals and alloys and in demonstrating the reality of those changes by photographic means. Demonstration was, in fact, one of his most useful attributes at a time when there were few opportunities for those immersed in engineering and productive work of becoming even acquainted with the trend which physical metallurgy was beginning to take.

Much of his earlier work at the Mint arose directly from problems presented by his official duties. From the difficulties in dealing with 'brittle gold' caused by the presence of traces of impurities, he passed, in time, to the consideration of the effects of traces of elements deliberately added both to ferrous and to non-ferrous metals.

From the difficulty in securing uniformity in the official standards of reference of the gold and silver coinages he passed to the determination of the molecular changes occurring during the passage of molten alloys to room temperatures. The need for the provision of better steel for the manufacture of coinage dies led to a closer study of the iron-carbon alloys, while the preparation of electro-deposited reproductions of plaster models furnished him with the means of studying the molecular transformations in pure iron. The 'flashing' or 'recalescence' of the cupelled buttons of gold and silver during the daily operations of assaying gold bullion led him to make an extended examination of the 'undercooling' or 'surfusion' of alloys.

These examples of his early work at the Mint are sufficient, I think, to show how he was led, from what one might regard as parochial matters, to extend his inquiries to wider fields and to matters of fundamental scientific and metallurgical importance.

The Royal School of Mines

Fifteen years elapsed from the time Roberts-Austen left the School of Mines in 1865 until he again became directly associated with it in 1880 as the professor of metallurgy at South Kensington. His outstanding contribution to the teaching of his subject was the compilation of "An Introduction to the Study of Metallurgy", first published in 1891 and revised in later editions, each growing in bulk and usefulness, the fifth edition being published just before his death.

During the twenty-two years of his professorship, Roberts-Austen was associated with many eminent colleagues. Huxley became dean in 1881 and continued to direct the work of the Royal School of Mines and the Royal College of Science until his death in 1895. Other familiar names are those of Judd, Warington-Smyth, Le Neve Foster, Frankland, Edward Thorpe, Guthrie, Rücker, Goodeve, and Perry. Norman Lockyer, who had been associated with Roberts-Austen in an investigation of the quantitative analysis of alloys by the spectroscope so early as 1873, was appointed to the chair of astronomical physics contemporaneously with him in 1881.

Alloys Research

Roberts-Austen had long wished to ascertain whether the influence of small quantities of impurities on the physical and mechanical properties of metals is governed by any law. The general interest which had been aroused in the 'eighties by the enunciation of periodicity by Newlands and by Mendeléeff, in relation to the chemical properties of the elements, had, no doubt, led him to seek some such generalization in regard to alloys.

In a paper to the Royal Society in 1888, "On Certain Mechanical Properties of Metals considered in Relation to the Periodic Law", he reviewed some of the practical implications of the presence of small amounts of other elements in metals of relative purity. It was as the direct outcome of this work that we find recorded in the *Proceedings of the Institution of Mechanical Engineers* (Annual Report, January 29, 1890, p. 6) that, on the recommendation of Dr. Anderson, the Council had decided upon starting an Alloys Research Committee, with the object of furthering the investigations which Roberts-Austen had already made, but with special regard to the physical and mechanical properties of iron, copper, and lead. Reference was also made to a previous suggestion by Mr. John A. F. Aspinal as to the desirability of inquiring into the serious deterioration experienced during recent years in the durability of copper fire-boxes and brass tubes of locomotive boilers. The hope was expressed that one result of the investigations might be to elucidate the causes of these failures and that "the laws regulating the effects of small admixtures of other elements with iron will also be arrived at".

Thus we see that the original intention of those responsible for setting up this Committee was that the inquiries should embrace both non-ferrous and ferrous metallurgy, terms, however, not then in general use. Under the chairmanship of the then Director-General of Ordnance Factories at Woolwich, Dr. (afterwards Sir William) Anderson, it was only natural and, moreover, fortunate that the scope of the investigations should be a wide one.

During the ten years which followed, five reports were presented to the Institution. It was, perhaps, through the medium of these reports and the vigorous discussions which they provoked that Roberts-Austen's enthusiasm had the greatest practical effect, leading to widespread and permanent results. The reports were mainly exploratory, and at times seemingly discursive, but coming, as they did, at a time when men occupying the highest positions in the engineering world were frankly sceptical as to the possibility of the pyrometer or the microscope serving any real purpose as an indication of the suitability of material for engineering work, they did much to arouse interest and to carry conviction to those dealing with metallurgical problems differing very widely in their character. One of the features, in fact, of Roberts-Austen's usefulness at this time was the close touch he kept with workers in many fields, from whom came inquiries and information which might never have reached the notice of a less accessible person. At a time when such rapid advances were being made in all directions, the work with which the Committee had entrusted him did much to establish and to uphold the best traditions of metallurgical research in Great Britain.

The First Report, 1891

At the outset Roberts-Austen directed attention to Osmond's recent work on the allotropy of iron and his experimental study of the action of impurities on iron. His admiration of Osmond's work was repeatedly manifested during the years which followed, and a close friendship and intimate correspondence con-

tinued between these two men until the end. In fact, it is just, I think, to say that in many ways Roberts-Austen was Osmond's disciple, preaching the gospel of allotropy in Great Britain and introducing to his countrymen, in the later reports, the exquisite metallographic technique which Osmond had developed. A considerable part of the first report was directed to the question of temperature measurement as a fundamental necessity in carrying out the proposed investigations.

The Second Report, 1893

Attention was given to matters having a practical bearing, and exhaustive experiments were described of the effects of impurities on copper.

The effect of pressure on metals was next considered and particulars were given of experiments to lower the recalescence point of steel by compression.

Chromium steel was examined and Roberts-Austen directed attention to the importance of studying the relation of this metal to carbon and to iron. How little could he have anticipated the part which this metal was to play in those steels in which his own name was to be perpetuated by his friend Osmond!

The Third Report, 1895

Much of the work which followed was in the nature of exploratory research in various directions. Curves were shown of the cooling of electro-iron, of standard gold containing bismuth, of aluminium-copper alloys, and of iron-aluminium alloys. Observations were made of the spontaneous disintegration of the latter. The welding of iron was then examined in conjunction with Sir Thomas Wrightson. Experiments in welding were made by electrical means, and pyrometric measurements were made during the application of pressure to the plastic iron with the object of ascertaining whether the operation is attended by a fall of temperature as in the regelation of ice.

An important appendix included in this report was by Alfred Stansfield on the alloys of copper and tin; it represents the first attempt to explain this series as a whole.

The Fourth Report, 1897

The opening paragraphs of this report contain much that is of historic interest, and they constitute, moreover, a concise statement of the position which the Committee's work had reached, and the stimulus it had given to similar work in France. Roberts-Austen added: "It should not be forgotten, moreover, that excellent investigations on alloys have also recently been made at Cambridge by Heycock and Neville, whose work has been carried on side by side with that of our Committee".

He concluded these opening paragraphs by saying: "As regards the immediate future, I am of opinion that the nature of what may be called 'Solid Solutions' of metals must be more carefully studied than has hitherto been the case. . . . It will be necessary to place on a firmer basis our knowledge of the mechanical constitution of metals and alloys, as revealed by the pyrometer and the microscope, before attempting to explain how 'structure' is built up of the ultimate atoms or molecules of the metals". This, of course, with no inkling of the contributions to the questions of structure which the physicists were to make within a very few years.

Following the work on the alloys of copper and tin given in the third report came a similar investigation of those of copper and zinc, which had been in progress for nearly two years. Freezing-point curves of this series of alloys were published for the first time in this report.

The diffusion of metals, which had long occupied his attention and which had recently formed the subject of his Bakerian Lecture to the Royal Society, was discussed in relation to alloys generally. With regard to the diffusion of solid metals in each other, it was pointed out that the experiments had shown that it is possible actually to observe and measure the migration of the constituent atoms in a metal or alloy at the ordinary temperatures, pointing to unexpected possibilities of structural changes in metals used in engineering construction generally. His determination of the coefficient of diffusion of gold in solid lead was the first of its kind and has proved to have been very nearly correct. His interest in this aspect of molecular mobility is surely traceable to his early association with Graham.

The Fifth Report, 1899

The ultimate transference of the work of the Alloys Research Committee to the National Physical Laboratory was foreshadowed in the opening paragraphs of this report.

The Committee had exerted a noteworthy influence in connexion with the preliminary inquiry which had led to the recommendation by a Treasury Committee, of which Roberts-Austen was a member, that a National Physical Laboratory should be established, having its control vested in the Royal Society.

The results of the experimental work published in this report, which are of outstanding importance, are those which sought to support the view that the iron-carbon alloys should be considered as solutions and brought into line with ordinary saline solutions. The curves already given in the previous report had clearly indicated the possibility of such an explanation, but the provision of a new and highly sensitive method of recording temperature changes, which was described at length, made it possible to resume this investigation.

Although such cooling curves had been obtained previously by Osmond so long before as 1888, and more recently by Henri Le Chatelier, those given by Roberts-Austen in the fourth report constituted the first attempt to embody in curves a comprehensive series of results.

The latter part of the fifth report was devoted almost entirely to a description of the methods of microscopic examination and to a discussion of its possibilities. It was perhaps this aspect of the work which attracted the greatest attention at a time when information regarding the technique of metallography was scanty and not readily accessible. The apparatus which had been improvised became the model from which more elaborate arrangements were installed in many centres of industry throughout the country, but more directly at the Royal Arsenal, Woolwich, at Elswick, and at Cambridge.

To those who were his personal assistants during these years, and to whom he owed so much, Roberts-Austen made generous acknowledgment: to Henry C. Jenkins (First and Second Reports), to Alfred Stansfield (Third, Fourth and Fifth Reports), to William H. Merrett (Fourth, Fifth, and, after his death, the Sixth Reports) and to A. J. Brett (Fifth Report).

One may also mention the names of others who at one time or other went to the Mint for varying periods and worked in the vaulted chambers collectively known as "The Cellars". Of these, Carpenter, Rosenhain, Hudson, Law, Bengough, Bannister, Reinders and Campbell are names which are identified with the period which saw the birth of the Institute of Metals. Sir Thomas Kirke Rose had been one of his official colleagues during this period and had collaborated with him in papers to the Royal Society.

I may perhaps recall that the first president of the Institute of Metals, Sir William White, was, at the termination of Roberts-Austen's work, chairman of the Alloys Research Committee and president of the Institution of Mechanical Engineers, and it was in no small measure due to his unfailing support and to his foresight that the work was continued at the National Physical Laboratory and that the Institute of Metals became the medium by which the results of so many later researches have been made available to the workers of all nations.

Departmental Committees

Running concurrently with the later phases of the Alloys Research Committee's reports were the increasing demands made upon Roberts-Austen's time and energy by official committees of inquiry set up by various Government Departments. Of these, the first in which his authority in regard to matters relating to iron and steel received recognition was that of a committee appointed in 1896 by the Board of Trade to inquire into the "Loss of Strength of Steel Rails through Use on Railways". The investigations were prolonged, the final report appearing four years later (1900). A summary of this work was afterwards presented to the Institution of Civil Engineers.

From time to time the Ordnance Committee of the War Department had submitted to him samples of steel used in the manufacture of guns and armour plate, and he continued until his death to be in active co-operation with the War Office and with the Admiralty in elucidating problems in the manufacture of ordnance.

In 1900 he was appointed a member of a special committee set up jointly by the Admiralty and the War Office to consider certain questions which had arisen in relation to explosives and ordnance. This committee was composed of distinguished men who were quite independent of either of the two Services. Lord Rayleigh was chairman and with him were Sir Andrew Noble, Sir William Crookes, the Right Hon. R. B. (afterwards Lord) Haldane, and Roberts-Austen. His own contribution to the work of this committee followed the lines of his earlier work. His death, however, prevented the completion of this work, which, it was said, promised to furnish valuable information.

Addresses

While his contributions to the *Transactions* and *Proceedings* of various scientific and technical bodies contain the records of his experimental work, it is to his addresses that we must turn to find the best expressions of a vivid personality which was a constant inspiration to those who knew him. These addresses were models of arresting exposition and constitute valuable contemporary records; they reveal clearly how very much 'worth-while' he found metallurgy to be.

Of these addresses, two are outstanding, and these came towards the close of his career. They were the presidential addresses which he delivered in 1899 and 1900 to the Iron and Steel Institute. In the first he gave an exhaustive review of the contributions made by Great Britain to the progress of the metallurgy of iron and steel during the nineteenth century, while in the second, delivered in Paris at the autumn meeting, he reviewed the contributions made by France during the same period. The circumstances accompanying the latter occasion were, in many ways, brilliant, coinciding, as they did, with the memorable Exhibition of 1900 and attracting a representative gathering of metallurgists from all countries. His friend, Osmond, translated his address into graceful French prose.

Henry Marion Howe, the distinguished American metallurgist and personal friend of Roberts-Austen, writing some years after his death, said: "The data which he recorded may be replaced by still more accurate and fuller ones. But his methods of presentation will retain their value unlessened, because they are adapted to the unchanging human mind. . . . The reason why on returning to London we went first to the Mint was that we met there one who welcomed us, not for his own sake, but for ours; who was truly glad to put his researches off till night in order that he might quicken us. You felt instinctively that you drew inspiration from his look and presence and became better fitted for receiving whatever is uplifting and broadening in the world's metropolis."

