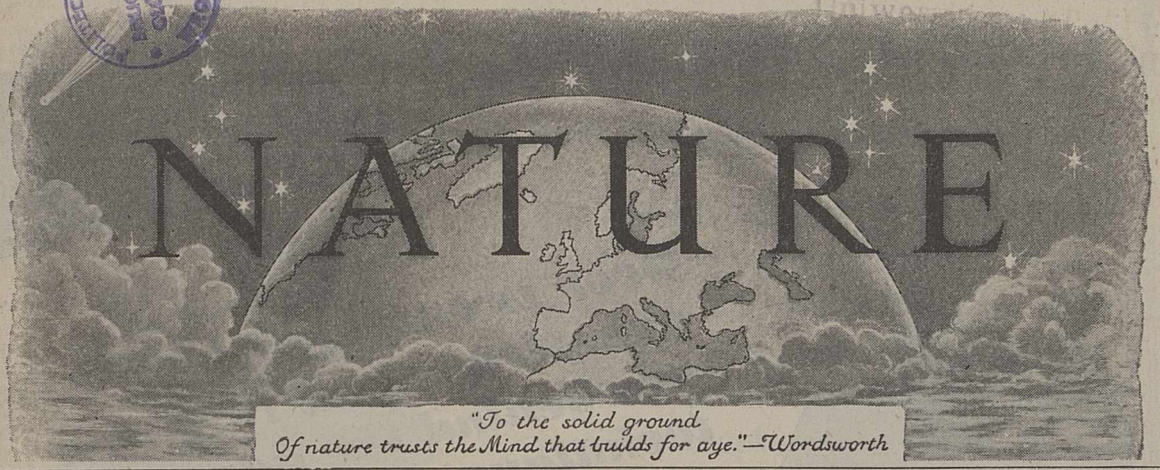

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CONTENTS

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PLANNING AND THE MACHINERY OF GOVERNMENT

THE fundamental questions of the machinery of government and its development to serve the growing burdens which are laid upon it by the increasing integration of political and economic affairs are being repeatedly emphasized by the problems of war and reconstruction alike. These fundamental issues have been admirably stated in a report which has been issued by the Select Committee on National Expenditure. Dealing essentially with "War Production and Methods of Settling Prices for War Stores", the fourteenth report of the 1942–43 session contains a short section on the machinery of government in which the wider issues are lucidly stated. The section follows logically on an earlier report, the sixteenth of the 1941–42 session, and should be carefully considered in connexion with the reorganization of either the Civil Service or of ministerial structure and responsibility itself.

The execution of Government policy, quite apart from what has to be done in total war, or in the special conditions of post-war reconstruction, has come to be a major factor in the economic life of the country, directly or indirectly affecting every branch of its activities. This change must be taken into account in the whole organization and working of the Civil Service, including its recruitment and training, and the report refers to the earlier recommendation of the Committee regarding opportunities for bringing Civil servants into closer contact with industrial practice. Primarily, it is the impossibility of properly handling departmental activities in isolation from each other or without regard to their reactions on the general economic activity of the country that has impressed the Select Committee, through its whole series of inquiries into war production, with the need for some measure of supra-departmental supervision. Each of the Supply Departments has as its primary objective the fulfilment of its own production programme; but the national interest demands that the national programme as a whole should be kept in view, and that the delivery of the goods required for the programme should be achieved in the right proportions and with the minimum demand on manpower, materials, machinery, transport, fuel and power.

Since the Cabinet cannot be brought in at every point, the task of ensuring that departmental activities are fitted together in a coherent national effort has tended either to be neglected or to be left to committees—ministerial or interdepartmental. These have not, in the Select Committee's opinion, proved to be fully effective either in decision or in unification, and the maintenance of separate departmental responsibility has operated against unification. At the same time, the report proceeds, the tasks now assumed by Government departments are of a scope which makes it important that there should be some effective independent supervision of their execution, while their nature tends more and more to put upon Government officials tasks which should be handled with the aim of achieving constructive results rather

than merely of adhering correctly to regulations. Risks must be taken, and it is inevitable that mistakes will occasionally be made.

In regard to this aspect, too, there is no unified ministerial authority clearly charged with, and adequately staffed for, the function of reviewing the execution of Government policy as a whole. As regards Parliamentary supervision, the only properly equipped organ of Parliament exercising a function of this kind has a limited field of inquiry. The question of how to ensure the protection of the public interest in the matter of public expenditure, without adopting measures which must act as a deterrent to boldness and initiative, is one which increasingly needs attention.

The Select Committee does not outline a full plan to deal with these matters, as that would involve going far outside its terms of reference. But while it reaches the conclusion that the instruments of financial control hitherto provided by the functions of the Treasury do not meet the need for watching all the reactions of the methods employed for controlling expenditure, or for seeing that the activities of departments fit in with each other as well as with the total economic effort, it considers that the Treasury should be the authority competent to appreciate the Government position as a whole and to satisfy Parliament that the position is being kept under review. The ultimate supra-departmental authority must, of course, be the Cabinet; but the Cabinet cannot exercise the required continuous supervision and needs some instrument with which to work. The Committee suggests that for some purposes the role of the Treasury should be more widely interpreted and more constructively exercised, but beyond suggesting the appointment to the permanent Treasury staff of one or two highly qualified men to be kept free from other departmental duties, and the setting up of an advisory panel of men with practical experience in production methods and cost-accounting, including independent chartered accountants, it deliberately refrains from specifying any detailed arrangements.

These conclusions may well be compared with those reached by Political and Economic Planning in regard to the organization of foreign publicity, another field which presents some complicated departmental relations. The policy which has to be interpreted abroad may be made in a number of different departments. Vital questions to be asked in determining the form which the organization of foreign publicity should take are whether each Government department should look after its own overseas information service, and whether we should reproduce in peace-time the distinction between the British Council and whatever body discharges the relevant functions of the present Ministry of Information. Surveying the position next from the consumer end, the broadsheet takes the view, contrary to that expressed by Mr. Law in the debate in the House of Commons on the proposals for Foreign Service reform, that the number and range of specialist officials will increase, particularly in the economic field, and visualizes nutrition, agricultural and labour experts attached to the Embassy staffs, possibly with attachés concerned with the Colonies and colonial policy. In this context PEP suggests that the official concerned with information, publicity and the Press, the public relations secretary or counsellor, while directly responsible to the ambassador or minister, must look homewards through the ambassador both for a co-ordinated and coherent public relations policy and for the supply of creative material. In this matter the initiative must often come from home, however much we may stress the importance of the public relations secretary, and indeed all overseas personnel, being of the highest calibre.

Without going into further detail, it must be emphasized that news is fundamental to Government information and publicity work abroad and that it may not in practice be easy to draw a dividing line between the cultural field and political publicity. Political and Economic Planning favours the attempt to do so, entrusting the former, including the popularization of British achievement in science, medicine and agricultural and industrial technology, to the British Council, and it advances powerful arguments in favour of re-creating the Foreign Publicity Department of the Foreign Office.

In advocating that political publicity in the widest sense should be under the control of a revived Foreign Publicity Department of the Foreign Office, staffed at its higher levels by permanent members of the Foreign Service, with a good deal of autonomy, a high status, and the right to be heard before foreign policy is formulated, Political and Economic Planning makes clear the aims which such publicity should serve. After the War, that aim should be the full and fair exposition and explanation of the policy, background and cultural life of a country to the public opinion of others. Pressure propaganda and concealed methods of any kind must be strictly avoided. So conducted, Government publicity services should be a force making for better understanding and for peace, and the broadsheet also visualizes an International Information Office, the functions of which would include publicity for international political and economic agencies.

There is much in this broadsheet which is highly relevant to the discussions of a publicity service for science which have taken place in recent months, but in the present connexion its bearing on the general problem of the machinery of government is also of interest. On some specific points, recommendations for the co-ordination of departments follow suggestions which have appeared in reports of the Select Committee on National Expenditure; but on the broad issue, the line of approach adopted is that which must be applied to larger questions, as well as to particular problems such as that of publicity. Only as the functions required and the problems they present are submitted to fundamental analysis from both the consumer end and the production end can we hope to arrive at a scheme which will provide the service demanded to-day of a central government, without placing intolerable and impossible strain on those individuals from the Cabinet downwards who are required to operate the machinery devised.

The analysis of particular problems in this way enables the principles to be laid down in handling the broader and more general problem to be determined with some assurance and precision. As might be expected, this is the approach adopted by Political and Economic Planning in a subsequent broadsheet in which are formulated its proposals for a Civil general staff. In the sphere of government, we have failed to take account of the enormous development in control over material environment, particularly over communications which has characterized this century and so greatly complicated the task.

Unfortunately, a tendency for discussion on war-time controls and their retention or dispensation after the War to pass into the sphere of faction has somewhat obscured this necessity for looking into the fitness of the machinery of government for its tasks and dealing with what may be called the problem of obsolescence. Similarly, faction obscures the fact that the true safeguard against the power of an efficient administration is not a less efficient machinery of executive government, but a strong and representative House of Commons, more of the members of which are in closer touch with, and understand more clearly, the processes of administration. The one inescapable condition placed on any policy-planning organization in a democracy is that it must be purely advisory to those representatives of the people who will have to take the executive decisions.

The recent proposal of Lord Chatfield for a defence council is a particular example of the planning suggested by Political and Economic Planning to remedy the inadequacy of the pre-war machinery of government in the field of fact-finding, planning for future policy, and co-ordination and timing of policy. The problem requires tackling both within the departments and at the Cabinet level.

A major problem is to provide for the organization and co-ordination of national policies and their execution at a level intermediate between that of the Cabinet as a whole and the individual minister. The P E P solution of this problem is along the line of a group of ministers with special functions and without departmental responsibilities, and the central planning organization would conform to this pattern. Within each major department it suggests the creation of a planning group, distinct from, but in working liaison with, the various administrative divisions, and directed by a standing policy committee in close touch with the minister. There should be some flexibility according to the methods of exploring particular problems and working out policies, but the departmental planning group should always play its part.

Some inter-departmental problems could be handled by joint action between the departments and their respective planning groups, but for those of major and general importance and for the co-ordination of policies, a central planning organization will be required and should form part of the Cabinet office. As model for this the organization which has been built up for the purposes of civil administration in the War is suggested, and in general the proposals recall the recommendations of the Haldane Report, although the advisory bodies to which that report attached some importance no longer find favour. On the importance of adequate provision for the continuous acquisition of knowledge and the prosecution of research to furnish a proper basis for policy, of unimpaired ministerial responsibility and of effective Parliamentary control there is close agreement. The core of the problem really lies in those issues which cut so completely across departmental boundaries that no single department can be said to have a predominant interest.

Recognizing that the Cabinet of the pre-war pattern was far too large to be an effective instrument for shaping major issues of national policy, the broadsheet contemplates a pattern in which the Cabinet, which might be somewhat larger, is organized into two differentiated groups: first, the departmental ministers as at present and, secondly, a much smaller group of ministers without any direct responsibility for departmental administration, but directly or concurrently responsible to the House of Commons for planning in some particular field and for taking action to secure co-ordination between the departments concerned. Normally these members would form a planning committee of the Cabinet, and the broadsheet visualizes these co-ordinating ministers in the first phase after hostilities cease as organized in five groups: external relations, defence, social developments and welfare, national resources (including land) and production and distribution, which at least conform to the principle laid down by the Haldane Committee that the business of government should be distributed according to the class of service rendered.

In regard to the central planning organization, the broadsheet suggests that the present Cabinet secretariat, the Economic Section, which at present operates primarily as the staff of the Lord President's Committee of the Cabinet, and the Central Statistical Office, strengthened possibly to meet the requirements outlined in the recent memorandum by the Royal Statistical Society, would at least in broad outline satisfy the requirements of peace-time policy-planning at the centre. It stresses further, however, the value of a working liaison between the departments and universities and research institutions, and due flexibility in the use of appropriate agencies outside government in dealing with particular problems. At this point, however, we find once more that stress is laid upon the vital importance of selecting planning staff, both in the departments and in the Cabinet office, with the requisite aptitudes and techniques.

Directing attention to the temptation to self-sufficiency to which a competent Civil Service is exposed, the broadsheet stresses the dangers which follow, particularly in the scientific field. Departments are slow to mobilize in the public interest the discoveries and achievements of modern science, and unwilling to give scientific men a full share in the constructive work of government. Civil servants likewise know far too little of the relevant experience of other countries, and the broadsheet for such reasons urges that the planning group should be empowered to use freely agencies outside the Government, such

as the universities, research institutes and individuals for particular pieces of work. Such institutions and individual experts are usually free from the inhibitions which often restrict the outlook of the departments, and also command sources of information of current developments in research and ideas which are lacking in the more traditionally minded departments.

There is undoubtedly room for more interchange, in both directions, of personnel and information between the State departments and universities and similar institutions. Specialists might well be employed temporarily for particular studies, but the planning staffs should include particularly men with qualifications in, and up-to-date knowledge of, developments in the natural and social sciences, with a large proportion of temporary appointments of experts. Flexibility of mind and flexibility of personnel in the planning group are as essential as flexibility of organization, and the training to be given to the selected personnel must be not so much in the practices of the past as in the problems of the future and of the methods of attacking them.

The broadsheet reveals no disregard of the experience of the past. It draws on the concept of Combined Operations, and the suggestion that experience gained in the War may help us here in planning for peace should not be dismissed without examination. A planning staff is visualized as consisting of Civil servants carefully selected without prejudice to their future career, a few picked people from universities and research bodies on limited engagement, and specialists in a working or consultative capacity and not necessarily whole-time. Transfer of individuals from one group to another and between departmental planning groups and the Cabinet Office should be encouraged, and a working liaison between the departments and the universities and research institutions is important to facilitate this interchange of staff and particularly its disposal when any particular task is completed, whether of a group or of an individual.

That there are many difficulties in developing any such arrangements is not disguised in the broadsheet. The advantages inherent in such flexible systems are too well attested to warrant hesitation in applying them to the attack on post-war problems. What is required in the first instance is clear thinking on the functional division of ministerial responsibilities, the resolute application of an adequate policy of reorganization, and the creation of the appropriate planning organization with the proper arrangements for staffing. That must be the first step, and then only can we proceed to the recruitment of staff with the requisite aptitudes, on the quality of whom the successful functioning of our machinery of government will depend in the future as in the past. But no excellence on the part of the Civil Service, whether permanent or specially recruited for particular planning tasks, will ensure results unless the machinery is functionally and administratively sound, and stimulates initiative and vision; giving full play to the knowledge and ability and creative powers of those who use it, while retaining unimpaired the essential responsibility to Parliament.

DEDUCTIVE GENETICS

Genes and the Man

By Prof. Bentley Glass. (Science in Modern Living Series.) Pp. xii+386. (New York: Teachers College, Columbia University, 1943.) 3.50 dollars.

PROF. GLASS'S book is intended for teachers, and might form the text for a course of lectures on biology, particularly in its application to man. Its structure is definitely original. He begins with an account of the cell, including the organization of the nucleus as revealed by genetic studies, describes the segregation of genes and their functions in development, culminating in an account of human development which allows him to describe a good deal of elementary anatomy and physiology.