Roberts-Austen lived wholly for the progress of metallurgy, and he did much in his day and generation to stimulate others to share his enthusiasm and his conviction of how much more there was to come.

FRESHWATER FISHERIES IN THE BRITISH COLONIAL EMPIRE

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COLONIAL development is being much discussed, and when scientific and other resources can be released for peace-time activities, we can assume that the new imperialism will, in the spirit of the age, concentrate on those aspects of progress which affect directly or indirectly the standard of life of the Colonial peoples. With this in view the Colonial Research Committee has already been busy for six months or so, and the establishment of a Colonial Products Research Council with executive powers has recently been announced (see NATURE, Jan. 23, 1943, p. 105).

So much work in recent years has gone to show that adequate and well-balanced feeding is an essential basis for bodily health and mental development that it is needless to labour its necessity for Colonial peoples, except to emphasize that in many of the Colonies the constituents of diet often most deficient are animal protein and mineral salts. Much work is being done to increase the supply of meat by the many Colonial departments devoted to agriculture and veterinary work, and the special organizations aiming at the control of pests such as tsetse flies and locusts. Nevertheless meat is still very short as an article of diet among Colonial peoples and is likely

to remain so. It is natural, therefore, to turn to the possibilities of providing the deficient ingredients from fish, which already contribute materially, but could do much more.

Attention has been directed to the potentialities of the marine fisheries of the British Colonial Empire in recent years, particularly by Kemp[1] in his presidential address to Section D (Zoology) of the British Association in 1938. There are, moreover, the fisheries departments which have been at work for many years in the Dominions and in Malaya, Ceylon and Palestine, with more recent developments in Hong Kong and the West Indies, and a new investigation now proceeding in West Africa. Meanwhile the junior partner, freshwater fisheries, has had few spokesmen in spite of the fact that fresh water is often capable of contributing even more than the sea to the cooking pots of the Colonial peoples. It is, of course, the great continental areas rather than the island colonies where freshwater fish come into prime importance. The British Colonial territories in Africa, for example, contain appreciably more than 50,000 square miles of fresh water, and, as a glance at a population map of Africa makes clear, there is a strong tendency for the people to congregate along the many hundred thousand miles of shore-line bordering these waters, especially in the area of the great lakes. It is scarcely surprising that freshwater fisheries of importance have grown up, but the diversity and scattered nature of the industry make it almost impossible to assess its value, either in terms of food or cash, except in a few instances. Several things are known for certain about these fisheries, however: many waters are capable of producing far more fish than they do at present; improved communications are causing new markets to be opened; and in certain waters easy of access the troubles of over-fishing are already becoming pressing.

Lake Victoria, which comprises 26,800 square miles of water all less than 270 ft. deep, is a good example; its 2,000 or so miles of coast are shared by Kenya, Uganda and Tanganyika. Statistics for the fish production are by no means complete, but a conservative estimate gives the local value at the landing points as about a quarter of a million pounds sterling a year. Practically the whole of this goes to the native market at an average price of rather less than 20 cents of a shilling per lb., so that the total annual production in terms of weight is, in round figures, about 10,000 tons. This, compared with the area of water of the whole lake, is equivalent to a crop of 1·4 lb. per acre per annum, which is ridiculously small compared, say, with about 15 lb. per acre taken annually from the North Sea, or much higher crops taken from fresh waters in various parts of the world. The reason for the poor showing of Lake Victoria is that only the inshore fringe of the lake is used by the fishery. In that fringe there are certain fish of high qualities, notably the ngege or African carp (*Tilapia esculenta*), which from time immemorial have been the quarry of numerous lacustrine tribes. European fishing methods, especially gill-nets, were introduced in 1905. Over-fishing was soon suspected as the first enormous catches fell off, and this led eventually to a six-month fishery survey in 1927. In his report on that survey[2], Graham gives an exhaustive analysis of the ngege fishery, backed by hydrographic and ecological data, with accounts of other fish resources which are being or might be developed. The recommendations for the restriction of mesh, etc., to conserve the ngege fishery were implemented by Kenya in 1932 and 1933, when fish protection rules and a system of inspection were instituted, but the administrations of Uganda and Tanganyika did not follow, so there is no common policy as yet. Thus Lake Victoria presents a big problem of undeveloped resources (if the whole lake were cropped at the rate of the North Sea, the catch would be multiplied at least ten-fold), coupled with a problem of local over-fishing. Neither of these problems can be solved without intensive research.

As another example there are Lakes Edward and George connected by the Kazinga Channel; they lie between Uganda and the Belgian Congo and comprise 960 square miles, of which part is shallow productive water and part deep. In 1930 a brief fishery survey was conducted here by the Cambridge Expedition to the East African Lakes[3], which revealed the fish resources, and since then a native fishery has been encouraged by the Uganda Government. In 1939, the most recent year for which figures are available, 1,060 tons of dried and salted fish (some 4,000 tons as landed) worth £24,000 were sold to the Belgian Congo, and large quantities not easy to estimate went to the Uganda markets. This is a good illustration of the high production of which these tropical waters are capable, for here, as in Lake Victoria, the fishery is restricted mainly to the inshore waters. Careful control will have to be exercised, however, if a repetition of the ngege fishery in Lake Victoria is to be avoided, and this will require the attention of scientific men as well as administrators.

The same story of large undeveloped resources is told for Lake Albert and Lake Kioga in Uganda[4], where several enterprises have been started under European management since a brief fishery survey in 1928; and the basic information for development of Lake Rudolf is available for the time when transport routes from that isolated area to the Kenya markets are developed. More recently, fishery surveys have been carried out on the great lakes farther south, namely, Lakes Nyasa[5], Lakes Rukwa and Bangweulu[6], which likewise tell of undeveloped resources coupled here and there with the danger of local over-fishing in the more accessible waters. The fishery of Lake Tanganyika still awaits examination, which is odd in view of the great attention this lake has received from men of science, and there is a long list of waters of less area but all capable of producing many tons of food every year.

There is another aspect to this subject, which has potentialities in every Colony and is not dependent on large lakes or rivers, namely, fish ponds. It is well known that, even in temperate climates, fresh water under careful management can be made to produce more animal protein food per unit area than can good farm land. Thus the fish farms of Central Europe may produce up to and more than 400 lb. of fish, such as carp and rainbow trout, per acre of water per annum, compared, say, with 200 lb. of beef or mutton from pasture land of high quality. In many parts of the British tropical Colonies the rigours of climate and animal disease are such that the cropping rate of domestic animal protein is very much less than in Europe; but the productivity of fish should be capable of even greater development on account of the higher water temperatures and lack of winter. Thus there may be a big future for fish farming in the Colonies, in ponds specially constructed for the purpose, properly managed and manured. For intensive fish farming in warm climates we have already the outstanding example

of the Chinese, who see to it that every square yard of water produces a crop of fish. In some Colonies there has already been a considerable interest in the possibilities and actual development, especially in Malaya and Palestine, but in the great areas of Africa where sea fish are not available and opportunities for fish ponds extensive, the subject at present is mainly in the suggestion stage. Before such a new industry can be established, intensive research work is necessary in order to bring to bear our knowledge of productivity in water, of manuring and of the life-histories of different species of fish. Such research should not be unduly delayed because it might go a long way to solve many problems of food supply, particularly those experienced by large employers of labour on plantations and mines in the great tsetse fly belt of Africa, where animal protein is so difficult to provide. The large peace-time imports of Norwegian stock fish to the west coast of Africa are by no means sufficient to supply the need.

Now coming to what might be done to help these industries along the right lines, it is a striking fact that, whereas large sums of money have been spent, with great advantage, on the development and control of agricultural, forest and mineral resources, the total spent up to now on freshwater fisheries runs to very few thousand pounds, and the regular annual expenditure on supervision is probably nil, being met from the charges for licensing fishermen, boats and nets. Lord Hailey, in his "African Survey"[7], when describing the many agencies which are designed to assist development of the British African Colonies, was unable to mention any such agency concerned with fisheries, and in the volume on "Science" which accompanied the survey[8], though I devoted a chapter to fisheries, reference to those of the British Colonial territories had to be extremely brief because so little work on them had been accomplished, and organization for their development and control scarcely existed. Since then, a Colonial Fisheries Committee was appointed in 1939 under the Economic Advisory Council, but the War intervened, and this Committee went into abeyance before it had an opportunity to meet. The case seems to be clear cut, and conclusions point to freshwater fisheries being one of those subjects which should be scheduled for development, with assistance from funds under the Colonial Development and Welfare Act, as soon as conditions for scientific work in the Colonies improve. Therefore it may not be out of place to sketch the sort of organization which might be envisaged to bring this development about, with reference particularly to the East African region, where potentialities are greatest.

It will be necessary to have: (1) a uniform system for inspection, control, and the collection of fishery statistics; and (2) a sound organization for research. The first may have to be arranged independently in each territory for the time being, until some form of closer union between the African Dependencies comes into being. In the research organization, however, which will start almost from scratch, there should be a great opportunity for avoiding the scientific isolation, local administrative control, and other troubles which have rendered a deal of Colonial research almost stillborn. Inland fisheries are unlikely to become so important as to warrant big organizations in each Colony, and a few experts scattered here and there could not provide the necessary skill in the diversity of subjects involved, namely, chemistry, botany, zoology, statistics and even economics. Therefore the research should be on a regional basis, and for the East African region we can envisage a central fishery laboratory with an aquarium, probably on Lake Victoria, as the seat of the largest fishery. It would be close to the central African air route and no more than four or five days travel from England. Here a team of workers would be equipped with a research vessel on Lake Victoria and motor transport for excursions of a few months duration to other lakes. They would be responsible through their director to the Colonial Fishery Committee in London, but would maintain close contacts with the local administrations and also with the institutes for fishery research and with the British Museum (Natural History) in England. A system of staff exchange for periods up to a year between the fishery centres in Africa and home institutions would go a long way to overcome scientific isolation.

The staff of this suggested centre would, at least in the early stages, be directed along lines connected with economic developments, because the extreme kind of free research is almost incompatible with a centre devoted to a special objective. As such they would, of course, be constantly held up for lack of work on pure research. To overcome this difficulty, which is ever-present in the Colonies, the laboratory should be made as attractive as possible to visitors from the home country. These should be attracted by an abundant provision of research facilities and special funds wherewith to defray air travel and living expenses of approved workers, who would come for periods of three months to a year to conduct their own research on relevant subjects. The biological characteristics of the tropics, and the growing realization in universities and institutions in Great Britain of responsibility for the Colonies, may well attract many a research worker to spend his long vacation by the lakes, swamps and rivers of East Africa.

By such means we can envisage a growing band of young workers with tropical experience, some of whom may be available when the time comes after a few years for the establishment of a second centre for inland fishery work, perhaps in the area of Lake Nyasa, and staff which will inevitably be required for developments in other Colonies. In this way the central station on Lake Victoria would in time come to act for Colonial inland fisheries in the same capacity but on a smaller scale as that fulfilled for Colonial agriculture by the Imperial College of Tropical Agriculture, Trinidad. The cost of such a research organization would not be large. An initial capital expenditure of £10,000 would probably suffice, and the annual budget would be in the neighbourhood of £6,000, rising after five years or so to £10,000. There is every reason to believe that the cost would be seen back many times over in the form of enlarged fisheries established on sound scientific lines, and in the increased welfare of the Colonial peoples who would consume the product.

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SEX EDUCATION AND GUIDANCE

AN EDUCATIONAL PROBLEM

By DR. R. SUTHERLAND

Medical Adviser, Central Council for Health Education

SEXUAL intercourse outside marriage is generally regarded as a breach of our moral code. It is impossible therefore to gauge exactly the extent to which it is occurring, but the extra-marital conceptions and venereal disease infections which often result from it are some measure of its frequency. Roughly a hundred thousand of the children born in Great Britain during 1938 were conceived outside marriage, and during the same year there were at a rough estimate forty-seven thousand new cases of venereal disease. Not every sex adventure leads to conception, however, and the patients who have contracted venereal disease from their first illicit intercourse are very much in the minority. Consequently, extra-marital intercourse must be by no means uncommon.

There is little doubt that war conditions have led to a further slackening of moral standards. Family life has been disrupted, young people are far from the restraining influence of home, and life for many has become less sure. It is not surprising, therefore, that last year the number of new cases of venereal disease in Great Britain increased to roughly seventy thousand among civilians alone. Apart from its significance as an indication of spreading moral laxity, this increase affects the war effort, the health and happiness of the community, and the welfare of innocent spouses and unborn children.

The Minister of Health has recognized that this problem must be tackled and has had the courage to initiate a campaign to break down the taboo that has in the past so sadly interfered with the attack on venereal diseases. His Chief Medical Officer, Sir Wilson Jameson, made history by speaking frankly of the venereal disease menace in a radio talk last year; and the Ministry of Health is now collaborating with the Central Council for Health Education in giving widespread publicity to the facts about venereal disease through advertisements which are to appear for the next six months in the national and provincial newspapers. The Ministry and the Central Council have also arranged for film and poster displays, and the Central Council has produced a variety of leaflets for distribution to the public.

If the campaign of public education is to be successful, however, there must be an honest examination of all aspects of the problem as well as a free and frank discussion of the nature, methods of spread, and signs and treatment of the disease. This has been recognized by the Central Council for Health Education, which has been charged by the Ministry of Health with the responsibility for the central provision of education in this as in other health matters. Accordingly, on February 26, the Central Council held a conference in London which was attended by more than a thousand representatives and medical officers of English and Welsh local authorities, and at which the various methods of approaching the problem were freely discussed by a large number of speakers, among whom were the Archbishop of Canterbury (president of the Central Council), and the Minister of Health. This conference, sitting under the chairmanship of Dr. Charles Hill, chairman of the Central Council, should be of the greatest value in helping the churches, the Ministry, the Central Council, and local authorities to work out the agreed and co-ordinated national educational policy, which the Minister of Health urged is needed.

As the Archbishop of Canterbury said, the problem is only partly medical because spiritual, moral and social considerations are involved (see also NATURE, **150**, 529; 1942). The Archbishop went on to say that the moral element is the most important and should have the first attention. At a similar conference held in Scotland the following week, however, the Moderator of the General Assembly of the Church of Scotland maintained that the medical problem should be dealt with at the same time as the moral problem. In this he was supported by the Secretary of State for Scotland.

The need for developing the moral approach is generally accepted, but dispute rages hotly over the extent to which a purely medical or epidemiological approach to the problem can be justified. All are agreed that venereal disease could be practically ended if all extra-marital intercourse were avoided.

The difficulty is that the sexual urge, upon which the spread of venereal disease depends, is one of the most powerful primitive instincts, and that, as the figures for extra-marital conceptions and new cases of venereal disease show, the moral forces and social measures so far at work have signally failed to keep it fully under control. On the other hand, it must be recognized that, however successful it might be in dealing with the epidemiological problem of venereal disease, a medical approach which largely neutralized moral teaching and encouraged promiscuity might in the long run do more harm than good. This is what the Archbishop fears. Are his fears justified?

In the past, the moral attack on lax sex conduct, and consequently on venereal disease, has been greatly handicapped by the public attitude towards sex education. We can now look forward, however, to rapid developments in this field. Children and young people should be brought up to a full knowledge of their own bodies and of those of the opposite sex. Sex should be a mystery no longer, and it should cease to be associated in the child's mind with the naughty and the furtive. The child's innocent curiosity about sex should be satisfied naturally as it arises; and, before he becomes emotionally involved at adolescence, he should understand his own body, the workings of sex, and the moral and social reasons for self-control and continence. The spiritual teachings of the churches would thus be immensely strengthened by an enlightened self-interest which would encourage the youth to defer immediate satisfaction in the interests of adult happiness and of his future home and family. The stress should be on pride in chastity rather than upon fear of the possible consequences of promiscuity. Information about the venereal diseases should therefore be given naturally as part of instruction in the communicable diseases. Although all the basic information should have been given before puberty, the emotional problems of the adolescent should be sympathetically discussed at the time when they are likely to arise. The educators, whether teachers or youth leaders, must themselves be taught, and the Central Council for Health Education is prepared to give this instruction if asked to do so by local authorities.

There must, however, be a social approach to the problem as well. The demands made upon self-control must appear reasonable and the rewards fairly certain and not too distant. Conditions of

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employment and of housing must therefore offer the prospect of early marriage. As the Archbishop said, young people must have ample opportunity of enjoying each other's company in innocent activities amidst pleasant surroundings.

We must not disregard the assaults upon youthful self-discipline that are constantly being made by erotic magazines, books, films, and revues, and by alcohol.

When we come to consider the medical, or epidemiological, approach we are on much more controversial ground. Nevertheless, "the wages of sin is death" policy is almost universally out of fashion, and all are agreed that there must be adequate and convenient facilities for the early treatment of those who have not been continent and have as a consequence developed the first manifestations of venereal disease. Differences of opinion appear when the logical epidemiologist asks why we should wait until infection has actually taken place before starting treatment. He contends that the medical treatment of the problem should begin immediately the spiritual, moral, and social approach has failed; that is, as soon as any individual has succumbed to the temptation to extra-marital intercourse. He maintains that hundreds of thousands are exposing themselves to infection each year and that we must not just leave them to their fate. To do so involves not only great mental distress, some disability, and much trouble and expense, but often exposes innocent people to the risk of infection. He therefore urges that all young people should be informed of the preventive measures which will very largely reduce the chances of infection if a risk is taken. These measures include the use of a condom as a mechanical barrier to the passage of the germs, self-treatment by thorough washing and chemical applications to the parts immediately after exposure, and in addition, or alternatively, attendance at a treatment centre as soon as possible for prophylactic treatment by experts.

If there were only the narrow medical problem of venereal disease to be considered, this course would undoubtedly be the correct one, and its general application would soon reduce these diseases to relatively negligible proportions. Not one case of venereal disease has occurred, for example, among tens of thousands of persons who received prophylactic treatment at a treatment centre within twenty-four hours of exposure to the risk of infection. But the Archbishop considers that instruction on prophylaxis would be bound to have an adverse effect upon the reaction of the young to spiritual and moral teaching. If he is right in thinking that prophylactic teaching would inevitably amount in effect to incitement to fornication, then obviously the epidemiological arguments in favour of such teaching must be disregarded. But is he right? Is it in fact impossible to find teachers who could combine the moral and medical approach in such a way as to inspire high ideals of sex conduct, while yet openly recognizing that the flesh is sometimes weak and that some of the pupils may succumb to temptation, and should at least protect themselves from disease? Are we not deceiving ourselves if we fail to recognize that, however good and undiluted the moral teaching may be, it will fail in many cases? Need a realistic recognition of this fact necessarily mean an increased number of failures?

Surely the time has come to convert this no-man's-land upon which this moral versus medical controversy is raging into a common ground on which the moralists, the educationists, and the medical men can meet to try to work out an agreed venereal disease policy which will improve our national moral standards at the same time as it reduces the incidence of venereal disease. The Central Council for Health Education has made a beginning by providing a platform for the free exchange of views on this important question. It now only remains for the various schools of thought to resolve their conflict and work together in this great cause.

OBITUARIES

Prof. J. Eustice

PROF. JOHN EUSTICE, late head of the Faculty of Engineering in University College, Southampton, was the son of a Cornish mining engineer. He was trained first at the School of Mines, Camborne, and then at the Royal College of Science; he was a Whitworth Scholar and a National Science Scholar.

In 1891 he became lecturer in engineering to the Hampshire County Council, and in the next year joined the Hartley College, Southampton, where he formed its engineering side. For forty years he built up the Engineering Department until his retirement in 1931. By that time he had developed courses for the external B.Sc. degree in engineering of the University of London and also an active system of part-time and evening instruction for the apprentices and employees of engineering firms in the district. The difficulties of this development must have been very great, and to one who relieved him on his retirement the marvel was that he had achieved so much with so little equipment and accommodation. In addition to the technical instruction, he kept in his own hands the large administrative work of the evening classes as they grew up.

Prof. Eustice could find little time for research, but he did make a very beautiful study of the flow of liquids in curved pipes. The system of showing coloured stream lines in laminar flow had been used by Osborn Reynolds and Hele Shaw, but Eustice adapted the same general method to show the complicated three-dimensional pattern in which the stream lines interweave as flow passes round a curved tube.

On his retirement at the age of sixty-seven, Prof. Eustice was thoroughly tired out, but he had two great assets: great love of his church and all connected with it; and a keen interest—and a good performance—in golf. He changed to the new conditions with remarkable success, and his retirement must have been very happy. His activity and good health lasted to within a few days of his death on February 24 in his seventy-ninth year.

T. R. CAVE-BROWNE-CAVE.

WE regret to announce the following deaths:

Mr. Joseph Bunny, late of the Nigerian Forestry Service, on March 9.

Dr. C. N. Haskins, Chandler professor of mathematics at Dartmouth College, U.S.A., on November 14, aged sixty-eight years.

Mr. R. W. Sayles, research associate of the Division of Geology, Harvard University, on October 23, aged sixty-four.

NEW FELLOWS OF THE ROYAL SOCIETY

THE following were elected fellows of the Royal Society on March 18 :

SIR SHANTI SWARUPA BHATNAGAR, director of scientific and industrial research, India. Distinguished for his numerous contributions to physical chemistry, more especially to magneto-chemistry. As professor of chemistry in the University of the Punjab he built up a flourishing school of research. Since the outbreak of war he has organized a new scientific department of the Government of India.

PROF. P. A. BUXTON, director, Department of Entomology, London School of Hygiene and Tropical Medicine. Distinguished for his researches in medical entomology with special reference to the conditions under which insects responsible for the transmission of diseases multiply and the measures which must accordingly be adopted for their control.

PROF. I. DE B. DALY, professor of physiology, Edinburgh. Distinguished as an originator of essential items of modern physiological technique, and for his important contributions to the physiology of the circulation in the lungs and the bronchial tubes.

VICE-ADMIRAL SIR A. EDGELL, R.N., hydrographer of the Royal Navy. Distinguished for the organization and encouragement of work in tidal research, in determining gravity at sea and in magnetic and electric survey of the oceans.

DR. A. J. EWINS, director of research, May and Baker, Ltd. Distinguished for his chemical and biochemical researches. His work in organizing an industrial research laboratory has led to the production of some of the most important synthetic remedies in recent years.

DR. A. FELIX, bacteriologist, Lister Institute. Distinguished for his contributions to serology and bacteriology. He is particularly associated with the Weil-Felix reaction for the diagnosis of typhus fever and with the antigenic analysis of bacteria.

PROF. ALEXANDER FLEMING, professor of bacteriology, St. Mary's Hospital, London. Distinguished for his contributions to bacteriology, immunology and chemotherapy. His work includes the very important discoveries of lysozyme and penicillin.

DR. J. J. FOX, Government Chemist. Distinguished for his application of physical methods to the discovery of the structure of chemical substances and for his work on new analytical methods and chemical processes.

DR. W. M. H. GREAVES, Astronomer Royal for Scotland. Distinguished for his contributions to stellar spectro-photometry and for the discussion of the colour temperatures of early type stars.

DR. S. C. HARLAND, plant breeder. Distinguished for his contributions to the study of genetics and especially of the cotton plants. His researches have not only been of practical value for tropical agriculture, but also have led to important advances in fundamental aspects of evolutionary theory.

PROF. G. A. R. KON, research professor of chemistry at the Royal Cancer Hospital. Distinguished for his researches in organic chemistry. During recent years his work on the polyterpenes has provided the basis for a number of important developments.

DR. A. MCCANCE, director and general manager, Messrs. Colville's, Ltd., Motherwell. Distinguished for his work in the steel industry and particularly for his applications of physical chemistry to the processes of steel making.

PROF. WILDER PENFIELD, director of the Montreal Neurological Institute. Distinguished for his researches in neuro-histology and as a neuro-surgeon.

DR. G. E. PILGRIM, formerly superintendent of the Geological Survey of India. Distinguished for his contributions to the geology of India, particularly in the field of Tertiary stratigraphy, and for his researches in vertebrate palæontology.

DR. R. E. STRADLING, chief adviser, Research and Experiments Department, Ministry of Home Security. Distinguished for his researches on the properties of building materials and for his direction of the Building and Road Research Stations and of researches relating to civil defence.

DR. C. SYKES, superintendent of the Metallurgy Department of the National Physical Laboratory. Distinguished both for his fundamental scientific advances in the study of alloys and for the practical improvements which he has effected in various branches of metallurgy.

PROF. J. L. SYNGE, professor of applied mathematics, Toronto. Distinguished for his contributions to mathematics, particularly to the geometry of dynamics, the theory of relativity, hydrodynamics and electricity.

PROF. G. F. J. TEMPLE, professor of mathematics, King's College, London. Distinguished for his contributions to mathematical physics, particularly to quantum theory, relativity and mechanics.

DR. A. L. DU TOIT, lately consulting geologist to the De Beers Consolidated Mines. Distinguished for his contributions to the geology and petrology of South Africa, particularly his work on the Karroo system and his comparative study of the equivalent succession of South America.

PROF. SOLLY ZUCKERMAN, professor of anatomy, University of Birmingham. Distinguished for his studies on the morphology and relationship of the Primates and on their reproductive physiology. He has also made outstanding contributions to the study of social behaviour in the lower Primates.

The election of Sir Shanti Swarupa Bhatnagar to the fellowship of the Royal Society is a well-deserved recognition of his distinguished contributions to the advancement of science. The event is indeed a signal one, for he is the first Indian chemist to receive this high honour.

As a young Indian M.Sc. graduate he went in 1919 to Prof. F. G. Donnan's laboratory at University College, London, where he carried out a series of investigations on the stability and inversion of emulsions, obtaining the D.Sc. degree of the University of London in 1921. Returning to India, he went first to the Benares Hindu University, and, in 1924, to the University of the Punjab at Lahore, where he was appointed to the professorship of physical chemistry. Here he began to build up a university school of physico-chemical teaching and research, which through his own personal investiga-

tions and those of his collaborators and students soon became one of the most active and successful centres of chemical research in India. His name is particularly well known for his investigations on magnetism and its relation to atomic and molecular structure. Together with K. N. Mathur, he wrote an important work entitled "Physical Principles and Applications of Magnetochemistry" (Macmillan and Co., Ltd., London, 1935). Apart from these magneto-chemical investigations, the researches carried out in the University Chemical Laboratories at Lahore under the directorship of Sir Shanti have covered a wide field, including, among many other subjects, surface actions, photochemistry, and chemi-luminescence.