The notion of a gene is introduced on p. 9, and biological facts are described, so far as possible, in terms of genes. He dispenses with any serious attempt to prove the existence of genes, which are, after all, hypothetical, like atoms or electrons, from the consideration of large-scale phenomena. Yet a teacher should surely be encouraged to state the evidence for such hypotheses as genes, atoms, or radiative waves with the utmost clarity if his pupils are to understand the nature of scientific method.

However, a deductive exposition of genetics might be of great interest if it were as accurate and logically coherent as that of dynamics as usually taught. Unfortunately, Prof. Glass's exposition does not possess these virtues. He devotes no less than thirty pages to an account of mitosis, but the exposition of meiosis given, for example, in the diagram on p. 66, is incorrect, save for a few exceptional organisms such as the male Drosophila. True, the account is corrected on p. 120, but meanwhile the reader will have learned that the first meiotic division is always reductional. This is simply untrue for most genes in most organisms; and until this fact is realized much of modern genetics is utterly unintelligible. So is the mechanism of meiosis, for chiasmata have the double function of holding the bivalents together at first meiotic metaphase and allowing the interchange of genes between homologous chromosomes. It is striking that Prof. Glass describes Belar's "Die cytologischen Grundlagen der Vererbung", published in 1928, as "the most complete and best survey yet made of the cytological bases of heredity". The book certainly marked an epoch; but a very great deal has been discovered about the chromosomes since Belar's death.

Unfortunately there are a good many other inaccuracies in the book. Two of my own exploded hypotheses are put forward (fortunately without acknowledgment), namely, that the exceptional linkage in Apotettix is due to translocation, and that structural homology is a product of genic homology, though Nabours has disproved the former, and Harland the latter. We are told that more human genes have been detected in the *X*-chromosome than in all the rest combined. In his classical "Inherited Abnormalities of the Skin and its Appendages", Cockayne lists thirteen sex-linked genes and ninety-eight autosomal, and the proportion is fairly similar for genes affecting other organs. Blood plasma "contains salts in concentrations strikingly similar to those in sea water"; and so on.

Nor is the logic much more reliable than the facts. We are told that racial prejudice is "biologically absurd", because "it is unlikely that there are many more than six pairs of genes in which the white race

differs characteristically, in the lay sense, from the black". No believer in Negro inferiority should have much difficulty in countering this argument. One pair of genes is quite enough to make a man an idiot, and Keeler and King have produced strong, if not absolutely conclusive, evidence that the differences in tameness, brain size and other characters between wild rats and a tame strain are due to three colour genes. Scientific arguments against the congenital inferiority of Negroes must be based on facts such as those discovered by Davenport and Steggerda, rather than on deductive arguments which are scarcely more cogent than the story of the curse on Ham. Many of the other sociological deductions from biology seem to have an equally flimsy logical structure.

Nevertheless, Prof. Glass's book raises an interesting problem. Would it not be possible to write a text-book of genetics on deductive lines, like a treatise on mathematical physics? The early chapters of Fisher's "Genetical Theory of Natural Selection" represent what would be a section of such a book, and Chapter 7 of Woodger's "The Axiomatic Method in Biology" yet another, though I think that even to-day an axiomatic treatment would be premature. But such a text-book would certainly be mathematical, even if it did not use logistic symbolism. Its main value might be the revelation of gaps both in our knowledge of genetics and in its logical structure. Nevertheless the attempt would be worth making, if only because genetics is the only branch of biology which could be treated in such a way.

Prof. Glass's approach is original, and if the book were rewritten with a careful eye on errors of fact and logic, it would be of great value to teachers of biology. In its present form it contains many useful hints on the exposition of the subject, and in particular shows the central position of genetics; but the reader must be advised to exercise his critical faculty to the full. J. B. S. HALDANE.

COLOUR SENSATION IN MAN

The Fundamental Colour Sensations in Man's Colour Sense

By Gastaf F. Göthlin. (*Kungl. Svenska Vetenskapsakademiens Handlingar*, (3), 20, No. 7, 1–76.) (Stockholm: Almquist and Wiksells Boktryckeri A.-B., 1943.)

RECOGNITION of colour is a process depending upon nerve impulses reaching the cerebral cortex; hence it cannot be overlooked that interpretation of the impulses is a cerebral function. At present it is believed that nerve fibres conduct only one form of impulse and that a different fibre is required for each separate sensory factor. The retina has to initiate nerve impulses corresponding to the pattern of the external world as well as the colours of the various objects. The merit of the trichromatic theory of colour vision is that the numbers of nerve fibres are reduced to three groups, one group for each 'fundamental' colour. The 'fundamental' colour is thus the sensation produced by impulses passing up one group of nerve fibres. The theory is based on the observation that all colours can be reproduced by the combination of three separate regions of the spectrum. The simplest acceptable assumption is that there are three sets of receptors, possibly two varieties of cones and one of rods.

Prof. F. Göthlin, of Uppsala, has published a monograph on some aspects of colour recognition. Section 1 gives an outline of the history of the trichromatic theory of colour vision. As already pointed out, this postulates three 'fundamental' colours, that is, three groups of receptors which are selectively stimulated by different regions of the spectrum. These three groups of receptors must send impulses up three groups of nerve fibres to the cerebrum. Section 2 deals with the problem of yellow. Is the sensation of yellow the result of stimulating one special type of receptor with impulses passing up one group of nerve fibres, or is it the result of stimulating two sets of receptors with impulses up two groups of nerve fibres? There are several peculiarities about that region of the spectrum which gives rise to the sensation of yellow. (*a*) The range of wave-lengths which give rise to a pure yellow sensation is very narrow, and it does not correspond to the same region in all individuals. Göthlin believes that this is conclusive evidence that the sensation of yellow is not a 'fundamental' one, but it might be that the receptors in different individuals do not respond to exactly the same wave-length limits. (*b*) There is a maximum colour discrimination in the yellow region. (*c*) A yellow sensation is produced when a red light shines in one eye and a green in the other. Therefore fusion of red and green to give a yellow sensation must take place either in the external geniculate body or the cerebral cortex. The conclusion is that the sensation of yellow is a delicate balance between impulses which should give rise to red and to green respectively. Psychologically, yellow is a pure sensation, but physiologically it is not a 'fundamental' colour.

Section 3 contains a discussion of the nature of the third 'fundamental' colour, red and green being the other two. Some authorities have selected blue and others violet as the sensation produced by impulses passing up the third group of nerve fibres.

Section 4 describes experiments to test whether blue or violet is the 'fundamental' colour. Prof. Göthlin examined the thresholds for light and for colour in six individuals using indigo (425–465 mμ) as a test light. In three of these individuals the first colour to be recognized throughout the whole region was blue, and the intensity had to be raised further before the colour was called violet. Göthlin argues that the special receptors are those that correspond to a sensation of blue and that the violet sensation is due to a red element conducted up a different set of nerve fibres. He says that he does not know whether the red element is due to stimulation of special receptors adapted to respond to the short wave-length end of the spectrum, but he thinks that the impulses must pass up the same fibres as those which conduct the impulses giving rise to the sensation of red initiated by the long wave-length end of the spectrum. The simplest explanation, surely, is that the receptors for red are stimulated both by the long and short wave-lengths of the visible spectrum. The fact that two subjects saw the dissociation of indigo into blue and violet at some wave-lengths only and one did not see it at all may be due to the difficulty of the experimental procedure.

Section 5 is devoted to a discussion of the nature of the receptors in the human eye. Göthlin considers that the colour filter mechanism, which occurs in birds, reptiles and amphibia, is without significance; yet it is no more improbable than the other explanations suggested.

The curves of colour sensitivity do not necessarily correspond to the ease of stimulation of the receptors by the spectrum. Göthlin states that the possible

mechanisms are: (*a*) separate 'visual substances' with selective light absorption in their respective regions of effectivity; (*b*) a substance of general sensitivity but associated with special sensitizers for the special regions of selective activity; (*c*) a substance of general sensitivity, each receptor being adapted to its effective region by some special physical structure entailing a selective absorption of energy radiations of certain determined wave-lengths. It is not clear whether colour filters are included or excluded from alternative (*c*).

Section 6 presents a working hypothesis. This hypothesis includes the idea that certain stimuli which give rise to one coloured sensation can inhibit impulses which would give rise to the sensation of another colour. This view that inhibition may occur to prevent stimulation of retinal elements from sending impulses to produce their usual colour sensation is not new, as it has been advanced, for example, by the present reviewer[1], and it is the underlying cause of the experiments on 'rivalry'.

Prof. Göthlin presents an interesting mechanical analogy to explain the balancing of the three-colour mechanisms. There are many other interesting points discussed, but these must be found by reading the original monograph. The translation into English is excellent.

H. E. ROAF.

[1] *Brit. J. Ophthal., Trans. Ophthal. Soc.*, **59**, 405 (1939).

PHILOSOPHY OF ECONOMICS

The Ideal Foundations of Economic Thought

Three Essays on the Philosophy of Economics. By Dr. W. Stark. (International Library of Sociology and Social Reconstruction.) Pp. viii+219. (London: Kegan Paul and Co., Ltd., 1943.) 15*s*. net.

DR. STARK, an economist from Czechoslovakia, has included in this volume a series of critical essays in the philosophy of political economy. His attempt to throw familiar strands of doctrine into new perspective gives his work a pleasing quality of freshness. The author's interest is moral and religious as well as economic: he disapproves of the modern tendency to cut away economics from any ethical roots and, resting it on the individual divorced from his social setting, to glorify freedom at the expense of equality. His outlook is one of hostility to the positivistic tendencies of the nineteenth century. Classical political economy of Adam Smith and his successors is considered by Dr. Stark to be superior in this respect to the modern; and he uses what he deems the greater breadth and depth of the former as touchstone to the latter. "The decision between the social and ethical approach of the classical and the individualist and scientific approach of the modern economists," he concludes, "depends upon the question whether it be desirable or even possible to divide the search for the true from the quest for the good." In his view, "the vital link between them should not be severed", since "of all creatures which we know man alone has the privilege, and the duty, to raise his face toward that Infinite Perfection, in whose image he has been formed".

The book falls into three parts. The first, in many ways the most interesting, emphasizes the essential continuity between the views of Locke and of Leibniz, on the contrast between man and Nature and on the relations of man to human society, and the outlook of the classical economists. "The theories set forth by François Quesnay and Adam Smith lie, not only in the economic and social, but also in the philosophic thought of the time that preceded them; and indeed they owed more to Locke and Leibniz than to Monchrétien and Mun". It is implied that neglect of this connexion has been the ground of much subsequent misinterpretation. Dr. Stark indicates, as the key to understanding of these early writers, the fact that the unity between freedom of the individual and the good of society which they postulated rested on the assumption of an economic society of petty production by individual worker-owners. In such a society, economic freedom would include equality of opportunities, and the vesting of property-rights in labour which Locke had expounded would acquire meaning. But the rise of industrial capitalism was to bring this conception into conflict with reality. "The industrial revolution changed the outlook: the trend of development no longer pointed towards a social organization of small-scale production, based on the concord of peasants and artisans; under its influence an economic system of large-scale industry sprang up, carrying with it the discord of possessing and dispossessed".

In the second part, the author examines at some length the views of two representatives of that group of writers who had begun to appreciate that "in and through the industrial revolution the principles of liberty and equality [had become] irreconcilable": namely, Thomas Hodgskin, who criticized the inequality he saw around him but remained "an egalitarian liberal" adhering to a policy of *laisser-faire*, and William Thompson, who looked to a co-operative Utopia to supplant the existant atomistic competition. In the third part, Dr. Stark approaches a more familiar theme: the transition to the modern subjective theory of value, with its concentration on the relation between commodities and the psychology of the individual consumer. As representatives of this modern tendency he takes two less-known writers, Hermann Gossen and Richard Jennings. For Dr. Stark the essence of this transition was the d sintegrat on of the old social philosophy and its replacement by the view that economics was a non-normative positive science; and the very deficiencies of the latter demonstrate that, if equality is to be pursued as an ideal, it can no longer in modern society be "the demand for a just division of the national wealth among all: in a society of proletarians it must be the call for the full concentration of the means of production in the hands of the community".

Dr. Stark writes with an ease and grace of style that is remarkable for one for whom English is not his mother tongue. His handling of ideas and their history shows a rare erudition and discernment. While few readers can fail to find these essays stimulating, there will be few, I think, who will not at some point be provoked to disagree. For the author's canons of criticism are individual and unusual: a quality which gives to his work much of its freshness. He is hostile to the modern tendency to analyse society in terms similar to those employed in the realm of Nature. He is hostile alike to capitalism and to the emphasis of most contemporary economic thought. But his criticism of contemporary ideas and institutions is less from a Marxist than from an idealist point of view; and as regards the method of economic inquiry, it is for a return to its ancient philosophical tradition that he pleads.

M. H. DOBB.

Basic Radio

By C. L. Boltz. (Nelson's Aeroscience Manuals.) Pp. 272. (Edinburgh and London: Thomas Nelson and Sons, Ltd., 1943.) 5*s*. net.

THIS book is one of a series of manuals covering a range of subjects suited to the needs of aeronautical students. It is of the nature of an elementary text-book, illustrated occasionally with descriptions of typical experiments, and provided at the end of each chapter with a series of exercises to test the progress of the reader's knowledge. The scope of the book is more than is indicated by the title, since no prior knowledge of electricity is assumed, and the first half of the manual describes the fundamental properties of electric currents, how these are produced, and the heating, magnetic and chemical effects that result from their use. The notion of electric charge is not utilized until Chapter 6, on condensers, is reached; and following this the nature of alternating currents is described and the manner in which these currents are affected by circuits containing inductance and capacitance. A chapter on waves describes the production of electromagnetic radiation from circuits carrying alternating currents of radio-frequency, and the main phenomena accompanying the transmission of wireless waves are dealt with very briefly. Five chapters in the later portion of the book describe the main facts concerning thermionic valves and the manner in which these are used for the generation of oscillations and for detection and amplification in wireless receivers. Other chapters deal with the use of aerials and feeders, and the methods of modulating the waves for signalling purposes.

Only the most elementary knowledge of mathematics and physics is assumed, and this can, if desired, be obtained from a perusal of other manuals in the same series. Although the subject-matter is arranged in such a way as to make this volume suitable for use as a class text-book, it will be found to be quite readable by the private student.

Clouds and Weather Phenomena

By C. J. P. Cave. Second edition, revised. Pp. viii+24+42 plates. (Cambridge: At the University Press, 1943.) 5*s*. net.

THIS little book contains a series of forty-two pictures of clouds, all beautiful examples of the photographer's art, and excellently reproduced, covering the common types of cloud. The letterpress of twenty-two pages begins with an account of the classification of clouds, including a brief but clear description of each type of cloud. There follows a discussion of the colour of the sky, sunset rays, the green ray, rainbows, haloes, coronæ, iridescent clouds, brocken spectres and mirages. The book contains a considerable amount of information of a character which is seldom to be found in books which aim at popularizing the study of meteorology, or even in more pretentious books.

The author has aimed at providing for those who depict or watch the sky, a simple account of the colours and other phenomena which they see in the sky. He has achieved his aim in a marked degree, and has packed into the few pages of letterpress much information which cannot fail to appeal to anyone who is interested in watching the sky. The book contains nothing too technical for any intelligent reader, and is one of the most satisfying books which have appeared in the field of meteorology for many years.