Although a number of industrial concerns in India have asked for and obtained valuable scientific help from him, Sir Shanti has consistently refused any personal financial reward. As a result, he has received from them very considerable sums of money for the improvement of the scientific equipment of the University Chemical Laboratories at Lahore and the foundation of research scholarships.

When in April 1940 the Board and Council of Scientific and Industrial Research was formed by the Government of India, Sir S. S. Bhatnagar was appointed the first director. The very important work already carried out by this Government research organization has been largely due to the great energy and ability of its director, whose valuable national services have been recognized recently by the conferment on him of a knighthood.

It is no exaggeration to say that a component and very important part of the great work which India is doing in the War is due to the successful labours of the Board and Council of Scientific and Industrial Research, and it is a source of deep satisfaction that the Board's first director of research is an eminent Indian man of science and a fellow of the Royal Society of London.

NEWS and VIEWS

Reconstruction and a Council of Europe

THERE have been comments from various sources in recent months to the effect that Mr. Winston Churchill was too preoccupied with the direction of the War to give adequate attention to questions of the reconstruction to follow it. His broadcast address on March 21 was an answer to such criticism ; it was delivered in measured terms, and set forth his views on the future of Great Britain, of Europe, and of the world. The first essential is, of course, the utter destruction of Nazism, and Mr. Churchill suggested that the first stage will be its disappearance from Europe. This will be the time to build up, on the lofty conceptions of freedom, law and morality which was the spirit of the League of Nations, a sort of Council of Europe, consisting of the great European States, associated with confederations of lesser States, so that "we shall achieve the largest common measure of the integrated life of Europe that is possible without destroying the individual characteristics and traditions of its many ancient and historic races". Towards this end, discussions are already taking place. Achievement of this project, however, will be possible only when the nations realize that none of them will be able to achieve the full satisfaction of its individual desires. The Council of Europe would be followed by a Council of Asia, leading on to a world organization.

The Prime Minister's Four Years Plan

TURNING to the domestic affairs of Great Britain, Mr. Churchill said he would propose a Four Years Plan to cover the period of transition and reconstruction which must follow the end of the war in Europe. Such a Plan would comprise five or six large measures of a practical character, all of which would require careful preparation in advance in order that they might fit into the general scheme. This scheme would have to receive the approval of the country at large. One such measure should be a scheme for compulsory national social insurance, and Mr. Churchill said that he and his colleagues are making the necessary preliminary legislative preparations. Agriculture must be maintained at a higher level by reviving healthy village life, so that Great Britain will not be so dependent on imported foodstuffs as hitherto. A national health service is another necessity, to combat the dwindling birth-rate as well as to carry on the war against disease. Education is also being actively studied. "The future of the world is to the highly educated races who alone can handle the scientific apparatus necessary for pre-eminence in peace or survival in war." Education must be broader and more liberal, with due consideration of the lessons of the past ; and opportunities for advanced education must be available to all. Religion has been a fundamental element in the schools of Great Britain, and must continue to play its part in building character. Secular schooling must be extended, and plans made for part-time education for those entering industry. The physical reconstruction made necessary by air-raid damage must also be planned effectively and preparations made well in advance.

Mr. Churchill concluded on the note of finance. He said that the Government will be responsible to the people for the money which they have provided for the war effort ; this involves stabilization of prices. Taxation, though it will necessarily be high after the War, must not stifle enterprise. The Government is preparing measures to enable it "to exercise a balancing influence upon development which can be turned on or off as circumstances require". The State must increasingly concern itself with the economic well-being of the nation, but must nevertheless revive as soon as possible a vigorous private enterprise. The intense demands for goods, both for home and export, which will come immediately the War ends, need not be succeeded by a disastrous slump such as that which followed the War of 1914–18. Under the stress of war, industry has learned new methods ; electrification has increased 50 per cent ; and new industries have arisen. Thus the radio industry, gas and electricity will be faced with many opportunities for expansion and service ; and transportation of all types must be developed. Throughout his address, Mr. Churchill stressed the need for work, for service and for general preparedness for the future, although he deprecated attempts to fill in detail or commit the country to large-scale expenditure in a future which cannot yet be clearly envisaged.

Evolution of Colonial Territories

THE debate on March 16 in the House of Commons on Colonial affairs may well come to be regarded as marking the beginning of a new phase in the handling of Colonial affairs—the phase that must follow and give substance to the accepted aspirations for the advance of the Colonial peoples to economic security, social well-being and ultimate partnership as responsible communities in the British Commonwealth. It was a first discussion of concrete but comprehensive plans for the development of one of the main regional entities into which the consideration of Colonial development will have, in increasing measure, to be grouped. The Stockdale Report, the proposals for a new constitution in Jamaica and the work of the Anglo-American Caribbean Commission which provided the substance of Colonel Stanley's speech, touched on every aspect of the development of the West Indies and raised the concrete issues involved in the next stages of advance. The Colonial Secretary himself emphasized the need to start with practical solutions of concrete problems. The proposals for the Jamaican constitution, published as a White Paper, attempt to give expression to the largest possible consensus of local opinion. Thus a bi-cameral system has been recommended, despite official demands for great simplicity, on the ground that a great deal more depends upon the spirit in which any constitution is going to be worked than upon the actual machinery that is devised. The proposal is seen as only a stage on the way. The paramount aim is declared to be to ensure further advances towards complete responsible government.

The Stockdale Report, in the same way, concentrates on the most essential needs and the recommendation of immediately practical remedies without losing sight of the long-term problems. Here the Colonial Secretary wisely emphasized the danger of reaction from recent conditions of insecurity in the export trade to too great a measure of self-sufficiency, which would condemn the West Indies and many other Colonial areas to an intolerably low standard of living. Here again, the achievements and the programme of the Anglo-American Commission constitute an immediate and practical response. By providing an organization which will bring the British West Indies and the rest of the Caribbean area together to find common solutions for their problems, the Commission is an instrument for the first, modest but indispensable, steps necessary to fit them into a prosperous world economy. All this is evidence of an enlightened and purposeful empiricism long overdue in the approach to Colonial problems.

Education and the Colonies

PROF. A. V. HILL, in the debate on Colonial affairs in the House of Commons, has given his powerful aid to recent pleas for the active support and co-operation of the universities of the British Empire in the advance of Colonial education. He recalls the opportunity for their active participation in the training of the body of teachers and scientific and professional men that the Colonial peoples so greatly need, and must provide as rapidly as possible from their own ranks. He suggests not only taking a mission—with a harmonium rather than a big drum—around the universities to enlist their active contribution, but also the establishment of a central organization of some kind to watch over the needs of the higher education of Colonial peoples and to bring their needs and the opportunities these offer continually to the notice of schools, universities and learned societies at home.

There can be little doubt that both the universities and the Colonies would derive great mutual benefit from the closer contacts that would follow from an increasing flow of students from the Colonies to Great Britain and of visiting teachers, lecturers, educational advisers and examiners from the universities to every part of the Colonial Empire. Moreover, Colonial development and welfare, as Prof. Hill declared, provide some of the grand adventures of our time. They constitute a creative task of social transformation. The initiative, energy and enthusiasm of many able young men and women in our schools and universities can be enlisted for the task of helping at the birth of these new societies. The immediate need is the widest appreciation of the needs and opportunities, and practical machinery which can operate without delay when the War is won.

Post-War Air Transport

THE debate upon post-war air transport in the House of Lords on March 11 disclosed several points of a technical nature. Viscount Cranborne said that it is the Government's wish to allot spheres of influence by international collaboration, and to avoid the cut-throat competition between air lines that have made it necessary in the past to grant subsidies in order to keep the services running in a manner worthy of the nation. The question of obtaining experience in air transport with the most modern aircraft, engines, and equipment is to be dealt with by the creation of an Air Transport Command within the R.A.F. This command will deal primarily with transport of materials and men, and its needs will bring parts of the industry into that sphere of design and production. Thus at the end of the War an organization should be in existence that can be changed over to civil air transport with the minimum of dislocation. It has since been announced that Air Chief Marshal Sir F. W. Bowhill, at present commanding officer of the R.A.F. Ferry Command, is to be in charge of this new section. Attention was also directed to the fact that a well-developed air transport service would be a valuable auxiliary to an invasion force operating on the European continent. Other suggestions were that a Ministry of Air Transport should be created immediately, to make plans for the future based on its present-day experience, and that the shipping companies might be asked to run air services, auxiliary to their ships, allotting each item of traffic to that class of transport most suited to its requirements.

Air Estimates in the House of Commons

SIR ARCHIBALD SINCLAIR, Secretary of State for Air, discussing the Air Estimates in the House of Commons on March 11, mentioned several points of technical interest in recent R.A.F. development. During the past year, it has been found possible both to raise the standard of skill demanded and lengthen the period of training given in the R.A.F.; this at a time when it is known that both have been reduced in the enemy organization. One concrete result has been that the number of flying accidents during the past year was 20 per cent less than in the previous year. A very great expansion of training facilities has taken place, a joint Empire Air Training agreement being now in operation in the United Kingdom,

Canada, Australia, and New Zealand. Expansion and improvement has taken place in the Air-Sea Rescue Service operating wherever the Allied air services are called upon to fly across the sea. An interesting variant of this, organized on similar lines, is the African desert rescue service, which has already saved about a hundred lives.

Another innovation is the introduction of a Commando Servicing Unit. Skilled mechanics, armed and trained to fight when necessary, are able to repair damaged aircraft under conditions that would normally mean their abandonment, and a very great saving in equipment has resulted. Tribute was also paid to the R.A.F. regiment, which has constantly been in the van of the advancing infantry, and has been able to re-condition enemy airfields even under fire. The effect of our bombing raids on Germany and the occupied countries goes far beyond the actual hold-up in the production of war material. Damage to transport systems and related workshops disorganizes the even flow of supplies to works, and delays the transport of troops to areas where they are required. The materials and labour necessary for the repair of damaged buildings also has to be diverted from war production.

Sir Bennett Melvill Jones, C.B.E., F.R.S.

SIR BENNETT MELVILL JONES, whose appointment to succeed Sir Henry Tizard as chairman of the Aeronautical Research Committee has been announced, has had a long and distinguished connexion with the scientific side of aeronautics. While his interests have ranged over almost the entire field of the subject, his name is more particularly associated with the elucidation of the problems arising out of the performance of aircraft. His work has resulted in a steady increase in the efficiency of the flying machine as a whole, and this, particularly when devoted to raising the speed of flight, has set problems in stability and control that have called for complex and systematic investigation both in the laboratory and in actual flight. Following his student days at Cambridge he took up aeronautics at the National Physical Laboratory, Teddington, and so far back as 1912 contributed a paper to the old Advisory Committee for Aeronautics on the properties of aerofoils. A paper on the stability of kite balloons (1915) was another contribution of his that laid the foundation of the systematic study of stability in flight. He then spent a period with Messrs. Armstrong Whitworth on the development of rigid airships, and followed this by work at the Royal Aircraft Establishment, Farnborough, on flight research. During the War of 1914–18 he was a member of the Experiment and Research Department of the newly constituted Air Board, and took an active part in the development of aerial warfare, particularly aerial gunnery, principally at the Experimental Station at Martlesham Heath.

Later, Melvill Jones was appointed Francis Mond professor of aeronautics in the University of Cambridge, a post which he still holds, and also became a member of the Aeronautical Research Committee. During that period he has contributed much to the development of those outlooks on aeronautics which he has made his own. He has been able to combine his theoretical work at the University with actual full-scale flying experiment at the R.A.F. station at Duxford. One of his most noted achievements during that period was to present a conception of the ideal streamlined aeroplane, suggesting general rules for its design that quickly received universal acceptance. During the present War he has been principally concerned with the development of fighting technique. He was elected a fellow of the Royal Society in 1939 and received his knighthood in 1942.

Royal Astronomical Society Gold Medallist

As already announced, the Gold Medal of the Royal Astronomical Society has been awarded to Dr. H. Spencer Jones, Astronomer Royal, for his determination of the solar parallax from observations of the minor planet Eros, made at the very favourable opposition of 1931. The solar parallax is a fundamental unit and is the astronomer's disguise for the principal astronomical unit of distance, namely, the mean distance of the earth from the sun. Dr. Spencer Jones' result for the solar parallax (v. *Mon. Not. Roy. Ast. Soc.*, **101**, 356; 1941) is $8{\cdot}790'' \pm 0{\cdot}001''$ and the corresponding mean distance of the earth from the sun is 93,003,000 miles; in each case the accuracy is of the order of 1 part in 10,000. Such an achievement is remarkable, and the Society's award will be acclaimed by astronomers all over the world as an honour deservedly bestowed and brilliantly earned.

The actual observations of Eros, made photographically at about a score of observatories, are represented by nearly three thousand plates; in addition, the positions of several hundreds of primary reference stars and nearly six thousand fainter secondary stars had to be determined. The successful planning of an international campaign of this magnitude was, in itself, no mean feat. The discussion of the immense amount of observational material secured has evidently been thorough, and the Astronomer Royal appears to have overlooked no possible source of error. The Eros observations also provide means of determining accurately the moon's mass and the constant of nutation: the value of the latter is found to be inconsistent with the value usually accepted, and the Astronomer Royal's next activity would seem to be the resolution of this discrepancy.

A New Method of Etching on Metals

A NEW electrolytic process of etching on metals makes use of a standard waxed-paper stencil such as is used in a duplicating machine, on which is cut the required design. This is placed between the metal article, which forms the anode, and an absorbent pad containing the etching reagent, which is connected to the cathode of a 15-volt D.C. circuit. The apparatus consists of a unit comprising the transformer, rectifier and output controller, giving a 15-volt D.C. supply from the 200/230-volt A.C. mains. When etching stainless materials, each stencil is good for at least fifteen etchings, or for about ten with less resistant alloys. The normal depth of attack is about 0·0005 in., and curved and irregular articles can be treated. The process is adapted to the marking of tools, plates, etc. The equipment is obtainable from Messrs. Griffin and Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2.

Training of Civil Servants

THE Chancellor of the Exchequer has announced that he has set up the following committee to consider the training of Civil servants: The Financial Secretary to the Treasury (Mr. Assheton), chairman; Sir Harold Hartley, vice-president, London Midland

and Scottish Railway Company; Sir Kenneth Lee, chairman, Tootal Broadhurst Lee Company, Limited; Miss Myra Curtis, principal, Newnham College, Cambridge; Mr. A. J. T. Day, chairman, staff side, National Whitley Council; Mr. A. L. N. D. Houghton, staff side, National Whitley Council; Sir Thomas Gardiner, director-general, General Post Office; Sir Robert Wood, deputy secretary, Board of Education; and Mr. H. Wilson Smith, under-secretary, Treasury. The terms of reference of the Committee are: "To examine the general question of the training of Civil servants, including the question whether a Staff College should be established, and if so, the particular form and character which that college should take".

Earthquake in Mid-Atlantic

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 December 31 which took place at about 12h. 03·7m. U.T. The instrumental data on which the calculations were based were obtained from the observatories at St. Louis, Tucson, Sitka, San Juan, Burlington, Pasadena, Spring Hill, Lincoln, Huancayo and Fordham. The epicentre turned out to be in the vicinity of latitude 18·1° N., longitude 47·0° W. This is in the region of the mid-north-Atlantic ridge between Puerto Rico (West Indies) and the Cape Verde Islands. Earthquakes are known to occur in this region from time to time and it would be interesting to have reports of the shock from ships which may have been in the region at the time.

Comet Oterma (1942*f*)

DR. WHIPPLE has computed the following elements of this comet:

T	1942	December 18·859	
ω	358°	03·0′	1942·0
Ω	78	30·8	1942·0
i	17	57·6	1942·0
a	11·9604		
e	0·86622		
P	41·4 years.		

Its positions for a few dates in April are given below. For intermediate dates it will be sufficiently accurate to interpolate, allowing a daily motion in R.A. +2·7m. during April 2–12 and +2·2m. during April 12–28. The corresponding figures in declination are −0·2° and −0·1°. It is not an easy object to find as its magnitude in the middle of the month, assuming the $\rho^2 r^4$ law, is about 13·5.

Date 1943	R.A.	Dec.	ρ	r
April 2·0d.	7h. 02·2m.	+40·9°	1·723	2·038
12	7 29·5	38·9	1·957	2·121
28	8 05·3	37·1	2·207	2·239

Comet Whipple (1942*g*)

THIS comet is no longer a naked-eye object but can be seen with the aid of a small telescope. Positions are given for the early part of April.

Date 1943	R.A.	Dec.	ρ	r
April 2·0d.	12h. 42·9m.	+46·5°	0·729	1·565
6	12 44·3	44·9	·762	·594
10	12 45·6	43·3	·796	·624

The Night Sky in April

NEW moon occurs on April 4d. 21h. 53m. U.T., and full moon on April 20d. 11h. 11m. Conjunctions with the moon are as follows: April 7d. 11h., Venus 6° N.; April 9d. 01h., Saturn 3° N.; April 12d. 05h., Jupiter 3° N.; April 29d. 17h., Mars 0·1° S. Occultations of stars brighter than magnitude 6 are as follows: April 16d. 22h. 16m., χ Leo (D); April 18d. 21h. 55·3 m., γ Vir. (D); April 18d. 22h. 43·2m., γ Vir. (R); April 25d. 03h. 42·6m., 21 Sgr. (R). The times are given for Greenwich and D and R refer to disappearance and reappearance respectively. Mercury is in superior conjunction on April 4, reaching its greatest eastern elongation on April 30 when it sets about 21h. 25m., two hours after sunset. Venus, an evening star, is in conjunction with Saturn on April 25d. 04h., Venus 3·1° N. Mars souths at 8h. 34m. in the middle of the month, but is too low for favourable observation in Great Britain. Jupiter souths at 17h. 42m. in the middle of the month and is well placed for observation in the earlier portion of the night. Saturn sets about 23h. in the middle of the month and will soon be too close to the sun for favourable observation. Times of setting are given approximately for the latitude of Greenwich. The Lyrid shower of meteors, April 18–24, which has not been very strong in recent years, will not be easily observed owing to moonlight.

Announcements

DR. KARL T. COMPTON, president of the Massachusetts Institute of Technology, will deliver the Pilgrim Trust Lecture before the Royal Society on May 6: he will speak on "The Organization of American Scientists for the War".

THE trustees of the Ray Lankester Fund have appointed Dr. Shu-Ping Chu, of Queen Mary College, University of London, as investigator for 1943–44 to carry out research at the Plymouth Laboratory of the Marine Biological Association into the effect on the development of marine algæ of the presence or absence of different substances in sea water.

THE following appointments in the Colonial Service are announced: R. A. Hutchinson, to be veterinary officer, Gambia; A. R. J. McGregor and E. J. Westcott, to be veterinary officers, Nigeria; C. B. Garnett, senior agricultural officer, to be assistant director of agriculture, Nyasaland.

A CORRESPONDENT of *The Times* writing from Gibraltar states that tunnellers of the Royal Engineers working there have discovered a hitherto unknown cavern. It is said to be of extraordinary beauty, with white, grey and red stalactite columns, and contains a lake of fresh water nearly 40 yards long and 7 ft.–20 ft. deep. The largest column is 7 ft. in diameter and 40 ft. high.

A USEFUL 16 pp. brochure on the preparation and preservation of insects for collections has been written by J. Manson Valentine of the U.S. Department of Agriculture and is published as No. 6, vol. 103 of the *Smithsonian Miscellaneous Collections* (November 1942). Although it has particular reference to the order Coleoptera it will be found applicable to some other orders of insects also. The methods of mounting, preserving, relaxing, labelling, etc., and other treatment of specimens are clearly described. Some of the technique explained will be found useful and more especially by British workers who are not always familiar with American methods.

LETTERS TO THE EDITORS

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

Action of Fluorine on the Teeth of Rachitic Rats

As is well known, the injection of sodium fluoride solution in small amounts causes a hypercalcified line in the dentin of teeth developing at the time of the injection, and thus this substance acts as a very elegant 'marker' for experimental procedures (Fig. 1). I have been using sodium fluoride for this purpose in experiments in which rats have been on diets with a high Ca-P ratio (4 : 1) or a low Ca-P ratio (0·25 : 1).

The histological appearance of the continuously growing rat's incisor tooth with either of these diets is virtually the same. Fig. 2 shows that of the labial side of the upper incisor of a rat on a low ratio diet. The chief departure from normal is the very wide and irregular predentin.

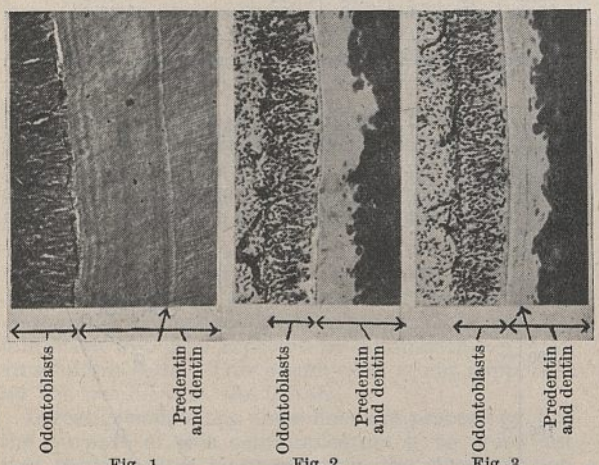

Fig. 1. Fig. 2. Fig. 3.

Fig. 1. LONGITUDINAL SECTION OF THE LABIAL DENTIN OF A NORMAL RAT'S UPPER INCISOR TOOTH. 0·3 C.C. OF 2% SODIUM FLUORIDE SOLUTION WAS INJECTED SUBCUTANEOUSLY 10 DAYS PREVIOUSLY. THE ARROW POINTS TO THE FLUORINE LINE IN THE DENTIN. (× 100.)

Fig. 2. LONGITUDINAL SECTION OF THE LABIAL DENTIN OF THE UPPER INCISOR OF A RAT ON THE LOW CA–P RATIO DIET. NOTE THE WIDE PREDENTIN. (× 100.)

Fig. 3. LONGITUDINAL SECTION OF THE LABIAL DENTIN OF THE UPPER INCISOR OF A RAT ON THE LOW CA–P RATIO DIET. 0·1 C.C. OF 2% SODIUM FLUORIDE WAS INJECTED SUBCUTANEOUSLY 10 DAYS PREVIOUSLY. THE ARROW POINTS TO THE FLUORINE LINE IN THE PREDENTIN. (× 100.)

The subcutaneous injection of sodium fluoride into rats on high Ca-P ratio diets causes a hypercalcified line in the dentin corresponding to the predentin laid down at the time, when that ultimately calcifies, but no visible change in the predentin itself. In the case of animals on the low Ca-P ratio diet, however, a fine calcified line appears in the predentin long before this would normally become calcified (Fig. 3). The injections were made in all cases 10 days before the animals were killed, and the predentin laid down between the calcified line and the odontoblast margin was formed during the last ten days of the animal's life.

It would thus appear that the pathological changes in the teeth with high and with low Ca-P ratio diets are not the same, despite their histological resemblance. It is, of course, well known that the changes in bone with these two types of diet are quite dissimilar[1]. It can also be concluded that the action of fluorine on teeth is governed to a large extent by the diet, and presumably by the levels of calcium and phosphorus in the blood. With a high blood calcium, conditions are not such that calcium can be readily deposited in the tissues, whereas with a low blood calcium, deposition is facilitated, and, in fact, the calcified line may even be calcium fluoride. Incidentally, the injection of sodium fluoride almost invariably causes tetany in the animals on the low Ca-P ratio diet, but usually produces no visible effect in the animals on the high Ca-P diet, unless in such doses as to depress the heart. The protective action of high calcium diets against the toxic action of fluorine has been noted by Lawrenz and Mitchell[2].

Schour and Smith[3] consider that fluorine acts directly on the odontoblasts in causing changes in the dentin, but my findings do not completely support this view.

It will be noted that the wide predentin with low ratio diets is due to considerable retardation in the rate of dentin calcification. Normally this begins twenty-four hours after the predentin has been formed. In rats on low ratio diets, I find that predentin is not calcified until 15–20 days after it has been laid down.

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Jan. 20.

[1] Gaunt, W. E., and Irving, J. T., *J. Physiol.*, **99**, 18 (1940). Karshan, M., and Rosebury, T., *J. Dent. Res.*, **12**, 437 (1932).
[2] Lawrenz, M., and Mitchell, H. H., *J. Nutrit.*, **22**, 91 (1941).
[3] Schour, I., and Smith, M. C., *J. Amer. Dent. Assoc.*, **22**, 796 (1935).

New Synthesis of Glycolesters

A CONTINUED investigation of the 'crossed' Cannizaro reaction[1] has been undertaken. It was possible to effect a condensation for the first time between an aliphatic saturated and an unsaturated aldehyde, with the aid of co-ordination catalysts of the type of magnesium aluminium ethoxide, $Mg[Al(OC_2H_5)_4]_2$. Two molecules of butyraldehyde and one of crotonaldehyde condensed to form an unsaturated glycolester, the structure of which was shown to be the following :

$$CH_3-CH=CH-CHOH-CH(C_2H_5)-CH_2-O-CO-C_3H_7.$$

From the unexpected manner of interaction it was deemed reasonable to extend the work into the aliphatic saturated series of aldehydes. The following compounds were examined : acetaldehyde, proprionaldehyde, butyraldehyde, *iso*butyraldehyde, hexaldehyde, alpha-ethyl-butyraldehyde, heptaldehyde and alpha-ethyl-hexaldehyde. Magnesium aluminium *iso*propoxide and magnesium aluminium butoxide were also used.

It was found that the co-ordination catalysts are able to condense three molecules of the aldehyde to yield mainly glycolesters, whereas the simple alkoxides as, for example, aluminium ethoxide, condense only two to give simple esters. This was observed in the case of the straight-chain aldehydes. The alpha-alkyl substituted aldehydes undergo mainly

the simple ester condensation with the aid of either type of catalyst.