D. BRUNT.

Post-Graduate Lectures

Inorganic Chemistry, by Prof. H. J. Emeléus; and Organic Chemistry, by Dr. H. B. Watson. Pp. 84. (London: Oil and Colour Chemists' Association, 1943.) 10*s*.

THIS slender volume contains lectures on some interesting aspects of inorganic and organic chemistry which should be useful to those who have not kept abreast of modern work and wish to know something of its teachings. The topics are well chosen and are expounded in a clear and authoritative manner. Prof. Emeléus deals with the structure of inorganic compounds as determined by various methods, such as X-rays and electron diffraction, with crystals, silicates, radioactivity, the separation and applications of isotopes, reactions in gases and in non-aqueous solvents, and cognate subjects. The subject-matter is illustrated by clear and instructive diagrams, and many tables of useful numerical data are given.

Dr. Watson is concerned with showing how modern views on the electronic structure of atoms and molecules throw light on large groups of organic reactions; substitution, addition and isomeric change being chosen as typical. He gives references to original papers for those desiring more information. It is shown how many facts long known to organic chemists find a very lucid explanation when interpreted in the light of one or two quite simple assumptions, and thus organic chemistry is linked with general progress in theoretical physics.

Both sets of lectures are interesting, and a good deal of ground is covered in a way which should attract any reader wishing to learn something of the subjects with which they deal.

Testing Radio Sets

By J. H. Reyner. Fourth and revised edition. Pp. viii+215+10 plates. (London: Chapman and Hall, Ltd., 1943.) 15*s*. net.

THOSE who have to use radio receiving sets, whether for the reception of broadcasting or communication signals, or as an auxiliary piece of equipment in various forms of radio-frequency measurements, are likely to require for occasional reference a book dealing with radio-receiver testing and fault-finding. The present book covers the technique of this subject in a clear and simple manner, and will be found to be a useful elementary manual for the constructor as well as to the serviceman and laboratory worker. The book was first published in 1930, and the present fourth edition has received considerable revision and rearrangement in order to make it as up to date as possible under existing conditions.

Electricity and Radio Transmission

By Sir John Townsend. Pp. xi+183. (Winchester: Warren and Son, Ltd., 1943.) 8*s*. 6*d*. net.

THIS volume comprises an elementary and lucid account of the main facts of electrostatics, magnetism and current electricity, leading thence by way of electromagnetic induction to oscillatory circuits and valve amplifiers and oscillators. An understanding of all this basic knowledge is necessary to a student who is taking an interest in the science of radio-communication, although much the same ground is covered by other elementary text-books. The author's object in presenting this book is, however, to demonstrate in a non-mathematical manner the relation of the principles of radio technique to other electrical phenomena.

SCIENCE AND TECHNOLOGY IN THE NORTH-WEST OF CHINA

By DR. JOSEPH NEEDHAM, F.R.S.
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THE previous five articles in this series[1–5], designed to acquaint the scientific workers and technologists of the English-speaking world with the present war-time work and conditions of their Chinese colleagues, dealt first with south-west China (Yunnan Province) and then with western China (Szechuan Province). We have now to report on China's great and undeveloped north-west (the provinces of Shensi* and Kansu).

A brief geographical introduction is necessary at the outset. Leaving the great Szechuan plain (Richtofen's *Rotenbecken*), itself an intermediate plateau between the high Tibetan plateaux and the low-lying plains of China east of Ichang, the traveller enters mountainous country in north Szechuan and south Shensi. Much of this is very historic ground, since it was at these passes that the warriors of the "Three Kingdoms" period attempted to maintain the independence of Szechuan. On entering Kansu province, the road goes for many hundred kilometres through the loess country, which travellers have so often described. The loess is nothing but wind-blown dust from the Gobi Desert of Mongolia to the north, but it covers and cloaks all the geological formations of the region, sometimes to a depth of hundreds of feet; and owing to its fertility and suitability for making cave dwellings, is generally thought to have provided one of the earliest homes of the Chinese people. To the north-west, the province narrows into a 'panhandle', following the line of the Silk Road of antiquity, between the snow-covered Nan Shan Mountains to the south-west which guard Tibet, and the vast wastes of the Gobi Desert to the north-east. Eventually the panhandle broadens out somewhat to meet Sinkiang (Chinese Turkestan), and here it is bordered on the south by the northern Sinised Mongolian province of Ninghsia.

The city of Lanchow itself, about which much must be said, lies on the Yellow River, at the entrance to the panhandle. Here the loess region changes to semi-desert, and the Lanchow area itself is really the first of a series of oases which runs up the panhandle and made the Old Silk Road possible; Liangchow, Ganchow, Suchow, Anhsi (formerly Guachow, the city of melons), and Tunhuang (formerly Shachow, the city of the sands). Some of these were visited by Marco Polo, at his entrance into China by the southern loop of the Silk Road (that is, round the south of the Tarim basin in Sinkiang), and he must have passed, too, through the great Han Dynasty "Gate" of China at Yümenkuan. The later Ming Dynasty one, farther in, at Djiayukuan, is still in excellent repair. Coming down into China, the modern version of the Silk Road, suitable for motor transport (and indeed from 1937 until 1940 the main channel through which assistance, from the Soviet Union, reached China in her struggle against Japan), runs into Lanchow, and then down through Shensi to Szechuan and the cities of Chêngtu and Chungking, with a loop to the city of Sian, and railhead at Baochi. This road, though in general well engineered, is subject to severe disorganization because of the nature of the country. Like the earlier main roads in the western parts of the United States, washouts are frequent and the surface is often inadequately protected against run-off water, presumably because of the lack of labour for road work. The loess country, in particular, is under constant violent erosion, and I shall never forget a day in the rainy season in southern Kansu, when the mountains seemed to be visibly dissolving, and the road was broken by a torrent of dilute brown creamy mud. The Northwestern Road Administration has done a very fine job already, but far more remains to be done before this country can be said to have been mastered.

The whole subject of transportation and communication in Chinese Central Asia is a romance in itself. On the Old Silk Road and other main arteries south of Lanchow run fleets of lorries for which the Government maintains some efficient repair and overhaul stations. These lorries all use petrol, but it may be questioned whether it would not have been preferable in the first instance to have adopted Diesel engines as a definite policy. The drivers are not as yet, of course, all very well educated; hence some strange mistakes, such as the filling up of accumulators with boiled, rather than distilled, water, presumably owing to the well-known medicinal advantages of the former. Besides the lorries, camel trains are still much employed. They operate in sections of about twenty Bactrian (two-humped) camels each; the leading animal carries the camel-driver with a white triangular flag marking the nature of the caravan, and the last animals carry bells in order to avoid their loss by theft unknown to the camel-driver ahead. A number of dogs accompany the trains to assist in protection against the wolves which at twilight abound in the winter near the Road.

As for communications, radio-telegraphy has proved of great advantage in this wild and desolate country; the remotest oases now possess hand-worked radio-transmitters, and a network of communications has thus been established throughout Central Asia. Telegrams in the Chinese ideographic language are sent according to a code, each character having its own number, and it is a remarkable sight to see the clerks transliterating their messages rarely at a loss for the right character or number, though the latter often reach five figures. The radio network forms an interesting contrast to the methods in use in the Han Dynasty (contemporary with the Romans), the beacon towers of which are met with so frequently by the traveller. Besides each ten-li fort there stand five small square conical towers, about 8 ft. in length and breadth and 10 ft. high; in this way the Han garrisons protecting the road could send to each other elaborate messages about the movements of the unsubdued tribes in the mountains to the south-west or the desert to the north-east. The positions of some of these buildings show that the fort was used as a receiving station and the five towers as transmitting stations.

One must think of Lanchow, then, as a city rather isolated at the entrance of Chinese Central Asia. It is nevertheless much modernized, and with its walls, towers and gates set in a loess valley of grand proportions beside the famous river, presents an imposing appearance. Tibetan lamas or notables and Mongolian herdsmen are to be seen in its streets, side by side with the Chinese Moslems of the province and the officials and soldiers of the Central Government. As a pioneer scientific and technological centre,

* I refer only to South Shensi, the so-called Communist area of North Shensi having been out of my itinerary, though it contains some interesting scientific institutions.

pushed out into Central Asia, it is very significant, not only now but also in its promise of future importance.

Apart from the machine shops of the truck transportation departments of the National Resources Commission and the Northwestern Road Administration, there is a large machine works jointly under the National Resources Commission and the Kansu Provincial Government, directed by Dr. Hsia An-Shin. This turns out lathes, drilling machines, shapers, centrifugal pumps, machine looms, etc., and serves the whole of China's north-west, including Sinkiang. It was interesting to see among their old machinery a 100-H.P. rolling mill for minting the copper 'cash' of former days; it is now intended to use it as a mine hoist. To stand in Dr. Hsia's foundry is to feel on the edge of some vast ocean, for there is nothing else of the kind between Lanchow and the Soviet Union two thousand miles or more to the west. The National Resources Commission also has a successful dry-cell factory and power station at Lanchow; here it was interesting to see, with Mr. Yang Chêng-Ching, insulators of all kinds of telegraphic apparatus entirely Chinese-made. Besides these industrial activities, there are flour mills, woollen mills, and a wool-washing plant, under partial Government control; and a great deal of work going on under Chinese industrial co-operatives. Some thirty branches exist in Lanchow, covering the leather, textiles, fur, paper, machine, brick and tile industries. In other cities such as Baochi, the number of such producing co-operatives may be so high as seventy. It was interesting to see, at Shuangshihpu, the Chinese Industrial Co-operatives Machine Works' pattern-shop set up in an old temple, and the wooden machine parts piled around the dusty Taoist gods. As is well known, the procedure in the Co-operatives is very democratic, and I was introduced to the chairman of the Lanchow co-operative federation, Mr. Wei Yu-Ling, an illiterate, but obviously very intelligent, textile worker, whose organizing ability has won him successive elections to this important post.

Lanchow is as important a medical as an industrial centre. It is the seat of the Northwest Epidemics Prevention Bureau's Vaccine Production Institute, analogous to that at Kunming in Yunnan, mentioned in my second article[2]. The Lanchow Institute is directed by Dr. Yang Yung-Nien, a former student of Sir Henry Dale, who worked at the National Institute for Medical Research with Dr. P. Hartley and Dr. Booth White. Apart from the usual vaccines, of which some 80 per cent go to the army, the Institute also produces diphtheria toxoid, and vaccines against cattle and sheep anthrax, and rinderpest. About eighty ponies are kept, with a special ranch for pasture feeding, and half a dozen large Arab horses captured from the Japanese. Like the Kunming Institute, the Lanchow Institute has its own glass factory. Owing to the extremely dusty nature of the country, work is almost impossible during the summer months, on account of contamination in the absence of up-to-date air-conditioning devices.

In the Pathological Department, the visitor immediately notices piles of mollusc shells on the chief's desk, and it was therefore no surprise to find that Dr. Li P'ei-Ling had been a pupil of Prof. A. E. Boycott. Dr. Li is not working at present, however, on the dextrality and sinistrality of Helicella, but rather on the position of this snail as a vector in the spread of lungworms and flukes in sheep. He is, in fact, an enthusiastic comparative pathologist. Even in this institute, the lack of materials and apparatus was depressing, although as a whole it is well-equipped with stores, considering all the conditions.

Another outstanding worker under the National Health Administration at Lanchow is Dr. Mêng Mu-Ti, one of China's best pharmaceutical chemists, and a former colleague of Prof. J. H. Burn. He is now engaged in starting a Government pharmaceutical factory, and work is proceeding on the making of petroleum jelly from the residues from the oilfield, mentioned below; saponins from soap beans, pure salts and borax from Chinghai (Lake Kokonor) bitterns, potassium permanganate from pyrolusite, ephedrine from *ma huang*, eumenol from *tang kuei*, etc. In this connexion, the following contrast is of interest. Everyone has read of the use of butter by the Tibetan lamas in their monasteries for modelling coloured pictures, burning in shrine lamps, etc. Recently the Chinese Air Force has established a casein factory at the famous lamasery of Labrang (Hsiaho, not very far from Lanchow), so that the butter now goes to a more technical, if less traditional, use. From the whey, lactose is prepared by Dr. Mêng Mu-ti's laboratory workers.

In medical education, Lanchow is also important. The National Health Administration's Personnel Training Institute, presided over by Dr. Li Wên-Ming, produces dispensers, sanitary inspectors and 'nursing assistants'—these latter may be regarded as analogous to the old Russian grade of 'feldshers' in remote country places, who were not medically qualified, but had sufficient medical education to run rural clinics 'of first appeal' and attend to public health. A somewhat superior grade of such men is being turned out experimentally by the North-western Junior Medical School, also in Lanchow, under Dr. Chi Ching-Hsing; here medical men are to be trained in four years instead of six, with a 'rural' instead of a regular qualification diploma. The emphasis is on practical rather than theoretical knowledge. It remains to be seen how successful this will be, but the Chinese certainly have an enormous problem in introducing modern medicine into Central Asia, and in the opening stages a system such as this may be very beneficial. Besides the above, Dr. Li Wên-Ming's Institute also organizes refresher courses for medical men, nurses, public health officials, and the groups originally trained there. Dr. Chi has on his staff the brilliant Edinburgh surgeon, Chang Cha-Li, whose work at the National Health Administration's Northwestern Hospital is very noteworthy. It was at this hospital that I noticed a little touch exemplifying the Chinese genius for improvization—on a table outside the clinical laboratory door, an egg-shell was lying; but it had a label attached to it, and on closer inspection proved to contain a pathological specimen. In the shortage of glass tubes, what more suitable sterile container could be found. Lanchow has another excellent hospital and leper colony under Dr. S. Hoyte of the China Inland Mission.

Among the most interesting of Lanchow's institutions is the Kansu Science Education Institute. This organization, a group of Chinese-style buildings in a beautiful garden just outside the city, was started with British Boxer Indemnity Funds in 1936. Successive directors were Profs. J. B. Tayler and Y. P. Mei of Yenching University; the present head is Dr. Yuan Han-Ching, a specialist in stereochemistry from Roger Adams' laboratory at the University of Illinois. It was intended to be a research institute as

well as a focus of Central Asiatic popular education in science, but under present conditions very little research can be undertaken. There is, however, work proceeding on the ecology and entomology of the Nan Shan Mountains, and the institute has a useful library. Particularly active are the workshops, under Mr. Hsieh Yu-Shou, making scientific apparatus for the schools of the province. This resembles that produced near Chêngtu (and referred to in the fourth article of this series[4]); tuning-forks and pulleys are made of salvaged aluminium from shot-down Japanese aeroplanes, and weights for chemical balances from melted bronze coins of former dynasties. About a hundred complete sets of eighty pieces of apparatus each are produced each year. The section of geology and mineralogy, moreover, produces boxed sets of ore and rock specimens, as well as wooden stratigraphic models, which were pronounced by a geological friend who accompanied me as better than those he had seen in many Western universities. Then the popular science education division under Mr. Chêng An-Lun is also active, and some of its work is to be seen in the large illustrated wall-newspaper, changed once every ten days, and set up at the city's civic centre. During my stay in Lanchow, I noted interesting articles on Archimedes and the history of geometry, on twinning and other questions in experimental morphology, and on parasitic insects.