The complex catalysts serve two functions as distinct from the simple alkoxides: namely, they cause an esterification preceded by an intermediary aldolization; whereas the simple alkoxides only esterify. The formation of the glycolesters can be represented as follows:

$$R{-}CH_2{-}CHO + R{-}CH_2{-}CHO \xrightarrow{\text{catalyst}}$$

$$R{-}CH_2{-}CHOH{-}CH(R){-}CHO + R{-}CH_2CHO$$

$$\xrightarrow{\text{catalyst}}$$

$$R{-}CH_2{-}CHOH{-}CH(R){-}CH_2{-}O{-}CO{-}CH_2{-}R.$$

The bifunctional influence of the catalyst may be attributed to the 'intermediate' basicity of the co-ordination complex compound, which is formed from the more basic magnesium alkoxide and the less basic aluminium alkoxide:

$$2\ Al(OR)_3 + Mg(OR)_2 = [Al(OR)_4]_2Mg.$$

The more basic media favour aldolization. Some related magnesium compounds of the type *R*OMgI are able to form aldols. The 'average' basicity so attained in the formation of the co-ordination compound seems to enable both the aldolization and esterification.

The work described above was presented before the autumn meeting of the American Chemical Society, Buffalo, N.Y., in September last. A more detailed account of the investigation will be published in due course.

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F. F. NORD.

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Jan. 18.

[1] Nord, F. F., *Chem. Rev.*, **3**, 65 (1926).

Inhibition of Tumour Growth

THE retardation of the growth-rate of tumours in experimental animals by chemical compounds and by extracts of tissue has been the subject of numerous investigations, and the fact that inhibition can be produced by so large a number of compounds suggests some general effect on metabolic processes. Samuel and Kugelmass[1] have shown that an acid-forming diet fed to young rats produces a much slower rate of growth than does an alkali-forming diet.

Preliminary experiments in this series have been reported[2] from these laboratories indicating an attempt to determine whether a tendency towards acidosis in a mouse would influence the growth-rate of tumours, ammonium chloride being administered to mice which had been inoculated with the Twort carcinoma. The ammonium chloride was given in the drinking water as a 0·6 per cent solution while control mice inoculated at the same time were given water. Administration of ammonium chloride has also been used as a concomitant treatment with *H*.11 extract in clinical cases of advanced inoperable cancer.

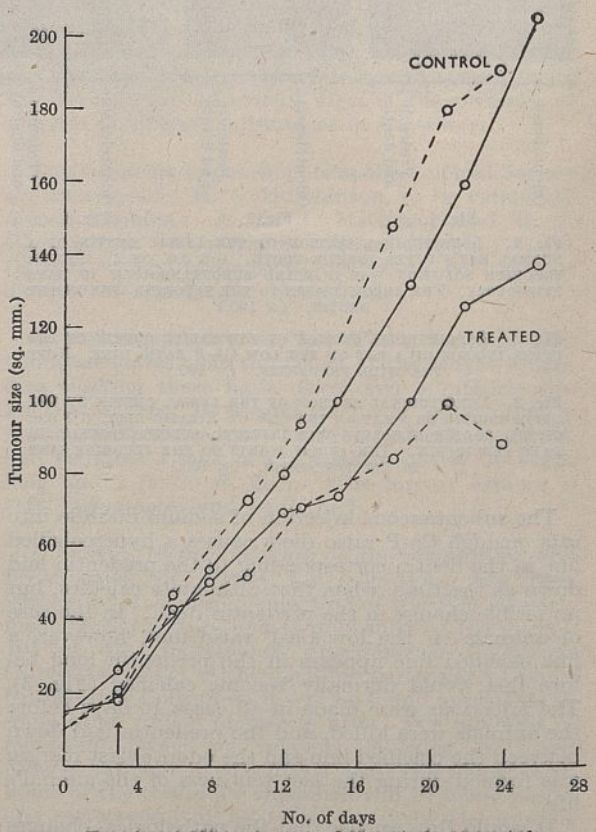
The experiments reported below were carried out on five batches of mice, the total number of surviving treated mice being 56 and of surviving controls 55. Tumour diameters of both groups were measured at intervals and size is recorded as the product of the two diameters. As an index of growth-inhibition, the difference between the average tumour size of the treated and untreated animals is expressed as a percentage of the average control size. An analysis of the results is given in the accompanying table. In the graph, tumour sizes at the various dates of measurement have been averaged and plotted against the time for experiments 328*A* and 328*B*.

EFFECT OF AMMONIUM SALTS ON TUMOUR GROWTH.

Expt. No.	No. of mice		Aver. tumour size (sq. mm.)		Aver. tumour wt. (gm.)		Inhibition %	
	C	T	C	T	C	T	size	wt.
NH_4Cl								
316*A*	17	18	293	149	2·32	1·75	49·2	25·0
319*B*	4	05	323	200	2·76	1·37	38·1	50·0
324*B*	6	11	339	246	2·03	1·07	27·4	47·3
328*A*	15	10	199	137	0·88	0·58	31·2	34·1
328*B*	13	12	177	89	0·70	0·32	50·0	54·3
CH_3COONH_4								
328*B*	13	11	177	136			23·2	
333*C*	11	7	137	62			54·6	
333*E*	9	6	94	80			14·9	
334*B*	7	6	90	74			17·8	

Mice were inoculated 7 days prior to administration of ammonium salts; latter given in 0·6 % solution for approximately 21 days.

At the end of the experiments the mice were killed and the tumours excised. Cystic fluid (if any) was drained and removed from the surface of the tissue by laying the tumour on filter paper, and the tumours were immediately weighed. The percentage inhibition



—— Experiment 328*A*. Average of 15 controls, 10 treated.
---- Experiment 328*B*. Average of 13 controls, 12 treated.

by weight was calculated by expressing the difference between the average final weights of the control and treated tumours as a percentage of the average weight of the control tumours.

These experiments show that the administration of a small quantity of ammonium chloride may cause a considerable reduction in the growth-rate of a tumour. That this inhibition is not due to any variation in tissue fluid content is shown by the figures given for tissue weight, which show inhibitions as considerable as those for tumour size. (The large difference between the degree of inhibition shown on the basis of weight and volume in the cases of experiments 316*A* and 324*B* was, however, due to the fact that the tumours in one set of animals contained more cystic fluid than those of the others.) No retardation of body growth of the treated mice was found in these experiments. The direct cause of the inhibition is not clear. Attempts to measure the degree of acidosis produced by titration of the urine of the animals with alkali were unsuccessful, as any differences were less than the variation in the individual groups.

Preliminary experiments have been carried out using other salts in an attempt to elucidate the problem. Of these, the results obtained by the administration of ammonium acetate in a similar manner to the chloride are reported in the table. These results do not confirm the original experiment mentioned in an earlier publication[2]. The inhibition was less than that produced by ammonium chloride but, in contrast, ammonium lactate has, in our early experiments, shown no inhibitory action ; in fact, an acceleratory effect was indicated. Since the acetate radical of ammonium acetate would presumably be rapidly oxidized, it is difficult to imagine the direct production of even a mild acidosis by this substance. If the diuresis induced by the formation of urea from the ammonium radical produced an appreciable acidosis, inhibition would be expected by administration of all ammonium salts. This assumption is not supported by the results with the lactate.

Investigations along these lines are proceeding, but the purpose of this communication is to point out that caution must be exercised in the interpretation of many of the results obtained by numerous investigators after administration of substances to tumour-bearing animals. Most of those shown to be inhibitory have been acids or substances which could easily give acids. Amines, for example, were usually administered as hydrochlorides, while bisulphite compounds themselves are strongly acid. In the preparation of tissue extracts, such as those employed by Boyland[3] and Roffo[4], and in the inhibitory extracts of urine described by Thompson *et al.*[2], the possibility exists that some part of the activity may be due to relatively simple salts.

We are indebted to Dr. N. Hajdu for assistance in this research.

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P. F. HOLT.
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Feb. 11.

[1] Samuel and Kugelmass, *Proc. Soc. Exp. Biol. Med.*, **27**, 195 (1929–30).
[2] Thompson *et al.*, *Med. Press and Circ.*, **205**, 334 (1941).
[3] Boyland, *Biochem. J.*, **35**, 1283 (1941).
[4] Roffo, *Lancet*, **235**, 184 (1938).

Apparent Stimulative Effect on Mould Growth of a Mercurial Preparation

IT was observed in the course of some experiments on the prevention of mould growth on leather that a preparation of an organic mercurial—used in the very low concentrations of 1 in 40,000 and 1 in 20,000—appeared to have a stimulative rather than an inhibitive effect on mould growth. Growth began earlier on samples treated with this preparation than on water-soaked controls, and was more profuse.

This finding is reported, since it appears to be analogous to observations on the stimulative effect on mould growth of certain copper and cobalt salts and—to a lesser degree—of mercury, reported by W. A. R. Dillon Weston and R. Eric Taylor[1].

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March 2.

[1] NATURE, **151**, 54 (1943).

Delayed Implantation in the Stoat (*Mustela mustela*)

RECENT investigations have shown that the discontinuous type of embryological development first described in the roe deer[1,2] is less uncommon than was originally supposed[3]. In this and some other species the blastocyst is formed normally, but there is a period of several months during which it lies free in the uterine lumen before it becomes implanted. Both the European badger[4] and the American badger[5] show this type of delayed development, and recently it has been described in American weasels[6] and martens[7]. According to Fischer[4], unimplanted blastocysts are found in the European badger from the end of July until January, the young being born in March. Wright[6] finds that in the long-tailed American weasel blastocysts lie dormant from July or August until about the following spring, the young being born in April. Watzka[8] is said to have found a similar delay in implantation in the stoat.

A study of the reproductive cycle of this common British species was published by me in 1935[9] from material collected in the field between 1930 and 1934. Although animals were kept in the laboratory for periods varying up to six months, most of the females did not thrive and there seemed little chance of their breeding in captivity, especially as no records were found of this having taken place. It was clear, both from the literature and from a cursory examination of the material, that stoats generally had one litter a year born in March or April. In the late spring and summer, however, both adult and first-year female stoats mated and ovulated, and it was puzzling that there were no further litters during the male fertile period, which lasts from February or March until July. The corpora lutea from those ovulations differed markedly in size and histological appearance from those of the spring pregnancies, as did the corresponding uteri. First-year females which had ovulated showed no development of the mammary gland rudiment.

The apparent absence of pregnancies after the late

spring and summer matings was originally attributed to the luteal stimulus being inadequate for implantation, owing to a reduced level of pituitary activity[9]. The possibility of delayed implantation in the stoat was not investigated, for I was unaware of Fischer's[4] and Hamlett's[5] work on the badger. The recent observations by Wright[6] and Watzka[8] suggested that delayed implantation would explain the peculiarities of the reproductive cycle of the female stoat, and ample evidence has now been obtained from the original material of the persistence of unimplanted blastocysts. Serial sections have shown that they can be found in first-year and parous stoats in every month of the year. The blastocysts, which are spaced in the uterus, are of the type seen in American weasels[6] and martens[7]—di-laminar with a differentiated ectoderm and an inner cell mass; the zona pellucida is extensive and generally distorted in fixation. The blastocysts show no obvious changes in their long period free in the uterus except for an increase in size during their first few months. Blastocysts occurred in a lactating female so early as April 15 and in first-year stoats, only two months old, in June. The latter included an 85 gm. animal taken on June 2, which was less than half-grown. The males of the same litters remain immature until they are about ten months old. Apparently most of the spring and summer matings are fertile, but since no older embryos or new-born young are found before the following spring, the quiescent period may last more than ten months in parous stoats, and nine months in those breeding for the first time.

The corpora lutea corresponding to the resting blastocysts often resemble those from a recent ovulation and this, combined with the occurrence of œstrous stoats in September, October and December, suggested originally that stoats ovulated several times in the year. It is clear that more than one œstrous period a year is possible—for example, a post-lactation stoat was on œstrus in June, all similar animals in the series having ovulated in April or May—but from the numbers of stoats with uteri in the resting luteal phase it would seem that the majority develop blastocysts as the result of their first post-partum ovulation, or at sexual maturity, and reproductive activity is suspended until March. Watzka[8] concludes that some stoats both mate and have their litters in the spring, but it seems likely that these would only include a small minority of the females, such as those referred to above, which are non-pregnant at the end of the male breeding season. Stoats in the present series taken in February and March provide no conclusive evidence of recent matings. The unimplanted blastocysts in these animals had reached approximately their full size. Occasional spermatozoa can be found in the uterine glands, but these are also present in three January stoats and may merely represent histological survivals. The possibility that early breeding season matings have taken place cannot be excluded, but no œstrous or pro-œstrous stoats were found earlier in the year than April, and these were recently parous.

The onset of active embryological development in the spring is preceded by enlargement of the corpora lutea, after which the uterus becomes œdematous and takes on an œstrous appearance, both processes suggesting a rise in the circulating œstrogens following renewed stimulation of the ovary by the pituitary gland. The uterus doubles or quadruples its weight while, concurrently, in first-year stoats the mammary glands proliferate and form small distinct nipple areas. All these changes take place before the uterine epithelium undergoes the immediate pre-implantation changes.

It was estimated previously[9], from the dates on which pregnant and lactating stoats were taken in the field, that pregnancy lasted for about a month in spring. With the addition of 10–12 days to this period to allow for the formation of the blastocyst in the preceding year, the duration of pregnancy, excluding the quiescent phase, might well be six weeks as in the closely related ferret[10]. Delayed implantation in the Mustelidæ appears to be confined to species with only one litter a year. There is no evidence that it occurs in the ferret or the European weasel[11], which may have two litters. Further investigation of the latter species is in progress.

I am indebted to Dr. E. C. Amoroso for examining the blastocysts.