The Chinese Industrial Co-operatives also have a research institute in Lanchow; it has a good library, and carries out work on leather technology, wool textiles, etc.

Coming now to more formal technical and scientific training, though no university exists in Lanchow, there are a number of institutions worth notice, since here in Central Asia, learners are truly in the 'front line' of science and technology. First, there is a Teachers' Training College, the largest of its kind in China, under Dr. Li Chêng, which includes scientific instruction; and then there is a Polytechnic College (similar to that at Chiating described in the fourth of this series of articles[4]) under Dr. Tsêng Chi-Kuan, specializing in animal husbandry, agronomy, irrigation, etc. Of particular interest are the Technical Training Schools of the Chinese Industrial Co-operatives, which exist at Shuangshihpu and Chêngtu, as well as at Lanchow. Here many child workers of promising intelligence are given a good all-round as well as technical education. At Lanchow one can see boys of sixteen or so acquiring an insight into all the mysteries of the textile industry, or a couple of Tibetan-Chinese youths newly arrived from the back country at work on the solid geometry of the screw-thread. The Co-operatives' schools, which act also as centres of local culture, keeping alive such things as the folk-songs of the people, are named Baillie Schools, after Joseph Baillie, an ex-missionary who devoted his life to the cause of technical education in China.

Before leaving the city of Lanchow, a few words may be devoted to some of the American technical experts who have made it for a time their headquarters. Dr. Theodore F. Dykstra, whom we have mentioned before, has been at work on a widely extended survey of potato culture across the length and breadth of Free China. There can be no doubt that his efforts will help greatly in the freeing of the Chinese potato crop from the curse of virus diseases of all kinds with which it has so far been infested. Dr. W. G. Lowdermilk, an internationally known erosion and soil-conservation expert, with a group of Chinese colleagues, such as Dr. Stephen Fêng, has also gone up and down the country, and they will be making important recommendations for the better conservation of the north-west, and the fight against desiccation. In this connexion, mention should be made of Kansu's exceptionally enlightened Commissioner of Reconstruction, Mr. Chang Hsing-I; according to him, Kansu's greatest problems are the more successful location of subterranean water along the Silk Road, and the full exploitation of the oil throughout the province.

Much has been written on the progressive desiccation of north-western China. I have myself observed in far North-west Kansu that the foothills of the Nan Shan, which are described on Sir Aurel Stein's maps of 1905 as "covered with thick brushwood", are now completely desert, with only the thinnest scrub in the dry watercourses. In Northern Suiyuan (another Sinized Mongolian province) the *pailous* (commemorative arches) of not very far-distant date are now buried in sand up to a foot or two of the top. It is not clear, however, that this process could not be stopped by modern methods of afforestation, soil conservation and irrigation carried on over a sufficiently long period by a sufficiently determined Government. The richness of the oases (for example, Gaotai, on the Silk Road in Kansu) and the well-deserved fame of the melons of Hami and Tunhuang, suggest that given irrigation, almost anything will grow on the sandy soil. It would seem that the main need for the north-west is the introduction on an enormous scale of modern agricultural methods. For example, on the rolling loess highlands between Tienshui and Lanchow, especially south of Huadjialing, the whole area could be put under fruit-trees, taking advantage of the lower southern slopes. Given then improved transportation facilities and a canning industry to take care of fruit surpluses, the area could become of great importance for the improvement of the national diet. Szechuan, again, perhaps the original home of the orange, suffers to-day from periodic gluts, which, if cold-storage plants and means of making ascorbic acid concentrates were available, could readily abolish vitamin C deficiency in large parts of China.

Animal husbandry, too, has great importance for Chinese Central Asia. The pastoral culture of many of the tribal peoples such as Mongols and Qazaqs was, and is, based on it, but Tibetans and Chinese also have many flocks and herds. Government sheep-improvement ranches are maintained at Minhsien and Yungchang in Kansu. Both the U.S.S.R. and New Zealand, at the request of Dr. Ku Chien-Chi (now scientific adviser to the Sinkiang Government, then of the Kansu agricultural service) have sent sheep to improve local stocks, and artificial insemination is now being undertaken. The 150 New Zealand sheep of various breeds are still, however, undergoing an odyssey; destined in the first place for the Burma Road via Rangoon, that city fell before they arrived, so they were sent to Calcutta instead; then after an ineffectual attempt to get them in through Assam, they were driven up to Lhassa in Tibet, and at present are somewhere on the road between Lhassa and Lanchow.

Besides the vaccine production institute already mentioned, there is another for veterinary sera at Lanchow, directed by Dr. Frank Liu under the Ministry of Agriculture. Since no refrigeration plant is available, the products are stored underground with ice from the Yellow River, which often freezes over in winter.

The reader must now imagine himself transported away up the Silk Road to a location in Central Asia which cannot be named or identified for security reasons, namely, the oilfield which to-day supplies the greater part of the petrol used by the Chinese. On the way, he will have passed for many miles along the Great Wall, and will have observed the triangulation tripods of the Chinese Geological Survey on some of the towers. At the oilfield, men from the Royal School of Mines (of South Kensington) are prominent; such as Dr. Shao I-Chou, who capably seconds Dr. Sun Yu-Chi as manager, and the oil geodesist, Dr. Ong Wên-Po. The field is one of the highest in the world, lying among the largely unexplored ranges of the Chilien Shan, and the issuing oil is probably the coldest, thus giving rise to special difficulties not met with elsewhere. The refinery, under the oil chemist, Dr. Chin Kai-Ying, produces all grades of petrol and light oils, waxes and greases. It seems clear that the field is a good deal larger than had hitherto been believed, and should be a highly important factor in post-war Chinese industrial prosperity. Nor does it stand alone, for seepages of oil occur all down through the Province of Kansu. They have been known to the peasants probably since remote antiquity, and have been used by them for greasing axles of country carts as well as medicinally; they account undoubtedly for mentions of oil by Marco Polo and for the accounts of "weak water" in other ancient and medieval writings.

Finally, the reader will remember that this region is one of the classical areas of the whole world for archæological exploration. The discoveries of Stein, von Lecoq and Hedin were possible largely because the desert climate preserves all sorts of antiquity in the most perfect way. One has only to dig in the rubbish-heap beside some deserted Han fort to find shards of Han basins, cloth belt of the Tang, a rope-end of the Sung, and broken pottery of all periods. So also the painted plaster surfaces of Lamaist stupa-tombs last in the open air surprisingly for centuries. Some fifteen miles south of Tunhuang, on the Kansu-Sinkiang border, lies the historic site of Chienfotung ("Thousand-Buddha Caves"). Here, for a distance of some two miles along the dry river-bed, the metamorphosed gravel cliff is honeycombed with caves, ranging in size from a suitcase to a cathedral and partially protected from the weather by a small, well-irrigated, and charming oasis.

The walls and ceilings of the caves are covered with well-preserved fresco paintings of all periods from early Wei through Sui, Tang, and Sung to Yuan (A.D. 380–1360), mostly of the earlier periods, illustrating the daily life of the people as well as the rites and ceremonies of the various forms of the Buddhist religion. They constitute, indeed, owing to the perishable nature of traditional Chinese architecture which used wood rather than stone, the greatest natural museum of art and archæology which China possesses. In one of these caves it was that Stein discovered long ago the famous hoard of Tibetan, Manichaean, Sogdian, Sanskrit, and Chinese books, much of which is to-day in the British Museum. In the oasis there is now a Tunhuang Research Station under the Ministry of Education; but unfortunately, in war-time, little has been done to preserve the caves, the painted plaster walls and statues in which do show a certain tendency to break away and spoil. It is a remarkable comment on Chinese traditions of scholarship, however, that in the middle of a war such as the present, their Central Press Agency should maintain at the caves a group engaged on a systematic photographic survey of the frescoes. This site will certainly in the future be the scene of further great discoveries of Chinese archæology.

[1] NATURE, **152**, 9 (July 3, 1943).
[2] NATURE, **152**, 36 (July 10, 1943).
[3] NATURE, **152**, 64 (July 17, 1943).
[4] NATURE, **152**, 343 (Sept. 25, 1943).
[5] NATURE, **152**, 372 (Oct. 2, 1943).

PHOTOGRAPHIC PHOTOMETRY

A SYMPOSIUM on "Microdensitometry and Microsensitometry" was held at the Royal Photographic Society's House in London on January 29. It was attended by members of the Royal Photographic Society and of the Association for Scientific Photography. There were four speakers: Dr. G. B. Harrison of the Research Laboratories of Ilford Limited; Dr. A. Hunter of the Royal Observatory, Greenwich; Mr. A. R. Stokes of the Crystallographic Laboratory, Cambridge; and Mr. D. M. Smith of the British Non-Ferrous Metals Research Association. Dr. H. Baines, vice-president of the Royal Photographic Society, was in the chair.

After formal opening of the proceedings by the chairman, the subject was introduced by Dr. Harrison. He said that his task was to remind the audience of the more important factors which have to be borne in mind in accurate photographic photometry, particularly microphotometry. After pointing out that photographic materials, being sensitive to light, lend themselves to the comparison of light intensities, he said he wished to emphasize the fact that the use of photographic materials for such purposes is not without pitfalls for the unwary. Photographic photometry is based on the assumption that if two exposures are made on two different regions of the same photographic material, and these exposures are equal in all respects, then the densities produced by the two exposures will be equal. By exposure is meant the total amount of light received, which is the illumination multiplied by the time of exposure. It will be recognized that this assumption is only true under certain conditions, and a thorough knowledge of these limiting conditions is necessary to avoid the pitfalls and to pick one's way skilfully between them.

In practice, the magnitude of the test exposure to be measured will not be known, and it is necessary to record on the photographic material a range of exposures so that a curve relating some function of the exposure to the density produced can be drawn. It is in the application of this series of exposures that lies the key to accurate photographic photometry.

Dr. Harrison then reminded the audience of the requirements, which he said must not be regarded as placed in order of importance, because this depends on the conditions of the work in hand. The calibrating exposures should be similar in size, shape and surroundings to the test area. This arose because the density developed in any given area of material may be influenced by the density being developed in an adjacent area. The fact that the sensitivity varies with wave-length of radiation is so well known that it is obvious that the calibrating source should have the same spectral emission as the test source. Although the photographic material records the total amount of light, it is not indifferent to the way in which it is received. A high intensity for a short time does not give the same density as a low intensity for a long

time, even though the total light received be the same. An exposure broken up into several shorter exposures may not give the same density as a continuous exposure of the same total light value. It is therefore necessary to ensure that the calibrating exposures have the same distribution in time as the test exposures, the intensity only being varied. The test and calibrating exposures should be separated by as short an interval of time as convenient, and if the interval has to be appreciable, a relatively long time should lapse before development. This precaution is occasioned by the possibility of changes in latent image after exposure and before development.

Having thus applied the calibration exposures, it is necessary to secure as uniform development as possible, and to measure all densities on the same densitometer. The particular type of densitometer used is of little importance provided it is capable of giving reproducible results.

Dr. Harrison said he had laid down briefly certain ideals to aim at, and he fully realized that it seemed a discouraging prospect, particularly as the practical conditions of the work frequently preclude the possibility of satisfying all the points enumerated. It is in these circumstances, however, that a full knowledge of the limitations of the photographic process is so valuable in enabling the user to judge, or better still determine, the penalty he will have to pay, if any, for neglecting any of the fundamental requirements. In fact, the art of photographic photometry may be said to lie, not so much in the ability to satisfy all requirements, as in the ability to minimize the consequences of the inability to satisfy all.

Dr. Hunter then followed with an interesting paper on the use of microphotometry in astronomy. He said that photography is probably the astronomer's best friend because it is capable of recording total light and can integrate that light over long periods of time, and because it provides a permanent record. It is surprising how much useful information is obtained as a result of a re-examination of old plates in the light of new discoveries. The main use of photographic photometry is in the measurement of stellar magnitudes, and in the recording and measurement of stellar spectra. The latter give valuable information on temperature, and the Stark and Doppler effects yield data on mass and velocity respectively. The wave-length range concerned usually lies between 3,000 and 10,000A., though astronomers are generally rather suspicious of the behaviour of photographic materials at very long wave-lengths. To give some idea of the light intensities involved, he said that a first magnitude star provides an illumination of about one millionth of a metre-candle, and although the telescope might increase this by about a thousand-fold, it is still a very low level of illumination. When spectra are being recorded, it is, of course, lower still.

Referring to the requirements enumerated by Dr. Harrison, he said that frequently they cannot all be satisfied. For example, if the star image be formed on the slit of a spectrograph, the varying refraction of the atmosphere causes the image to move about, and in any event since the image is necessarily small, it is often artificially moved up and down the slit during the exposure to increase the effective height of the recorded spectrum. The exposure is therefore intermittent, though the calibrating exposure is normally continuous.

Perhaps a more flagrant breach of the conditions occurs when the calibrating exposure time differs from the test exposure time. Exposures are sometimes necessarily lengthy, and it is inconvenient to make the calibrating exposures of the same length. It is recognized that this procedure may lead to errors, and Dr. Hunter recalled an investigation he had made to determine the magnitude of the effect in relation to a series of experiments he was making. The calibrating exposures were made with an exposure time of 20 sec. and the test exposures varied from 20 sec. to more than 500 sec. The error was found to be appreciable and to vary with the type of plate used. He was able to obtain a relationship between observed and true stellar magnitude, so that a correction could be applied according to the test exposure time.

Dr. Hunter then discussed the question of the microdensitometer. He pointed out that most instruments give a record of the variation of transmission against position on the plate. What is really required is the curve of density against position, which can only be obtained by laboriously going over the transmission curve, taking the logarithm of the reciprocal of the transmission, and replotting. He showed diagrammatically the principle of a recording microdensitometer developed in Holland just before the War, which consisted in an addition to be fitted to any existing densitometer. The Dutch succeeded with this instrument in making a new atlas of the sun's spectrum which is already yielding valuable results. The chief drawback to this instrument is that a template has to be placed in part of the optical system of the subsidiary unit, and the shape of the template depends on the characteristics of the photographic material at the wave-length being measured.

In the United States a much more elaborate instrument has been built which overcomes this difficulty. The test spectrum and calibrating plate are both placed in position on the table of the instrument and the preparation of the density record is fully automatic. The instrument is said to be accurate, and a slide was shown of duplicate traces showing extremely good reproducibility.

The meeting was next addressed by Mr. Stokes, who commenced by briefly describing the fundamentals of X-ray crystallography with special reference to the Debye-Scherrer method. The specimen, consisting of a single (rocking) crystal or a 'powder', is placed at the centre of a circular camera carrying a strip of film located on the circumference of a circle with the specimen at the centre. A narrow pencil of X-rays as nearly monochromatic as possible is incident on the specimen, and the emergent beam is trapped to avoid scattered radiation in the camera. The lines in the spectrum are reflected at different angles depending on the lattice structure of the crystal material and the wave-length of the incident radiation. The wave-length range with which the crystallographer is concerned is 0·5–2·5A. The width of the lines obtained depends on several factors, among which is the perfection of the crystal lattice itself. The line width is usually of the order 0·5 mm. on the film.

With reference to the requirements laid down by Dr. Harrison, Mr. Stokes said that the crystallographer is probably in a privileged position in that the photographic material does not exhibit reciprocity failure when exposed to X-rays. It is therefore possible to make the calibrating exposures by means of a time scale, for which a sector wheel giving exposures increasing in arithmetical progression is

used. From density measurements on these regions a curve relating density to exposure can be drawn. This usually yields a straight line up to a density of about 1·5.

Mr. Stokes raised the important question of the effect of the size of the slit of the microdensitometer. The error introduced can be corrected by formula. In this connexion figures were given for the variation of observed density due to the graininess of the photographic material. The variations are appreciable, and it was pointed out that the height of the densitometer slit is limited by the fact that the spectral lines are curved, particularly at large angles of reflexion.

Another interesting point concerns the difference between the appearance of the X-ray spectrum and the recorded trace. A slide was shown illustrating a series of spectral lines and the corresponding density trace. The appearance of one of the lines suggested that there were two lines close together, one being much denser than the other. The densitometer trace revealed that the less dense 'line' was no more than a barely significant shoulder on the record of the line. The second peak was, in fact, not a peak at all, but merely an indication of the existence of a point of inflexion in the density trace. The slide showed the method of taking account of the fog or background which is nearly always present and usually increases towards the position of zero deflexion of the incident beam. It is usually possible on the density trace to draw a smooth line passing through the minimum density positions.

The use of photographic photometry in quantitative spectrum analysis was dealt with by Mr. Smith. The spark spectra of metals or alloys containing small quantities of impurities are recorded photographically, the most important region being in the ultra-violet from about 2,300A. to 4,500A. Spectrum analysis is most useful when the impurities are present in amounts less than about 2 per cent. The principle of the method is that the intensity of an impurity line is related to the intensity of a basis metal line according to the percentage impurity present. The procedure is to prepare a series of standards containing known quantities of impurity, and, by comparing the relative densities of basis metal and impurity lines, to determine the percentage corresponding with the relative densities obtained from the test sample.

Accurate calibration of the plate presents difficulties peculiar to the problem. Since a light source similar in constitution to the test source is required, a spark source is indicated; but unfortunately this is variable in both intensity and in the relative intensities of the different lines. The simplest and probably the most accurate method is to photograph a range of standards samples on each plate; but this has the disadvantage that it leaves less room for test exposures, it rapidly consumes carefully prepared and analysed standards and it appreciably increases the time taken. Another method is to use a rotating stepped sector in front of the slit. This method yields an intermittent calibrating exposure, but it has been claimed that this is permissible provided the sector disk is rotated at a rate of 200–300 r.p.m. The intermittency effect can be overcome by using a stepped density wedge in place of the sector shutter, but this has been little used owing to the difficulty of obtaining satisfactory densities which are neutral over the requisite wave-length range.

Mr. Smith believes that the chief sources of error lie in the inconsistency of the light source, and that errors in the photographic process play a relatively unimportant part. He hopes that the reproducibility of the source will be improved in the near future.

Some discussion took place after the papers in which questions of detail were asked. Mr. L. V. Chilton agreed that photographic photometry has its difficulties and that a complete understanding of the principles involved is essential to success. On the other hand, microphotometry has its own particular difficulties, and though some of the speakers had indeed dealt with certain aspects, there are many interesting points peculiar to this field which could profitably be discussed in detail.

THE FOREST AS A FACTORY

By PROF. E. P. STEBBING
University of Edinburgh

IN a memorandum written for a Government conference last summer, I made the statement that the forest is a "factory" just as much as a factory turning out tanks or aeroplanes. The statement appeared to create some surprise. Let us consider how it may be justified though, with the exception of India, inadequately recognized in that great organization the British Empire and Commonwealth of Nations.

We will first look at India; in spite of the fact that many heads of the other forest services hold that Indian forestry conditions, with all their great range of climate, soils, species, plains and mountains, are not applicable to conditions outside that country. During the War of 1914–18, India very soon found herself, owing to deficient shipping, deprived of many imported goods and left to her own resources. The forests, with an adequate forest staff for the purpose, were soon called upon to supply large military and civil requirements; and the young Forest Research Institute played a remarkable part in assisting in this matter. This is familiar history. Once again, in the present War, the same position has had to be faced in India on an even larger scale. Once again her forests, having been under a conservative management for just eighty years, under an adequate forest staff and assisted by one of the biggest and best equipped forest research institutes in the world, have proved adequate to the call upon their resources.

An examination of some of the War publications from the latter, *Records*, *Bulletins* and *Leaflets*, prove, if proof be necessary, that the forest is merely a giant factory which in combination with the work of the research officer (for example, in an aircraft factory where the combination is now fully recognized) can face new demands, provided a sufficiency of labour is available. Examples of this work have already been given in these columns (NATURE, **153**, 201; 1944). They furnish evidence of how research, with the forest to provide the necessary raw materials, was able to come to the assistance of the Fighting Services, as well as civilians, when imports of many kinds ceased. The research part of the 'factory' solved the problem of finding a substitute article for the one which could no longer be imported; the 'forest factory', according to location of supplies, well known to an organized department, provides the raw material; and the third 'factory' in the business, the only one recognized by so many, makes up the article. But the third would have been non-existent

had not the second existed. A prerequisite to all this organization and its successful issue, without over-exploiting or devastating the national forests, the ownership of which is—or should be—vested in the peoples of the country, depends upon an adequate forest staff, and a working knowledge by the latter of the whole of the forest areas of the country concerned.

A study of recent annual reports of some of the Colonial Forest Services is by no means so reassuring. In many instances the 'forest factory' is being heavily exploited for war requirements without the requisite safeguards, which are adequate knowledge of the contents of the forests and a sufficient staff to superintend excessive fellings. The capital of the country, which belongs to the people of the country, is consequently being dissipated.

Reference has already been made to the heavy unsupervised fellings being made in the United States in the Douglas fir and companion species, West Coast hemlock, Sitka spruce and Western cedar forests to supply war-time demands (NATURE, 152, 651; 1943). Another instance of the same is quoted from Alaska. In the rain-drenched Tongass National Forest of the unknown south-eastern Alaskan panhandle, a forest larger than the State of Western Virginia, is situated what is said to be the world's last great reserve of Sitka spruce, the pre-eminent aircraft timber. Many thousands of these great trees, with a height of 200 ft., 80 ft. clean bole to first branch and 6 ft. diameter at breast height, were felled in 1943; the War Production Board, with much of the best forests in Oregon, Washington and British Columbia cut over, having arranged to open out the Alaskan wilderness.

Many examples from recent publications could be culled to show the position the forest occupies in a country in periods of stress when that country can no longer rely on imports of certain staple commodities. The forest at once forms one side of the 'factory'. Without the forest several types of factory, including one of the latest, the plywood factory, would not exist. No commercial man would consider it possible to run a factory in peace- or war-time without the necessary trained supervisory staff to ensure efficient output and a continuity in that output. Any attempts to reduce such staff as redundant would be met with suspicion and a *non possumus*. Further, it would be equally recognized that to ensure that a continuity of output is maintained supplies of the necessary raw materials must be available in the amounts already calculated.

How does the 'forest factory' come off in this respect? A study of even the few instances given above serves to show that the position of the forest as regards the supplies it affords to the factory dependent upon it and its relation to that factory is rarely understood. The idea appears to be still held in some quarters that the forest can go on supplying indefinitely the products required from it with a very inadequate supervisory staff, if indeed any such staff is present; whereas the truth is that this type of utilization of the forest results (far quicker in war-time) in its gradual exhaustion, and with the latter the collapse of industries and their man-power dependent upon them. For a forest is a delicate organism and easily ruined by ill-judged fellings.

How is the forest to be maintained and safeguarded? To rehabilitate a forest which has been wastefully and ignorantly exploited, in the absence of expert supervision controlling the work, will take a century or more, if timber is the desideratum. How is a continuity of material from the forest and the consequent continuity of the factories dependent upon it to be maintained? A trained and expert staff is necessary for the factory. Equally so for the forest. If, as so often in the past in the British Empire, such a staff is only brought in in inadequate numbers after the forests in question have been partially or totally ruined by over-exploitation in one or other of its many possible forms, a long and uphill struggle has to be faced and considerable expense. Trees are not agricultural crops; they require considerable periods of time to produce what is required; even if only of small size such as pitwood, fuel plantations and so forth. In the absence of a trained staff, an ignorantly exploited forest, if of conifers, may result in the total disappearance of the forest from the area; if of hardwoods, the same may take place, the time elapsing being much longer. But the final results in many cases may be the disappearance of the population which lived in that neighbourhood. History has already witnessed whole populations moving to more salubrious parts or gradually dying out owing to the destruction of the neighbouring forests, with the consequent impoverishment of the soils and the diminution of the water supplies. In former times the aftermath of forest destruction and impoverishment of the soils only made its appearance over long periods of time; not so nowadays. With increased populations, with increased methods of rapidly exploiting rich forest areas, and greatly improved methods of transport, a forest can be destroyed, so far as its future usefulness to man is concerned, in a comparatively short time, even in days of peace.

In times of war and stress, an accessible forest and, with expense no object, previously so-termed inaccessible forests, unless under the watchful supervision of their only possible guardians, the trained forest officers, fully acquainted with their regions and in sufficient numbers to enforce correct methods of working, can be exploited and ruined in a very short space, as in the American examples quoted above.

In connexion with the improvident and ignorant utilization of the forest by the populations inhabiting the regions in the past, alluded to above, the present-day consideration being paid to soil conservation schemes both in parts of the Old World and the New merits mention here. Perhaps the most modern examples of the ignorant treatment of forest and agricultural soils is to be seen in the popularly termed 'desert bowls' in the United States and parts of Canada; and also in Australia. As a result, thousands of farmer families have had to emigrate, the once fertile regions having been reduced to desert conditions. But the world has had for long many older examples, and over wider regions, of this misuse of the land and its vegetation. The British Empire affords many illustrations, of which large stretches in Africa offer examples. This position is at length being considered from the only possible practical aspect, to wit, soil conservation schemes—schemes the primary objective of which is to stay the further desiccation and spread of desert conditions, coupled, as they invariably have been, with lessening rainfall and water supplies and the migration of the peoples affected.

Excellent examples of the modern changed attitude to this question are afforded by the Governments of the Sudan and Kenya. These Governments have apparently realized that soil conservation must be

approached by bold schemes, not by small experiments of merely local interest having little reference to the broad requirements of the country affected as a whole. In the Sudan, an active soil conservation policy is under consideration. The sitting committee has adopted, it is understood, a comprehensive programme for which a considerable sum has been earmarked, and which, if and when put into force, will immediately provide employment for a portion of the demobilized native troops. In Kenya, projects of development are foreshadowed. The principal scheme is one for soil conservation, for which it is said a sum of £940,185 has been allocated.

The forester will indubitably take an active part in this work; for trained supervision will be essential if money is not to be wasted. One of the forester's jobs will be an endeavour to replace blocks of forest on the ruined and impoverished soils, the primary purpose of which will admittedly be a protective one while assisting in the restoration of the soil water supplies. But as the secondary objective, these forests will in time serve as the factory from which produce will be available to an increasing population returning to a formerly destroyed but now rejuvenated area.

These are neither visions nor dreams. But to understand the job and its possibilities, it will be at least necessary to allow those whose business in life it has been to study, consider, and interpret the factors concerned, to prescribe the possible practical remedial measures to be put into force and, in addition to the necessary funds, to ensure that a trained staff in the necessary numbers is forthcoming.

PRENATAL MORTALITY AND THE BIRTH-RATE

By Dr. A. S. PARKES, F.R.S.

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MAXIMUM reproductivity in a monogamous society requires that males and females of appropriate age shall be available in approximately equal numbers. A considerable excess of one sex or the other will decrease the reproduction-rate. In practice, there rarely seems to be an excess of males of this age; among European races a slight excess of females is usual. War, or other events involving a differential toll of men of reproductive age, naturally exaggerate the excess of females. In England and Wales before the War of 1914–18[1], there was an excess of some 649,000 or 8·7 per cent of females over males, at ages 20–45 years. For several years after 1918 the excess was more than a million, being about 1,050,000, or 13·4 per cent in 1925[2]. Ten years later, in 1935[3], the effects of the war were disappearing and the excess of females was down to 658,000, or 7·9 per cent, but it may well increase again considerably as a result of the present War. The surplus women, on statistical grounds alone, are evidently unable to get married in Great Britain, and the great majority of them, therefore, are sociologically sterilized. The number represents an appreciable percentage of the females of reproductive age, and this sociological sterility is a not inconsiderable factor in birth-rate problems. Groome[4] calculated that an increase in the net reproduction-rate of some 15 per cent would be expected to result from equalizing the numbers of males and females of reproductive age, even without any increase in the total population.

The only immediate solution of this problem of sociological sterility, whether due on a smaller scale to natural causes or on a larger scale to war, lies in a fundamental change in our social conventions. There are, however, other possibilities for a longer term policy. The excess of females is not found at all ages. In England and Wales, about 104 males are born to every 100 females. According to Russell[5] the mean ratio for 1838–1933 was 104·3, the range of yearly variation being about 103–106. The highest ratio was recorded in 1919, and this apparent effect of war conditions is confirmed by evidence from other countries and by the fact that during the present War the ratio has again risen to more than 106. The effect may well, as Martin[6] suggests, be due to lowering of the age of parents. The excess of males at birth is only temporary. Infant- and child-mortality fall differentially on the males, and the excess found at birth is abolished before or early in the reproductive period, and thereafter there is always an excess of females. The reduction in the infant and child mortality-rate has been associated with a raising of the age at which the excess of males disappears and a decrease in the excess of females in later age groups, but it is not certain that this factor will operate any further.

The purpose of this note is to lay emphasis on another aspect of the differential mortality problem, the prenatal wastage of lives, particularly of male lives. The amount of prenatal mortality from the time of conception to the time of birth is known to be considerable in many mammals, figures so high as 40 per cent or more having been determined. In man, the prenatal mortality cannot be estimated with any accuracy, but it is probably at least 20 per cent and may be much higher. Most of the information then available on this subject was summarized by me[7] some years ago.

This prenatal mortality in man will not depress the birth-rate to a corresponding extent, since it must often happen that, where fertility is good, the unsuccessful termination of one pregnancy allows of another one which would not otherwise have occurred. Nevertheless, it must exert a certain influence, and it is clear that a substantial decrease in prenatal mortality would lead to a rise in the birth-rate. More important, however, is the sex incidence of abortions, etc., which has been the subject of a number of researches. The earlier literature is summarized in the review referred to above. Almost all investigators agree that prenatal loss, like infant mortality but more so, falls differentially on the males. Auerbach[8], for example, found that there were 156 males per 100 females among more than 4,000 fœtuses aborted between the fourth and seventh months. The proportion of males was greater among the younger abortions. More recently, Russell[5] has given figures from American sources in which prenatal deaths under four months included 375 males per 100 females.