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[1] Ziegler, "Beobachtungen über die Brunst und den Embryo der Rehe" (Hannover, 1843).
[2] Bischoff, "Entwicklungsgeschichte des Rehes" (Giessen, 1854).
[3] Hamlett, *Quart. Rev. Biol.*, **10**, 432 (1935).
[4] Fischer, *Verh. d. Anat. Ges. Ergänzungsheft zum Anat. Anz.*, **72**, 22 (1931).
[5] Hamlett, *Anat. Rec.*, **53**, 283 (1932).
[6] Wright, *Anat. Rec.*, **83**, 341 (1942).
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[11] Hill, *Proc. Zool. Soc.*, B, **109**, 481 (1939).

Czechoslovak Medical Students at Oxford

THE conferment of degrees of Czechoslovak universities on a group of medical graduands at Oxford on February 27[1]—*spectaculum tam novum tamque magnum*—may serve to recall the almost forgotten name of Daniel Stolczius Cuttenus, of the family of Pardubští, domiciled formerly at Kutná Hora in Bohemia. This student-poet of alchemy graduated at Prague in 1618, and five years later published a remarkable alchemical work, "Viridarium Chymicum" ("Pleasure Garden of Chymistry"), consisting of a collection of 107 copper-engravings, each provided with a Latin epigram. Although Stolczius does not appear to have become a member of the University of Oxford, he dated the dedication of the "Viridarium" from Oxford, July 6/16, 1623, and in it he wrote: "In this my journey abroad, undertaken in the cause of Medicine . . . I hear with grief of the strange and pitiable disasters of my country, and am, to my extreme sorrow, very often interrupted by these tumults of war that are scattered everywhere". It is interesting to find this link between Prague, Oxford, and medical studies, at the outset of the Thirty Years' War.

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March 8.

[1] NATURE, **151**, 274 (1943).

THE BOTANIC GARDEN, OXFORD*

BY a change of Statute, approved on March 9, the University of Oxford's ancient Botanic Garden enters yet another phase of its history.

The Garden was founded by the Earl of Danby in 1621 : it is thus the oldest Botanic Garden in Britain and the sixth oldest in Europe. In that year Danby secured the lease of a piece of swampy water-meadow from Magdalen College and made it over to the University for a physic garden. This lease has been renewed from time to time for more than three hundred years.

Danby first built the wall and gateways, then had the level of the ground raised in an attempt to avoid floods. Some time previous to 1641 he appointed Jacob Bobart gardener on a ninety-nine-year agreement, with benefit of the produce and a payment of £40 per annum for labour and materials. Bobart on his part undertook to keep the garden planted with trees and plants requisite for "the service and use of the said University". It would appear that Danby intended to have a "Botany Professor" also, but the Civil War broke out and funds were short. Morison, first professor, was not appointed until 1669 (*obit.* 1683).

The shortage of funds forced Bobart to support the Garden on what he could grow in it. There is in the archives a rather pathetic appeal (undated) to the Vice-Chancellor from Jacob Bobart jun., who succeeded his father, asking for a salary. He pointed out that the "Exoticks" he cultivated needed special care, and he thought it "a digression, to make Cairfax shine wth the spoils of the Physick Garden, allways haveing respect to the dignitie of the Universitie".

Bobart the younger died in 1719. The year before there had returned to England Dr. William Sherard, sometime fellow of St. John's, who had been consul at Smyrna. Sherard was a man of means with a considerable interest in botany. He regretted the state of neglect into which the Garden had fallen and entered into negotiations with the University to put botanical studies on a sounder footing. He had a remarkable library and an extensive herbarium. He proposed to found a chair of botany, with £3,000 endowment, nominating Dillenius, a distinguished botanist in his employ, as professor, and to leave his library and collections to the University, if the University would revive the Garden, erect the necessary greenhouses and library buildings, and make due provision for upkeep. The negotiations were protracted (Sherard mistrusted early eighteenth-century Oxford) and before they were completed he died (1728). A dispute arose between his executors and the University which dragged on for years, until it was finally settled by an award of Chancery on June 11, 1734. By it the University got the £3,000, the library and collections, and Dillenius became the first Sherardian professor. The University on its part erected the buildings, guaranteed £150 per annum for upkeep of the Garden and appointed a Perpetual Committee, consisting of the vice-chancellor, the proctors, and seven senior resident members on the "Physic Line" to see that the provisions of the award were carried out. The Royal College of Physicians was made visitor.

It is from this award in Chancery that the curators have derived their authority, and it would again become operative should the University at any time cease to maintain the Sherard collections under the custody of the Sherardian professor.

* Substance of an article in the *Oxford Magazine* of March 11, 1943.

It is clear from the early minute book preserved in the archives of the Department that the Perpetual Committee took its duties lightly. It met once a year (with occasional omissions) to approve the accounts and appoint a head gardener. By the beginning of the nineteenth century the Garden had again fallen into a bad state. Its revival owes much to the energy and liberality of Daubeny, Sherardian professor during 1834–67. During his tenure of office the existing range of greenhouses took shape.

In course of time the importance of the Garden as a source of materia medica became less, and its value as part of the University's equipment for the wider study of botany increased. Members of the medical faculty, as such, had less interest in the Garden, and the constitution of the Perpetual Committee was changed (1871). In 1886 an order of the Court of Chancery established a Board of six elected curators, who were given the management of the Garden under the scheme drawn up in 1734. But the same scheme had given the Sherardian professor control of the gardener, as is recognized in the statutes defining his duties ! Obviously there was need for clarification.

The new Statute, just adopted, makes the professor (at present, Prof. T. G. B. Osborn), *ex officio* a member of the Board of Curators and confirms his duties of 'charge and supervision'. The constitution of the Board remains otherwise unaltered, and the Board as a whole is responsible for the general policy and upkeep of the Garden from the funds which it receives.

In June, 1942, Mr. W. G. Baker, who had been head gardener for more than fifty years, retired, and by good fortune the curators secured the services of Mr. G. W. Robinson, formerly superintendent of Chelsea Physic Garden, to succeed him. With his skill and experience the Garden should thrive and develop.

If by further good fortune some graduate of Oxford should be moved to give to the Oxford Garden only a part of what Cory recently bequeathed to the younger Botanic Garden at Cambridge (see NATURE of March 20, p. 328), then indeed the future of the oldest botanic garden in Great Britain would be assured.

ASPECTS OF PHOTOMICROGRAPHY

A SYMPOSIUM on photomicrography was arranged by the Scientific and Technical Group of the Royal Photographic Society and took place at the Society's premises on the afternoon of February 20.

Mr. F. Martin Duncan opened the symposium with a general description of the applications of photomicrography to biological research. He stressed that much good work may be done by means of comparatively simple home-made apparatus. He illustrated the type of equipment he uses for low-, medium- and high-power photomicrography, and dealt with the particular requirements and difficulties of each branch in turn. For low-power work with living specimens a long-extension camera with a short-focus lens is used ; it should be mounted on a rigid stand with the axis vertical. The need for rigidity increases with the magnification. For medium powers the camera is fitted to the end of a microscope tube, and for high-power work at a

thousand diameters or more a well-made box camera can be used. For critical work, centring the microscope is most important. Not only should a centring substage condenser be used, but it is also advisable that each objective should be capable of being centred with respect to the remaining lenses in the optical system of the microscope. Most of the double and triple nosepieces sold give unsatisfactory centring of the objectives and cannot be recommended.

Some slides were projected to demonstrate the correct use of filters and choice of negative material, showing the difference in rendering of tone and detail which may be attained by such means. Infra-red technique can sometimes be used with advantage to reveal fine detail in structures that appear dark and opaque in ordinary light. Examples were shown of certain coal specimens, beetles and fleas. In one case the infra-red photograph revealed the presence of some minute parasites on the fleas themselves. The paper was illustrated throughout by a large number of photomicrographs of various subjects of general interest.

Dr. V. G. W. Harrison said that in investigating alloys one of the first tasks is to establish, at all events approximately, the constitution diagram of the system. The means available include the determination of arrest points on cooling curves, thermal dilation curves, magnetic permeability curves, X-ray analysis and photomicrography. None of these is infallible alone, but taken together they are a powerful combination. Dr. Harrison said that his own work has been devoted mainly to the metallography of nickel-iron alloys, which are particularly interesting because the meteoric nickel-irons have a peculiar structure which cannot be reproduced under terrestrial conditions.

Metal specimens can rarely be cut so thin that they transmit light; thus they usually have to be examined under vertical illumination. A specimen is first cut with a hacksaw; one face is filed flat and then rubbed down on successively finer grades of emery. The aim is to finish with a plane mirror-like surface free from scratches and flow marks. There is no royal road to this; care and patience are more important than the exact materials used. The finer grades of commercial emery paper are, however, of little use on account of the grit in them, and better results are obtained by grading 'flour' emery powder oneself and using it wet on an ordinary cork household knife-board. The final polishing is done on a rotating cloth-covered wheel fed with a suspension of a polishing material such as rouge or alumina; chromic oxide gives good results. The surface so prepared is not characteristic of the alloy since it has undergone a certain amount of cold working, and to reveal the true structure of the alloy this layer has to be removed. This is usually accomplished by etching. The etchant used varies according to the chemical nature and physical state of the alloy and the constituents or structure which it is particularly desired to examine. For 10 per cent nickel nickel-iron alloys, 5 per cent nitric acid in water is suitable for most purposes. The depth of etching has to be learnt by experience. Too little etching fails to remove the cold-worked layer and gives poor contrast; too much etching throws the structure into relief and makes focusing difficult in high-power work.

When examined by vertical illumination, constituents that are little attacked by the etchant retain their mirror-like surface and appear bright; the others are dark. Photographically, the images may usually be treated as black-and-white subjects; nothing looks worse than a section represented in the print by pale washy greys and dirty whites. For this work a medium-speed orthochromatic plate which will stand development to high contrast without fogging is generally suitable. Most of the photographs were taken with apochromatic objectives and light filtered through a blue 'narrow band' filter.

Slides were shown to illustrate some of the changes in structure which occur when natural and artificial nickel-iron alloys are subjected to heat treatment, and it was explained briefly how these visible changes can be correlated with changes in physical properties due to phase changes within the alloy.

Dr. L. C. Martin continued the symposium with an account of the optics of photomicrography. Photomicrography at low magnifications with a field of, say, 18° requires a lens of 'photographic' type, for example, of 2 in. focal length and 'aperture' $F/4{\cdot}5$. Such a lens may be used for magnifications up to about 35 diameters, if long working distances are no drawback. Ordinary microscope objectives may also be used. The field is then restricted to 6°–8°, but the aperture may be greater and the definition better. For magnifications of 20 and upwards it is convenient to use a compound microscope. A well-made projection eyepiece does not cause any deterioration in the image yielded by the objective, at least in the centre of the field.

The magnification to be employed depends upon the fineness of detail and the circumstances in which the print is to be viewed. The separation of fine lines such as pearlite will be apparent at a distance between them of 0·2 mm., but this can be brought up to 1·0 mm. with advantage: this entails a magnification of 1,600–3,000 diameters. In general, to show the greatest amount of detail the magnification should be about a thousand times the numerical aperture of the objective. Magnifications higher than this will not reveal fresh detail; the use of lower magnifications may mean that some details escape observation. Greater numerical aperture means better illumination and more detail; but also a more restricted field of good definition and less depth of focus, which is a disadvantage when thick sections are being examined. For routine work it is a good plan to use no greater numerical aperture than is necessary.

Much depends upon the illumination of the object. A great variety of arrangement is possible for opaque objects. For transparent objects, both dark ground and ordinary bright field illumination may be employed. Dark-ground pictures are attractive but more difficult to interpret than those taken with the light field. If the object to be viewed by transmitted light is a narrow opaque strip, the sharpest picture of the boundaries may be obtained in two ways. One can use a broad source of light, such as a window or opal lamp. The disadvantages of this are that the illumination may not be intense enough for photomicrography, and stray light may spoil the image. The latter may be avoided by using a diaphragm. Alternatively, a lens system is made to form an image of the effective source of light in the plane of the object. The angle of convergence of the rays produced by the lens must be as great as the divergence required to fill the aperture of the objective. Dr. Martin then described two optical expedients suitable for cases in which the size of the image of the source is not sufficient to illuminate the required area of the object slide. He stressed that one should never let more light into the system than is required

for the illumination of the minimum necessary area of the object field and for filling the aperture of the objective. In order to control the light, the source and lenses must be correctly aligned.

For transparent objects, when the visibility is due merely to a change of refractive index, the boundary of change may appear dark in the picture unless the aperture of the condenser is reduced. Usually a reduction of the illuminated aperture of the objective to a diameter of about two thirds the full amount is suitable.

Mr. F. J. Pittock concluded the symposium by dealing with the practical application of colour filters to the recording of the image of microscopic specimens by transmitted light. The use of colour filters must take into account not only the colour of the microscopical preparation, but also the relative densities of regions of the same preparation. In the days before the introduction of panchromatic material, the illuminants used were of great intensity and a cooling bath containing a coloured solution had to be introduced to absorb the heat and reduce the brilliance of the light. Other dimming devices were ground glass and 'signal green' glass. It has been known for many years that the resolving power of objectives is much increased if blue or green monochromatic light is used.