Two implications follow from observations such as these. First, it is quite clear that in man, as in some lower mammals, the proportion of males is much higher at conception than at birth. Anything approaching accuracy is impossible in the present state of our knowledge, but it is likely that in man there are at least 120 males to every 100 females at conception. This conclusion is curious in the light of the fact that *X*- and *Y*-spermatozoa are produced in equal numbers; but various explanations, which

are outside the scope of this article, can be offered. Secondly, it is evident that the amount of prenatal mortality must have considerable influence on the sex-ratio at birth. Many years ago, Tschuprow[9] concluded that the sex-ratio at birth was largely determined by the amount of prenatal mortality. This generalization requires various qualifications—allowance for the sex-ratio at conception, for example—but all subsequent work has tended to emphasize the influence on the sex-ratio at birth of the decrease in the proportion of males which takes place during the gestation period. For example, the greater number of males born to younger mothers is probably due to decreased prenatal mortality[10].

From the point of view of population problems, the important aspect, as Groome[4] pointed out, is that a substantial decrease in prenatal mortality would give an increase in the proportion of males born. If the sex-ratio at conception is 120, and 20 per cent of the fœtuses, having a sex-ratio of 200, die before term, then the ratio at birth will be a little more than 106. If the prenatal mortality were halved and retained the same sex incidence, the ratio at birth would be more than 113. Such an increase, coupled with the present reduction in infant mortality, would ensure an excess of males at reproductive ages and would do much to reduce or abolish the excess of females with no chance of marriage. This long-term effect would seem to be of real potential importance in counterbalancing the declining birth-rate, and an intensive programme of research on the causes and prevention of prenatal death offers one of the more promising medical contributions to the problem. Such a line of attack, unlike many projects designed to raise the birth-rate, could arouse opposition only from the sternest exponents of the principle of natural selection.

[1] Registrar General's Statistical Review, 1913.
[2] Registrar General's Statistical Review, 1925.
[3] Registrar General's Statistical Review, 1935.
[4] Groome, J. R., *Eug. Rev.*, **29**, 154 (1937).
[5] Russell, W. T., *J. Hygiene*, **36**, 381 (1936).
[6] Martin, W. J., *Lancet*, **245**, 807 (Dec. 25, 1943).
[7] Parkes, A. S., *Biol. Rev.*, **2**, 1 (1926).
[8] Auerbach, E., *Arch. f. Rassen. und Gesellschafts Biol.*, **9**, 10 (1912).
[9] Tschuprow, Al. A., *Bull. Inst. Int. Stat.*, **20**, 378 (1915).
[10] Parkes, A. S., *J. Genetics*, **14**, 39 (1924).

NEWS and VIEWS

Sir Napier Shaw, F.R.S.

ON March 4 Sir Napier Shaw attains the age of ninety years. The present generation may be surprised to know that he had a distinguished career as a physicist before he took any part in meteorology. He was educated at King Edward's School, Birmingham, and at Emmanuel College, Cambridge, of which he was fellow during 1877–1906. He was University lecturer in experimental physics during 1887–99, and with Sir Richard Glazebrook was demonstrator in physics at the Cavendish Laboratory; their joint "Text-Book of Practical Physics" was a household word to students of physics of a generation ago. Sir Napier was elected to the Royal Society in 1891 and it was not until six years later that he was officially connected with meteorology, when he became a member of the Meteorological Council, a body responsible for the Meteorological Office. He became director of the Office in 1905. Then under his influence began a period of great advances in the science along many lines. He had the gift of stimulating the interest and enlisting the help not only of those working directly under him, but also of those outside his official orbit, and his ungrudging help is gratefully remembered by many.

Sir Napier retired from the Meteorological Office in 1920, but he did not retire from meteorology; in 1926 there appeared the first volume of his monumental "Manual of Meteorology", completed in 1931; a second edition of volume 2 appeared in 1936. A much enlarged and revised edition of his "Drama of the Weather" appeared so lately as 1939. These works show Sir Napier's energy at an age when many would have rested on their laurels. Honours have been showered on him by universities and societies both British and foreign. He was knighted in 1915. He was president of the International Meteorological Committee during 1907–23, of the Royal Meteorological Society during 1918–20, of Section A (Mathematical and Physical Sciences) of the British Association in 1908, and of Section L (Education) in 1919. In 1885 he married Sarah Harland, who ably helped him, whether when he was tutor of his College or later when he had to preside over meetings national and international; she died in 1923. Meteorologists and many others will join in all good wishes for Sir Napier's ninetieth birthday.

John Theophilus Desaguliers (1683–1744)

IN the later years of Newton's life, there were few figures better known among the men of science in London than that of the short, thickset, near-sighted but broadminded and generous Frenchman, John Theophilus Desaguliers, who died on February 29 two hundred years ago in his lodgings near Covent Garden. Born at La Rochelle on March 12, 1683, he was brought to England by his father at the Revocation of the Edict of Nantes in 1685, and spent the remainder of his life here. At first his father was minister of the French chapel in Swallow Street, London, but also had a school at Islington. The son helped his father and then proceeded to Christ Church, Oxford, and after taking his degree qualified for the Church. In 1710 he was appointed successor to Keill as lecturer in natural philosophy at Hart Hall, and three years later removed to Westminster, living first in Channel Row and then over the Bedford Coffee House, lecturing with great success year after year to "persons of all ranks and professions and even the ladies". He gained a reputation, too, by his translation of s'Gravesande's "Elements of Natural Philosophy". For many years he was demonstrator to the Royal Society and it was to him that the first actual Copley Medal was given, although both he and Stephen Gray had previously received monetary awards under the Copley bequest. As a clergyman he held various livings, one of these being that of Whitchurch, Middlesex, of the church of which Handel was organist. In his works he gives full particulars of the many experiments he made and also much information about the principal mechanical constructions of his time. His death took place when he was nearly sixty-one, and he was buried in the Savoy. One of his sons, Thomas Desaguliers (died 1788), for many years superintended Woolwich Arsenal, and was the first scientific investigator into gunnery in the British Army.

Pascal's Arithmometer

AT a well-attended meeting of the Newcomen Society held in the rooms of the Royal Society on February 16, Mr. R. Nilsson gave a paper entitled "The Pascal Arithmometer and Other Means to Solve Mathematical Problems". The audience included many distinguished foreigners. Premising that accuracy in calculation is one of the most important elements in scientific progress, Mr. Nilsson said that by a calculating machine is understood a great number of working parts conjoined in action by various mechanisms to obtain arithmetical or algebraic results. Describing in detail, with the use of slides, the arithmometer invented by Blaise Pascal (1623–62) when a youth of nineteen, the author said that Pascal's basic invention was the 'ten-carry-over' which is seen in the counters, meters, cash registers, etc., which are part and parcel of our daily life. Two years were occupied in making the first machine, and more than fifty models were constructed before the machine was in working order. Pascal showed it in 1647 to Descartes and in 1649 to Chancellor Séguier, who helped him to obtain a patent. Mr. Nilsson mentioned the machines which succeeded Pascal's; Sir Samuel Morland's (1666), that of Leibniz (1672), and those of Grillet, Poleni and Charles Xavier Thomas, of Colmar, Alsace, who began the manufacture of calculating machines. In the ante-room was a representative exhibition of machines and documents. In proposing a vote of thanks to the Royal Society for its hospitality, the chairman, Eng. Captain E. C. Smith, said that there could be no more suitable place for the gathering. Pascal was associated with some of the French men of science whose meetings led to the founding of the French Academy of Sciences, and his death coincided with the grant of the Act of Incorporation to the Royal Society.

Ankara University: Opening of Faculty of Science

A NEW Faculty of Science in the University of Ankara was opened on November 8, 1943, in the presence of President Inönü. The President, accompanied by the Prime Minister, Sükrü Saracoglu, was welcomed at the inauguration ceremony by the chairman of the National Assembly, B. B. Abdülhalik Renda. All the members of the Cabinet were present; Mr. R. F. Lucas, of the British Council, was also invited to attend the ceremony. The Minister of Education, Hasan Ali Yücel, in his opening address, referred to Turkish progress during the twenty years since the establishment of the Republic. The consequent changes in the national outlook have developed a need for scientific and technical training which is now enhanced by the mechanization of armed forces in a world at war. Hitherto Turkish educational institutions have lacked equipment for practical training; but Turkey has now an established policy of education based on positive knowledge to reinforce the earlier practice of theoretical training only. The nation needs mechanical engineers, mining and civil engineers, and the great problem of Turkey to-day is to find the means for training students in large enough numbers to satisfy the national requirements without reducing the educational standard. The Government is keenly aware of these needs and has sanctioned the establishment of this faculty as a step to meet them. The assembly was later addressed by the Rector of the Faculty, by a student, and by Prof. Kerim Erin, of the Faculty of Science, University of Istanbul.

The new Faculty is temporarily installed in the Gazi Teachers' Training Institute. The Dean of the Faculty, Bay Hayri Dener, is also professor of physics, and a member of the Board of Education. The chair of chemistry and the presidency of the new Chemistry Institute of the Faculty is held by Dr. Avni Refik Bekman. The Ministry of Education has invited the British Council to nominate British candidates for a professorship in each of the existing Departments of Chemistry, Physics and Mathematics. The establishment of this Faculty thus implements the approval of the Bill recently presented by the Turkish Cabinet to the Chamber of Deputies.

Science in China

A PAMPHLET entitled "The Place of Science in China" by Yap Pow-Meng, honorary secretary of the National Science Society of China, British Branch, published by the China Campaign Committee, 34 Victoria Street, London, S.W.1 (6*d*.), attributes the failure of the scientific method to establish itself in the intellectual tradition of China mainly to social and economic reasons. From the first, the makers of the revolution of 1911 seized upon science as a means of achieving their ideal of a progressive, industrialized China, and the pamphlet gives a brief account of the organization of education in science, of scientific research institutions, including the Academia Sinica, which is essentially an organization providing facilities for scientific research, the National Academy of Peiping, the Science Society of China, the National Science Society of China, the Fan Memorial Institute of Biology, the Henry Lester Institute for Medical Research, and private technical research institutions, of which the most important is the Hangwai Institute of Industrial Chemistry.

The majority of the research institutions of China were founded in the coastal areas and have now been moved to the west and south-west. Apart from those of the Radium Institute of the Peiping Academy and the Metals Research Institute and Science School of the National Tsing-hua University, Chinese researches in physics and chemistry have not so far been impressive, and in China as elsewhere experimental psychology has not made a complete break from the old philosophical psychology. The pamphlet also includes some account of the organization of science in China's war effort under the National Economic Council, the Ministry of Economic Affairs, the National Resources Commission, the Ministry of Agriculture and Forestry, the National Geological Survey and the National Health Administration, as well of the attempts being made to overcome educational difficulties due to the War.

Isinglass as a Substitute for Human Blood Plasma

MANY substances have been tried as substitutes for human blood plasma. Recently (NATURE, **153**, 145; 1944) reference was made to the use of 'despeciated bovine serum'. A recent note (*Edin. Med. J.*, **50**, 758; 1943) describes the use of isinglass, which is available in sufficient quantities and can be cheaply prepared, as a substitute for human blood plasma. Its injection causes no antigenic response. Prof. N. B. Taylor and Miss M. S. Moorhouse (*Canad. Med. Assoc. J.*, **49**, 251; 1943) transfused 25 dogs from which 47–71 per cent of the blood had been bled, with 4 or 6 per cent solutions of isinglass, and most of the dogs made a complete and uneventful recovery. Repeated injections over a period of weeks caused

no changes in the viscera, and isinglass does not interfere with the normal regeneration of the blood plasma. H. E. Pugsley and R. F. Farquharson (*Canad. Med. Assoc. J.*, 49, 262; 1943) gave the isinglass solution 58 times to 51 human patients to test it for pyrogenic and other toxic effects. A slight rise of temperature occurred on eight occasions, but no other unfavourable signs were noted in the other cases. When the isinglass was given to patients suffering from acute hæmorrhage, extensive burns, compound fractures and severe circulatory failure, the results were all good, and there were no toxic effects. The amount given varied from 200 c.c. to an infant to 8,800 c.c., given over a period of three days, to an adult.

Oil from the Sunflower Plants

There are probably few countries of the temperate regions which have a superabundance of fats and oils. War-time conditions, moreover, always accentuate any deficiency, and turn attention upon the possibilities of home production. A recent paper by E. F. Hurt (*J. Roy. Hort. Soc.*, 68, Part 11; Nov. 1943) gives the results of experience with the sunflower crop. Oil from the seeds of this crop is useful for edible and culinary purposes, for making margarine, as food for cattle and poultry, for canning fish and making fine soap. Its gastronomic value is equal to the finest olive oil. The crop is widely tolerant of soil types, but removes large quantities of soil nutrients, most of which are retained in the stalk, and can be returned to the ground after harvest. Sowing the seed at an even depth of 1½–2 in. appears to be important, and 7½ lb. of seed is needed to sow an acre by drill. Sunflower is a good cleaning crop, and appears to be but little affected by disease, though it is susceptible to wireworm attack and the depredations of birds at harvest time. Three semi-dwarf varieties—'Mars', 'Pole Star' and 'Southern Cross'—are suggested for Great Britain, and as the supply of fats and oils may be one of the most acute of post-war agricultural problems, the crop appears worthy of more extended trial.

Thermoplastic Electric Cables

A PAPER on thermoplastic cables, read by Dr. H. Barron, J. N. Dean and T. R. Scott on February 10 before the Institution of Electrical Engineers, reviews the circumstances which have led to a considerable increase in the use of thermoplastic cables within the last few months. It is pointed out that the relative importance of such cables cannot yet be evaluated on a peace-time basis, for the economic level cannot be established and also synthetic rubber is now making its appearance. In order to establish a basis for evaluation, it is desirable to have a thorough understanding of the general characteristics of thermoplastic cables; this is attempted in the paper with particular reference to polyvinyl chloride cables. Indications are given of the polymer situation, the definition of a thermoplastic material and the resulting implications. The building-up and testing of polyvinyl compounds is discussed, and the manufacture, characteristics and uses of cables derived therefrom are considered in detail. A brief survey of other thermoplastics is followed by a comparison of polyvinyl chloride with rubber.

It is concluded that suitably selected thermoplastic compounds can produce satisfactory wires and cables the characteristics of which are such that the corresponding rubber cables can be replaced by these thermoplastic cables. Oxidation need no longer be considered as the predominant factor in determining life; there are still restricting factors which prevent thermoplastic cables from being worked at temperatures appreciably in excess of those suitable for rubber cables; but these factors are of a different nature and may be countered by development and design along lines which would be impracticable for rubber. The cable engineer has acquired a range of alternate materials which, while they present problems of their own, promise interesting solutions for some existing problems. A period of rapid development of wires and cables of compound characteristics must inevitably ensue so soon as free choice, on an economic basis, of such materials is practicable.

Industrial Fire Risks

IN a paper read in London on December 9 before the Institution of Electrical Engineers, Messrs. W. Fordham Cooper and F. H. Mann describe first the classification of buildings and structural materials in relation to fire resistance, and then deal with the hazard from various industrial materials and processes and the special precautions which should be adopted in providing and operating electrical installations in view of these risks. Flame-proof and intrinsically safe constructions are briefly described. The second part of the paper illustrates the application of the matter discussed in the first part; but, as it is impossible to deal with every risk, attention has been particularly paid to the heavy chemical (gas, coke and by-product) and textile industries by way of examples, although some other matters, notably switch and transformer oil-fire risks, are also mentioned.

Tuberculosis in Paraguay

IN a recent article (*Bol. Of. San. Panamer.*, 22, 318; 1943), Drs. A. R. Ginés, A. Alvarez and M. Mercado state that in June 1941 the control of tuberculosis in Asunción was started under the direction of Dr. Angel R. Ginés, and 40,000 persons were examined in the course of a year. In November 1941, the Ministry of Health amended a decree of 1938 making compulsory the X-ray examination of all public officers, public and private employees, teachers, students, labourers, etc. The examination consisted of a tuberculin test, pulmonary röntgenograms or sometimes merely fluoroscopy and a rapid examination of the skin and mucous membranes. The Tuberculosis Dispensary at Asunción, which was founded in 1922, during the first ten years of its existence could treat only general advanced tuberculosis owing to the lack of modern means of diagnosis; but in 1932 a chair of tuberculosis was created and the campaign against tuberculosis now includes a röntgenological and tuberculin survey and a morbidity and mortality survey in the urban areas of the Republic, diagnosis of the disease by modern methods, effective isolation or quarantine of contagious cases, creation of schools for the tuberculous or pre-tuberculous, vaccination of the newborn with B.C.G., economic and social improvements, creation of an Institute of Social Security, intensive educational propaganda, and eradication of tuberculous animals. The tuberculosis death-rate is calculated to be 199·9 per 100,000, and its relation to general mortality is 15·50 per cent. Tuberculosis with other diseases of the lungs caused a third of the deaths in 1941. Relation to the standard of living is supported by the following death-rates:

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merchants 3 per cent, intellectuals 6 per cent, seamstresses, domestic helpers and other employees 10–11 per cent, farmers 22 per cent and labourers 29 per cent. The highest death-rates were noted in the 1–5 year old group and in the 20–40 group.

Immunizations in Large Cities of the United States

In a recent paper (*Public Health Rep.*, 58, 1121; 1943), Selwyn D. Collins, head statistician, and Clara Councill, assistant statistician of the United States Public Health Service, record their study of immunization against diphtheria, smallpox, scarlet fever and typhoid fever based on a canvas of 213,931 households in 23 cities of 100,000 or more inhabitants. Their conclusions are as follows. Immunizations against scarlet fever and typhoid fever are negligible compared with those against diphtheria and smallpox. In the pre-school age immunizations against diphtheria are more frequent than vaccinations against small-pox, but after five years the reverse is true. There was considerable geographical variation in the extent of immunization against the diseases. In the north, for example, the percentages of native, foreign and coloured children of specific ages immunized against diphtheria are approximately the same, while in the south a higher percentage of the native whites is immunized than of the foreign whites or coloured.

Cattle Fodder from Wood

According to an annotation entitled "Fir to Fodder" in the January issue of the *Anglo-Swedish Review*, the Swedish forests provide a practically inexhaustible store of timber which can be converted into fodder for horses and cattle. It can be made from the wood of the fir tree, but pine can also be used. The raw wood has no food value for man, even if ground to a fine flour, as there are no enzymes or micro-organisms in the human digestive tract to dissolve the wood and its cellulose. Cattle and horses, however, can absorb it almost entirely because their digestive organs contain bacteria which can break down the pure cellulose into products which can be absorbed into the blood. To make the fodder cellulose more nutritive and palatable to animals, molasses and sometimes phosphates or salts are added at the pulp mill. Alcohol is also obtained during the process of making fodder pulp.

Research in Human Nutrition

The Medical Research Council has established a Unit for Research in Human Nutrition as part of its staff organization, and Dr. B. S. Platt has been appointed its director. Temporary accommodation has been provided at the National Hospital for Nervous Diseases, Queen Square, London. Some part of the investigations undertaken by the Unit will be directed towards nutrition problems in the tropics. Among other things, Dr. Platt will continue the work, for which he joined the Council's staff in 1938, of co-ordinating a programme of nutritional investigations in the Colonies by arrangement between the Colonial Office and the Council.

Properties and Uses of Diamonds

A research department has been established by the Diamond Trading Company, Ltd., the London office of which is at 32–34 Holborn Viaduct, London, E.C., under the management of Mr. Paul Grodzinski, assisted by a staff of five. The Department is engaged in investigations into the properties of diamonds, their preparation for use and, in particular, their application in industry. An extensive library, built up over a long period of years by Mr. Grodzinski, forms part of the Department, and its information service is available free of charge.

The Night Sky in March

Full moon occurs on March 10d. 00h. 28m. U.T., and new moon on March 24d. 11h. 36m. The following conjunctions with the moon take place: March 2d. 08h., Mars 6° N.; March 2d. 13h., Saturn 3° N.; March 7d. 11h., Jupiter 0·1° S.; March 22d. 16h., Venus 2° N.; March 29d. 23h., Saturn 2° N.; March 30d. 18h., Mars 5° N. The following occultations of stars brighter than magnitude 6 take place: March 3d. 19h. 59·4m., ν Gemi. (*D*); March 28d. 20h. 31·1m., 63 Tauri (*D*); March 31d. 19h. 23·5m., ζ Gemi (*D*). The times refer to Greenwich and *D* refers to disappearance. Mercury rises at 6h. 44m. and 6h. 05m. at the beginning and end of the month, but is too close to the sun for good observation. The planet is in superior conjunction on March 17. Venus, a morning star, rises at 5h. 34m. and 5h. 14m. at the beginning and end of the month, and can be seen only with difficulty. Mars sets at 2h. 54m. and 2h. at the beginning and end of the month and can be seen in the early part of the night. On March 7d. 15h. there is a conjunction between Mars and Saturn, Mars being 3·4° N. Jupiter is visible throughout the night, setting at 6h. 15m. and 4h. 13m. at the beginning and end of the month. Saturn is visible in the early part of the night, setting at 2h. 40m. and 0h. 49m. at the beginning and end of the month. Spring equinox begins on March 20d. 18h.

Announcements

Dr. Harry R. Ricardo, the well-known consulting engineer and authority on the internal combustion engine, has been elected president of the Institution of Mechanical Engineers for the year 1944–45.

J. P. Rutland (*New Phyt.*, 40, 210; 1941) has published a supplement to the Merton Catalogue of Chromosomes of British Plants. The new list contains about a hundred new chromosome numbers discovered by the author and other workers, and is a valuable contribution to the analysis of the British flora.

The following appointments have recently been made in the Colonial Service: H. Doggett to be agricultural officer, Tanganyika; A. J. Browning to be assistant conservator of forests, Sierra Leone; S. L. Finding to be assistant conservator of forests, British Honduras; H. Tordoff to be assistant conservator of forests, Trinidad; A. W. Vaughan to be veterinary officer, Jamaica; Dr. E. F. Thompson to be fishery officer, Jamaica; D. W. Duthie (chemist, British Guiana) to be soil chemist, East African Agricultural Research Bureau, Tanganyika; A. F. A. Lamb (assistant conservator of forests, Nigeria) to be senior assistant conservator of forests, British Honduras.

Erratum. In the paragraph entitled "Road Research" in Nature of February 12, p. 193, the names of Major H. E. Aldington (chairman) and Mr. W. Savage were inadvertently omitted from the list of members of the committee.

LETTERS TO THE EDITORS

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

Nature of Peptones

IN a letter published in NATURE[1], a method was described by us whereby the ratio

$$\frac{\text{N-total cleavable}}{\text{N-split hydrolytically}}$$

may be easily computed, and hence the extent of cleavage which has been performed by one or several proteinases acting on a given protein or peptone determined. Since then, still more proteins and peptones have been investigated and it seems desirable to give a brief account of the results achieved. It should be emphasized beforehand, however, that the proteins investigated by us generally showed the same behaviour as regards their cleavability by the proteinases employed irrespective of their physical-chemical properties, chemical composition and source of occurrence, as indicated in Table 1 below.

(1) The ratio $\frac{\text{N-total cleavable}}{\text{N-split hydrolytically}}$ as obtained by exhaustive cleavage with pepsin-hydrochloric acid was in all cases equivalent to a Z value of 4 with the sole exception of casein (Table 1).

TABLE 1.

Substrate	Cleaved exhaustively by	N-total cleavable / N-split hydrolytically
Ovalbumin-pepsin peptone	Pepsin-hydrochloric acid	4·02
,, ,, ,,	Pancreatic proteinase	4·02
Pancreatin proteinase peptone from ovalbumin (cleaved exhaustively)	—	3·96
Fibrin pepsin peptone	Pepsin-hydrochloric acid	4·10
Casein pepsin peptone		4·82
,, ,, ,,	Pancreatic proteinase	3·93
Pancreatic proteinase-peptone from casein	Pancreatic proteinase	3·82

(2) All peptones obtained from proteins by incomplete splitting with pepsin-hydrochloric acid (thus leaving a substantial margin for further action by additional enzyme) are split by the succeeding action of purified pancreatic proteinase (tested as to its freedom from protaminase and polypeptidases) to the above ratio of 4 (Table 1).

(3) Exhaustive cleavage by pepsin-hydrochloric acid followed by exhaustive cleavage by pancreatic proteinase reduced the above ratio in all cases to a value of 3 (Table 2).

TABLE 2.

Substrate	Cleaved exhaustively by	N-total cleavable / N-split hydrolytically
Ovalbumin pepsin peptone	Pepsin-hydrochloric acid followed by exhaustive cleavage with pancreatic proteinase	3·18
Casein pepsin peptone	,, ,, ,,	3·10
Fibrin pepsin peptone	,, ,, ,,	3·09

(4) Proteins split by the action of pancreatic proteinase alone were found to give the same nitrogen ratio as obtained by the action of pepsin-hydrochloric acid, namely, 4 (Table 1).

These results are summarized in the accompanying tables.

The peptones prepared from proteins by cleavage with pepsin-hydrochloric acid as shown in Table 1 were not subjected to exhaustive splitting during the process of preparation, since this would involve the addition of substantial amounts of enzyme carrier protein which might cause aberrations from the real N-values, etc., of the substrates investigated. The further degree of cleavage which might be performed by this enzyme or any other proteinase employed in succession had always been observed in enzyme tests and added to the N-value corresponding to the free (NH_2 + NH)-groups found in the peptone (see ref. 1).

A detailed report will be given elsewhere.

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Growth Stimulation of *L. casei* E. by Pyrimidines

PURINE and pyrimidine derivatives have been shown to be growth stimulators for a number of organisms; uracil has been shown necessary for *L. arabinosus* and *Leuconostic mesenteroides*[1], and the anaerobic growth of *Staph. aureus*[2], thymine for *S. Lactis*[1], adenine for *L. arab.*, *L. pentosus*[1], and adenine and guanine for *L. plantarum*[3]. Adenine, guanine, uracil and xanthine have been included in media for the growth of *L. casei*[4,5], and Feeney and Strong[6] have shown adenine and guanine to be stimulatory for *L. casei* E. under certain conditions.

During work on the purification of unknown factors present in liver and required for the growth of *L. casei* E., it was found that the active material displayed properties which suggested the presence of purine or pyrimidine derivatives, and accordingly a number of synthetic compounds were tested for growth-promoting activity. Of those tried only one was found to give any response, namely, orotic acid (uracil 4-carboxylic acid).

A casein hydrolysate basal medium was used, the same as that described by Chattaway, Happold and Sandford[7] with the inclusion of riboflavin (40 μgm./l.) and biotin (5 μgm./l.) and without the addition of a liver eluate. The inoculation was a loopful of a faintly opalescent suspension of bacterial cells in sterile water, and growth was estimated by titration of the lactic acid produced after 72 hr. incubation at 37° C., using brom-thymol blue as indicator. Titrations from 0·5–2 c.c. $N/10$ lactic acid have been repeatedly obtained with the derivative mentioned in a minimum concentration of 0·01 μgm./ml. medium, with no growth in control flasks. The response has varied from time to time and on a few occasions there has been no response, and this is ascribed to variations in the casein hydrolysate used, since the concentration of unknown factors in the hydrolysate may vary. Substances which have been found not to

stimulate acid production either alone or in combination and in concentrations ranging from 20 to 0·01 μgm./ml. are adenine, guanine, uracil, thymine, 4-methyl-5-ethoxymethyl uracil, 4-methyl-4 : 5-dihydro-uracil, 2-methyl-4-amino-5-aminomethyl pyrimidine, 4-methyl-5-amino-uracil and 4-methyl-uracil.

I should like to thank Prof. A. R. Todd and Dr. F. Bergel, of Roche Products Ltd., for supplies of materials, and Dr. F. C. Happold for helpful advice.

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Importance of Pyrimidine Derivatives in the Growth of Group C (Lancefield) Streptococci upon a Simplified Medium

RICHARDSON[1] showed that uracil (2 : 6 dihydroxy pyrimidine) is necessary for the anaerobic growth of *Staphylococcus aureus*, and more recently Snell and Mitchell[2] have reported that purine and pyrimidine derivatives stimulate the growth of certain lactic acid bacteria. Möller[3] had previously claimed that adenine and guanine increase the growth of *Lactobacillus plantanum*. Pappenheimer and Hottle[4] showed that uracil is not necessary for the growth of a strain of hæmolytic streptococcus Group *A*. The latter authors reported, however, that purine derivatives are necessary for this organism unless the carbon dioxide tension in the atmosphere above the culture is high. At a partial pressure of 40 mm. mercury of this gas, rapid and optimal growth occurs without the addition of purines to the medium.

It was found here that a strain of Group *C* (Lancefield) type 7 (Griffiths) hæmolytic streptococcus (called *C*7) gave only slight and variable growth upon a casein hydrolysate medium unless this was supplemented by uracil. The casein hydrolysate basal medium was similar to that designed by Bernheimer, Gillman, Hottle and Pappenheimer[5], except that biotin, which is not necessary for the growth of *C*7 upon the casein medium, was omitted. Bicarbonate, and, of course, uracil were also not added. The growth-factors present were thiamine, nicotinic acid, pyridoxin, calcium pantothenate, riboflavine, adenine and glutamine. It is probable that not all these factors were necessary for the growth of the organism, but they were included in the medium for completeness. The glucose concentration was 0·25 per cent.

Two inocula were used: the first (I) was three drops of faintly opalescent suspension of bacterial cells in isotonic saline per 10 ml. of medium. The cells were from a 6–7 hour broth culture of *C*7 and were twice washed with saline. The second inoculum (II) was three drops of a 1/100 dilution of (I) per 10 ml. of medium.

Table 1 shows the mass of growth, as milligrams of bacterial N per 50 ml. of culture, after twenty-four hours incubation at 37° C. in the medium supplemented by uracil or orotic acid (uracil-4-carboxylic acid).

TABLE 1. INFLUENCE OF ADDING VARIOUS AMOUNTS OF URACIL AND OROTIC ACID TO THE BASAL MEDIUM, UPON THE GROWTH OF STREPTOCOCCUS *C*7.