Though neutral density filters of colloidal carbon or silver grain cannot be classed as colour filters, they should form part of the equipment of all photomicrographers. Two filters, reducing the intensity one tenth and one hundredth respectively, are recommended for general purposes. There are two reasons for the employment of colour filters proper: first, the resolution is often improved by the use of approximately monochromatic light; secondly, it is usually important that the photomicrograph should show certain areas with greater contrast than is given by differential staining or the density or texture of the material under consideration. By using monochromatic light, chromatic aberration of the lenses is eliminated.

Mr. Pittock exhibited photomicrographs of the developing eye of a pig embryo stained with borax-carmine. On an ordinary plate without filter, the screen sharpness was never faithfully reproduced, whatever the quality of the objective. Exposures on orthochromatic process and panchromatic process plates showed progressive improvement. The introduction of a green filter gave further improvement, and the best result was obtained with the combination of green filter and panchromatic plate. The speed of the plate is generally of little consequence, and a slow plate is therefore preferred because of its superior resolving power.

The question of what is meant by 'contrast' in photomicrography is difficult to answer. Generally, some less important detail has to be suppressed by the use of appropriate filters to give clearer expression to the points of main interest. That is, contrast is reduced in one region and increased in another. If specimens are transparent, this fact should be obvious in the photomicrograph; it is undesirable to give the effect of an opaque mass without internal detail against a white background. Mr. Pittock showed photomicrographs of a section of spruce fir stained green and counterstained red, and explained the difference in appearance produced by the use of blue-green and orange-red filters respectively. The best filters for use with some well-known stains and counterstains were next discussed. Certain structures are commonly revealed in sections after impregnation with silver salts followed by weak development in a reducing solution. Specimens so made are dark brown or black in colour, semi-opaque and need an orange filter, or even infra-red technique. It is not generally realized that silver-impregnated specimens are amenable to further treatment by any of the colour toning methods recommended for lantern slide-making, with an appreciable increase in transparency.

When objectives giving the utmost resolving power at high magnifications are used to reveal the fine cytological detail of stained sections, the best results are obtained with blue-violet filters and ordinary or ortho-process plates. This was demonstrated by photomicrographs of the pituitary body by yellow-green and by blue light. Mr. Pittock concluded by giving some technical details of the exposure and development of the various photographic plates used.

The papers presented at the symposium will be published in due course in the *Photographic Journal*.

V. G. W. HARRISON.

A GRAIN-BORNE DISEASE OF BARLEY

THE incorporation of barley in bread as a war-time expedient gives added interest to a recent study of the host-parasite relationships of this cereal and *Helminthosporium sativum* P., K. and B. (Mead, H. W., *Canad. J. Res.*, **20**, 501; 1942).

Infected barley grains usually show a pale to dark brown discoloration of the adhering lemma and palea. The cells of the host react to penetration by the formation of callosities, and those invaded, either singly or in groups, die and become discoloured, although hyphæ may also be present without discoloration. Hyphæ may also be present in the cells of the pericarp, and thick-walled resting mycelium may be found on the surface of the tissues or in the intercellular spaces. Many samples have been observed to contain as high as 38 per cent blighted kernels. When the grain is planted the mycelium renews its growth and may infect other cells or form conidiophores. Although mycelium from infected grains may spread through the soil for as much as 2·5 cm., this probably plays little or no part in the infection of seedlings.

At germination, the plumule and the radicle are in contact with the lemma, palea, lodicules and pericarp, any or all of which may be diseased, with the result that infection of the seedling often occurs at the base of the plumule and the radicle. Seedlings usually reach a degree of development because the fungus takes some little time to penetrate to the growing point.

Inoculation of the heads at or immediately after flowering results in the death of the ovaries or the production of only small grains with non-viable embryos. Hyphæ may be found as deep as the cells of the inner layer of the pericarp, but they do not seem to penetrate beyond this. Infection 7–10 days after flowering leads to the invasion of the pericarp tissues and the production of shrunken and discoloured kernels, although as microtome sections show, the inner integument, aleurone layer, endosperm and embryo are free from mycelium. Infection 15–20 days after flowering results in the invasion of the lemma and palea, but the pericarp has mycelium

mainly in and on the surface at both ends of the grain, where it is not protected by the lemma and palea, which are now becoming fused with it. Only a little is found on the central portions of the dorsal and ventral surfaces. Such grains are as plump or plumper than non-infected ones.

When diseased grains are planted, severity of infection may express itself in any of five degrees: (1) lack of germination due to the blight of the plumule and radicle at a very early stage, (2) early blight of the still unemerged shoot with infection spreading to the emerged roots, (3) post emergence blight of the shoots and roots, (4) stunting of the seedlings, (5) superficial lesioning of the seedling.

FORTHCOMING EVENTS

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

Saturday, March 27

BIOCHEMICAL SOCIETY (at the Courtauld Institute of Biochemistry, Middlesex Hospital, London, W.1), at 2 p.m.—Annual General Meeting.

Sunday, March 28

SOUTH PLACE ETHICAL SOCIETY (at Conway Hall, Red Lion Square, London, W.C.1), at 11 a.m.—Sir Richard Gregory, Bart., F.R.S.: "Education in World Ethics and Science" (Conway Memorial Lecture).

Tuesday, March 30

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 3 p.m.—Sir Henry Dale, G.B.E., P.R.S.: "Chemistry in Modern Medicinal Treatment". (iii) "The Beginning of Chemotherapy".*

Wednesday, March 31

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. R. E. Slade: "The Chemical Attack upon Pests".

Thursday, April 1

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5 p.m.—Sound Films of Honorary Members and Faraday Medallists—Sir Ambrose Fleming, F.R.S., and Dr. A. E. Kennelly.

Friday, April 2

ROYAL SOCIETY OF ARTS (JOINT MEETING OF THE INDIA AND BURMA SECTION WITH THE EAST INDIA ASSOCIATION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir David Meek: "Post-War Industry in India".

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at Lincoln's Inn Fields, London, W.C.2), at 4 p.m.—Sir Hugh Lett, Bart.: "Anatomy at the Barber-Surgeons' Hall" (Thomas Vicary Lecture).

ASSOCIATION OF SCIENTIFIC WORKERS (HARPENDEN BRANCH) (in the Congregational Hall, Harpenden), at 5 p.m.—Mr. A. L. Bacharach: "World Agriculture and Man's Nutritional Needs", 2: "The Scientific Measurement of Human Food Requirements".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—A programme of Scientific Films.

APPOINTMENTS VACANT

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

CHAIR OF CHEMISTRY in the University College of North Wales—The Bursar and Acting Registrar, University College of North Wales, Bangor (April 3).

SENIOR ASSISTANT MASTER (PRINCIPAL SUBJECTS: MATHEMATICS AND SCIENCE, PARTICULARLY ELEMENTARY BIOLOGY) in the English School, Nicosia, Cyprus—The Secretary (I.P.R./CA), Board of Education, Belgrave Square, London, S.W.1 (April 5).

EDUCATIONAL PSYCHOLOGIST (MAN OR WOMAN)—The Director of Education, Education Offices, Leeds 1 (April 7).

LECTURER (WOMAN) IN SCIENCE (BIOLOGY AND GENERAL ELEMENTARY SCIENCE)—The Principal, St. Charles's R.C. Residential Women's College (London), at St. Gabriel's, Coldash, Berks. (April 10).

BOROUGH ELECTRICAL ENGINEER AND MANAGER—The Town Clerk, Town Hall, Keighley (endorsed 'Borough Electrical Engineer and Manager') (April 10).

LABORATORY SUPERINTENDENT FOR THE MEDICAL DEPARTMENT, Government of Nigeria—The Secretary, Overseas Manpower Committee (Ref. 746), Ministry of Labour and National Service, Sardinia Street, Kingsway, London, W.C.2.

TEACHER OF ENGINEERING SUBJECTS, and a TEACHER OF BUILDING CONSTRUCTION AND ALLIED SUBJECTS in the Rotherham College of Technology and Art—The Director of Education, Education Offices, Rotherham.

LABORATORY ASSISTANT (MAN OR WOMAN) for the Physics Department of the London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street, London, W.C.1—The Warden and Secretary, Reed Hall, Streatham Drive, Exeter.

EDUCATION LECTURER, with good qualifications and experience, particularly in methods of TEACHING ARITHMETIC AND ELEMENTARY MATHEMATICS—The Registrar, Municipal College, Portsmouth.

ENGINEER TO A CATCHMENT BOARD in the North-East of England—The Ministry of Labour and National Service, E.609.X., Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Section B (Biology). Vol. 61, Part 4, No. 27: The Larval Maxilliary Glands of *Euphausia superba* Dana. By M. V. Schorstein. Pp. 375–384. 9*d*. Vol. 61, Part 4, No. 28: Hybrid Sterility in Artificially Produced Recombinants between *Drosophila melanogaster* and *D. simulans*. By G. Pontecorvo. Pp. 385–397. 1*s*. (Edinburgh and London: Oliver and Boyd.) [82

Imperial Forestry Institute: University of Oxford. Eighteenth Annual Report, 1941–42. Pp. 12. (Oxford: Imperial Forestry Institute.) [82

Geological Survey of Great Britain: Scotland. Wartime Pamphlet No. 13: Limestones of Scotland, Area 2: West-Central Scotland. By Dr. J. B. Simpson; with Contributions by Dr. M. Macgregor and Dr. T. Robertson, and Analyses by Dr. A. Muir and H. G. M. Hardie. Pp. 30. (London: Geological Survey and Museum.) 1*s*. 6*d*. [82

Institution of Heating and Ventilating Engineers. Tables of Hygrometric Data for Air Conditioning Calculations. Pp. 76. (London: Institution of Heating and Ventilating Engineers.) 2*s*. 9*d*. [82

Sheffield City Libraries. Research Bulletin No. 7: Management and Labour. Pp. 46. (Sheffield: Central Library.) 3*d*. [102

Committee of the Privy Council for the Organisation and Development of Agricultural Research. Agricultural Research in Great Britain. Pp. 100. (London: H.M. Stationery Office.) [102

Report on the Phenological Observations in the British Isles from December 1941 to November 1942. By Major H. C. Gunton. (Quarterly Journal of the Royal Meteorological Society, Vol. 69, No. 299.) Pp. 32. (London: Royal Meteorological Society.) 3*s*. [112

Eire: Roinn Talmhaidheachta (Department of Agriculture), Brainse Iascaigh (Fisheries Branch). Statistics of Salmon, Sea Trout and Eels captured during each of the Years 1941, 1939, 1937, 1935, 1933, 1931, 1929, 1927. (P. No. 5698.) Pp. 19. (Dublin: Stationery Office.) 6*d*. [152

London School of Hygiene and Tropical Medicine. Report on the Work of the School for the Year 1941–42. Pp. 43. (London: London School of Hygiene and Tropical Medicine.) [182

Economic Proceedings of the Royal Dublin Society. Vol. 3, No. 13: *Argyresthia conjugella*, Zell., and other Lepidopterous Pests in Ireland during 1942. By Dr. Bryan P. Beirne. Pp. 163–172. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 1*s*. [182

Carnegie Trust for the Universities of Scotland. Forty-first Annua Report (for the Year 1941–42) submitted by the Executive Committee to the Trustees on 15th February 1943. Pp. iv+68. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [182

University of Leeds: Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor (D. T. A. Townend) for the Session 1941–1942. Pp. 16. (Leeds: The University.) [192

Other Countries

U.S. Office of Education: Federal Security Agency. Health Services in City Schools. By Dr. James Frederick Rogers. (Biennial Survey of Education in the United States 1938–40, Vol. 1, Chapter 5.) Pp. iii+50. (Washington, D.C.: Government Printing Office.) 15 cents. [291

Carnegie Corporation of New York. Report of the President, the Secretary and the Treasurer for the Year ended September 30, 1942. Pp. 125. (New York: Carnegie Corporation of New York.) [82

Bulletin of the Auckland Institute and Museum. No. 2: The New Zealand Recent and Fossil Mollusca of the Family Turridæ; with General Notes on Turrid Nomenclature and Systematics. By A. W. B. Powell. Pp. 192+14 plates. (Auckland: Auckland Institute and Museum.) [112

Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation. Nineteenth Annual Report, 1942. Pp. 6. (Boston, Mass.: Ella Sachs Plotz Foundation, c/o Massachusetts General Hospital.) [152

Smithsonian Miscellaneous Collections. Vol. 103, No. 1: Distribution and Variation of the Hawaiian Tree Snail *Achatinella apexfulva* Dixon in the Koolau Range, Oahu. By d'Alté A. Welch. (Publication 3684.) Pp. ii+236+12 plates. (Washington, D.C.: Smithsonian Institution.) [152

Bulletin of the American Museum of Natural History, Vol. 80, Art. 9: Results of the Archbold Expeditions, No. 48: Pteropodidæ (Chiroptera) of the Archbold Collections. By G. H. H. Tate. Pp. 331–348. Vol. 81, Art. 1: The Vernay Collection of Cretaceous (Albian) Ammonites from Angola. By Otto Haas. Pp. 224+47 plates. (New York: American Museum of Natural History.) [172

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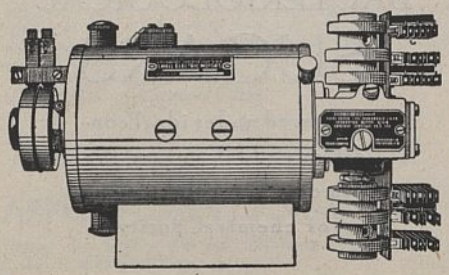

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