Mgm. of uracil or orotic acid added per 10 ml. of medium	Growth in mgm. bact. N per 50 ml. of medium					
	Inoculum I			Inoculum II		
	Uracil		Orotic acid	Uracil		Orotic acid
	Exp. *a*	Exp. *b*	Exp. *a*	Exp. *a*	Exp. *b*	Exp. *a*
0	5·9	2·3	6·6	3·8	0·7	3·9
0·005	—	3·4	6·1	5·2	0·7	3·5
0·02	9·2	6·0	7·4	8·1	3·5	7·5
0·10	12·5	—	11·5	—	—	10·8
0·20	10·0	8·6	10·2	10·0	10·0	11·2

The amount of growth which occurred in the media containing only small amounts of the pyrimidine derivatives was variable but did not increase during a further twelve days incubation. The addition to the medium of 10–20 μgm./ml. of uracil or orotic acid, however, resulted in growth as good as that in peptone broth cultures.

Increased carbon dioxide tension up to 50 mm. mercury had no influence on the mass of growth that occurred in any of the media. Complete removal of carbon dioxide from the atmosphere above the culture inhibited the growth of inoculum II but not I, even in the presence of 20 μgm./ml. of uracil.

Four out of five of the strains of Group *C* streptococci of various types which were tested also needed uracil or orotic acid for optimal growth. The two pyrimidine derivatives were equally effective in increasing both the rate and mass of growth of these organisms. Table 2 summarizes these results and includes *C*7 for comparison.

TABLE 2. INFLUENCE OF URACIL AND OROTIC ACID (EACH AT A CONCENTRATION OF 0·10 MGM. PER 10 ML. OF MEDIUM) UPON THE RATE AND MASS OF GROWTH OF GROUP C STREPTOCOCCI. THE INOCULUM USED WAS OF STRENGTH II ABOVE.

Strain	Basal medium		Basal medium + uracil		Basal medium + orotic acid	
	M	*T*	*M*	*T*	*M*	*T*
Mare (2)	++	4 days	++++	40 hr.	++++	40 hr.
Mare (3)	+	5 ,,	++++	20 ,,	++++	20 ,,
Loewentahl *M*	+++	6 ,,	++++	60 ,,	++++	40 ,,
Loewentahl *O*	+++	40 hr.	+++	40 ,,	+++	40 ,,
Human (20)	+	5 days	++++	16 ,,	++++	24 ,,
*C*7	+ to ++	40 hr.	++++	20–40 ,,	++++	20–40 ,,

M equals final mass of growth; *T* equals time to reach maximum growth.

My thanks are due to Dr. F. Bergel, of Roche Products, Ltd., for helpful advice and the supply of growth factors, and to Prof. A. R. Todd for the supply of synthetic uracil and natural orotic acid.

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Sodium Sulphate as an Agent Causing the Development of the 'Chloride-secreting Cells' in Macropodus

IN an earlier paper[1], I have reported the enormous development of the 'chloride-secreting cells' in the branchial lamellæ of the paradise fish acclimatized in a table-salt solution of salinity 27·3 per cent. As these cells are very scanty and rudimentary in the control specimens, the conclusion was drawn, in harmony with the suggestion of Keys and Willmer[2], that they are intimately concerned in the undertaking of osmotic regulation against a hypertonic external medium. The question now arises as to whether the secretory activity of these cells is restricted to chloride alone, as their name implies, or is of a more general nature, capable of turning out salts other than chloride.

To shed light on this problem, I have conducted an acclimatization experiment on *Macropodus opercularis* similar to that described in the earlier paper (*vide supra*), except that Merck's extra pure crystals of Glauber's salt ($Na_2SO_4.10H_2O$) was employed in substitution for the table-salt. Commencing on March 12, 1942, 0·5 gm. of that salt was introduced daily into the 3,000 c.c. jar, which housed four individuals, until May 10 inclusive. Then the daily dose was increased to 1 gm. from May 11 to May 20 inclusive, to 2 gm. from May 21 to June 9 inclusive, to 3 gm. from June 10 to June 19 inclusive, and up to 4 gm. from June 20 to June 24 inclusive. At the close of the course of acclimatization, the *milieu extérieur* was composed of a Glauber's salt solution of 3·83 per cent strength (since a total of 115 gm. had been dissolved in 3,000 c.c. of water), and in this the fish lived, apparently with depressed appetite, for four days before they were killed and their gills fixed (on June 29). Microscopic examination revealed quite a number of the 'chloride-secreting cells' at the base of the branchial lamellæ, the larger ones of which sometimes measured $12\mu \times 9\mu$ in size. Although not so prominent as those acclimatized in the table-salt solution, these cells are clearly evident and much more well-developed in comparison with the control specimen, so it is scarcely possible for them to be wrongly identified.

The result thus obtained points to a non-specificity of the secretory activity of these cells. As the external medium is practically chloride-free and owes its osmotic gradient exclusively to the sulphate, there is no reason to think that these cells should secrete chloride instead of sulphate under such a condition. The development of such cells in a hypertonic sulphate solution can most easily be interpreted on the assumption that these cells are secreting the sulphate, for in this way water could be freed and osmo-regulation effected. Accordingly, I suggest that the substance destined to be secreted would not necessarily be chloride in all instances, but would vary according to the chemical nature of the environment, and would probably correspond to the osmotically active substance in the external medium. In the case of a marine environment, the osmotically active substance is naturally the chloride, hence chloride is secreted by these cells[3]. In the present experiment, however, sulphate should be expected, inasmuch as it is the only osmotically active substance present.

That the 'chloride-secreting cells' develop in response to a sulphate medium tends to weaken the conclusion reached by Smith[4] that "SO_4, like Ca, Mg and PO_4, is excreted exclusively by the kidneys". According to his opinion, sulphate should combine with sodium, to be excreted afterwards by the kidney, as he puts it: "In the absence of other salts, SO_4 takes Na into the urine with it, . . ." If so, then the burden of osmotic regulation in a hypertonic sulphate solution would appear to have been borne by the renal organs rather than the gills. But this is wellnigh impossible in view of the osmotic limitation of the fish kidney. Based on the result of the present experiment, considering the 'chloride-secreting cells' as the anatomical basis for hypertonic excretion, I suggest that divalent ions, at least the sulphate, might also be secreted extra-renally by these cells. Determination of the secretion of these cells by direct chemical methods is much required to settle this question.

I wish to express my gratitude to Dr. H. W. Wu, at whose suggestion the present work was carried out.

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Congenital Porphyria in Pigs

CONGENITAL porphyria in animals was first described by Fourie and Rimington[1], who found the condition in cattle in South Africa. The most striking features of the disease are the colour of the bones due to the deposition of uroporphyrin and other pigments, and the excretion of considerable amounts of porphyrin in urine and faeces. The finding of such pigmented bones in cattle and swine in slaughterhouses has been reported from time to time (for review see ref. 2), but so far as we are aware no living domestic animals other than South African cattle have been available for study.

Recently, some pig bones showing a reddish-brown discoloration were sent to the Animal Research Station, Wallaceville, by Mr. J. A. Chenery, supervising meat inspector at Waitara. The bones gave a brilliant red fluorescence in ultra-violet light and were found to contain uroporphyrin I. Congenital porphyria was therefore suspected. When a second pig from the same farm was found to show similar symptoms, it was possible to trace the sow which was producing offspring with pigmented bones. A urine sample from this sow was dark red, with absorption bands, after acidification, at 555 and 600 mμ, and on extraction yielded uroporphyrin I and coproporphyrin I, together with small amounts of the series III isomers. The fæces contained coproporphyrin I and traces of coproporphyrin III.

Full details of the chemical examination of material from this sow and affected progeny will be given elsewhere; here it is sufficient to state that the nature and type of the porphyrins obtained resemble those found in human and bovine congenital porphyria. The sow appears to be the first living case of congenital porphyria in pigs which has been examined.

Fourie[3] has shown that in South African cattle the disease is inherited as a recessive character. Information so far available on the breeding of the pigs is incomplete, and no conclusions as to the mode of inheritance can be drawn. The affected sow is of mixed breeding, out of a Tamworth-Berkshire-

Large Black dam by a pedigree Tamworth sire. When first examined she had produced two litters by a Tamworth boar (Boar *A*), and has since given birth to a third litter by another Tamworth (Boar *B*) which is a half-brother, on the sire's side, to Boar *A*. Such details as can be obtained on the occurrence of offspring with pigmented bones in these three litters are given in the following table :

Litter	No. in litter	Pigmented	Normal	No information	Sire
1	10	1	–	9	Boar *A*
2	10	2	3	5	Boar *A*
3	7	2	5	0	Boar *B*

A full sister to the affected sow, mated to Boar *B*, produced 14 pigs none of which had coloured bones. Both boars appear to be clinically normal.

The porphyria sow shows no symptoms of the photosensitivity which often accompanies congenital porphyria ; but as she is black all over, this is not unexpected.

The sow and Boar *A* have both been purchased by this Research Station for breeding experiments and chemical studies.

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Treatment of a Virus Disease of Chickens with Sulphonamides

BLAKEMORE has published[1] an account of a disease produced in young chicks by the inoculation of suspensions of tissues from typical cases of fowl paralysis (neurolymphomatosis). While the lesions were superficially unlike those of typical fowl paralysis, the course and pathology suggested that the experimentally produced disease was an acute form of fowl paralysis. Glover[2] produced a similar disease in chickens by the inoculation of tissue suspensions from a turkey affected with neurolymphomatosis. It was shown that the infective agent was filterable[3]. During the course of experiments which have been carried out in this Laboratory, a number of strains of virus which originated from paralysed fowls have been studied. Intraperitoneal inoculation of young chicks with virus results in the production of lesions which are primarily necrotic and are most conspicuous in the liver and heart. Visceral lesions become visible to the naked eye 48–72 hours after inoculation. They increase in extent and frequently reach maximum severity 6–8 days after infection. In the experiments recorded here, all chicks were killed 5–10 days after infection. Diagnosis was based upon the presence or absence of macroscopic lesions.

The influence of sulphonamides in the treatment of this disease has been striking. For ease of administration the sulphonamides have been mixed into the food or dissolved in the drinking water. Chickens treated continuously from the time of inoculation until the time of killing failed to develop lesions and their tissues proved to be non-infective. Treatment commenced at the time gross lesions were established resulted in the arrest and resolution of the disease process. A total of 138 chicks inoculated with eighteen strains of virus have been treated with sulphadiazine mixed in the food at a level of $\frac{1}{24}$–$\frac{1}{8}$ gm. per oz. None has developed macroscopic lesions. Of 117 control infected untreated chicks, 101 showed gross lesions on post-mortem examination.

The disease is sensitive to treatment with most of the sulphonamides in common use. As judged by the smallest dose necessary to prevent the development of gross lesions, the value in descending order is sulphadiazine, sulphamezathine, sulphathiazole, sulphapyridine, sulphaguanidine. The toxicity of sulphanilamide to chicks is such that it proved valueless.

The action of sulphonamides in this condition appears to be similar to that in bacterial infections. It is neutralized by *p*-aminobenzoic acid. A virus-containing suspension remained infective for more than twenty-four hours when prepared in a saturated aqueous solution of sulphathiazole and kept at room temperature.

The observation that this virus disease responds to sulphonamide treatment is of special interest, since apart from lymphogranuloma inguinale and possibly trachoma, virus diseases have proved refractory to chemotherapy.

The effect of sulphonamide treatment on the clinical condition and infectivity of fowls affected with typical fowl paralysis is being studied. It is clear that much careful work will be required in order to determine if means exist whereby sulphonamides might be employed in an attempt to control fowl paralysis. The low economic value of the individual fowl imposes obvious limitations upon the medical treatment of the diseases of poultry.

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Urease Activity and Ascorbic Acid

IN a recent note, Elson[1] has shown that ascorbic acid at low concentrations inhibits urease activity, and that this inhibition is prevented by addition of cysteine. Quastel[2] suggests that the inhibition of the activity by ascorbic acid is due to the oxidized form of ascorbic acid, namely, the diketone (dehydroascorbic acid) and not to the ascorbic acid itself. The disappearance of the inhibition on the addition of cysteine has been attributed to the reduction of the dehydroascorbic acid to the inert ascorbic acid. It seemed to us more probable that the action of ascorbic acid is not connected with either ascorbic acid or dehydroascorbic acid, but with the oxidation of the vitamin by traces of heavy metals like copper present in the reaction mixture. For several years we have been investigating the influence of ascorbic acid on enzymes, and we have obtained results showing that the vitamin as such or the dehydroascorbic acid has very little influence on the enzymes (phosphatases and amylase) ; but when the vitamin is oxidized by traces of copper present in the reaction mixture the enzyme is inhibited to a considerable extent. It was also found that substances which inhibit the oxidation of ascorbic acid annul the inhibition by the vitamin. In the light of these results we have now investigated the influence of ascorbic acid,

dehydroascorbic acid and substances which inhibit the oxidation of the vitamin, on urease. The experimental method adopted was as follows.

Briefly, it consists in incubating a mixture of solution containing 0·5 c.c. of urease (prepared by extraction of jack bean powder with water), 3 c.c. acetate buffer *M*/5, *p*H 6·0 and the substance under investigation in a total volume of 8·0 c.c. for 30 min. at 30° C. At the end of this period, urea (2 c.c. of 3 per cent) was added to the mixture, and the ammonia formed at the termination of a subsequent 30 min. incubation at 30° C. was estimated by the usual aeration method. Representative results showing the effect of ascorbic acid, dehydroascorbic acid and substances which inhibit the oxidation of the vitamin on the activity of the enzyme are given in the accompanying table.

	Ammonia formed after 30 min. (mgm.)		Ammonia formed after 30 min. (mgm.)
Exp. No. 1.		Exp. No. 3.	
Urease	7·6	Urease	2·1
Urease + ascorbic acid (1 mgm.)..	2·6	Urease + ascorbic acid (1 mgm.) ..	0·0
Urease + dehydroascorbic acid (prepared by Norit oxidation of ascorbic acid)	6·9	Urease + ascorbic acid (1 mgm.) + 8-hydroxyquinoline (2 mgm.) ..	2·0
Exp. No. 2			
Urease	8·3	Urease + ascorbic acid (1 mgm.) + sodiumdiethyldithiocarbamate (2 mgm.)	2·1
Urease + ascorbic acid (1 mgm.)	2·4		
Urease + ascorbic acid + (1 mgm.) + creatinine (2 mgm.)	4·6		

The results show that the inhibiting action of ascorbic acid is not due to dehydroascorbic acid, as the degree of inhibition exerted by dehydroascorbic acid is negligible compared with that exerted by ascorbic acid at equal concentration. Furthermore, the fact that the inhibition by ascorbic acid can be prevented by substances other than cysteine, which are known to inhibit the oxidation of ascorbic acid by forming complexes with copper[4], tends to show that the inhibition is due to the oxidation of the vitamin by traces of copper present in the reaction mixture. We believe that the function of cysteine also consists in its combination with traces of copper in the reaction mixture, thereby preventing the oxidation of the vitamin.

Our experiments give further support to the view expressed by us[3] that the inhibition of the activity of enzymes by ascorbic acid is associated with the oxidation of the vitamin, and that those compounds which protect the vitamin from oxidation annul the inhibition produced by the vitamin. The inactivation of urease by ascorbic acid undergoing oxidation catalysed by traces of copper may be attributed to intermediate products such as Cu_2O formed during the oxidation.

Further evidence with regard to the mechanism of the reaction will be adduced in the detailed paper to be published elsewhere.

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Intracellular Localization of Vitamin C

IN a recent communication referring to the use of acid silver nitrate to demonstrate the intracellular localization of vitamin C, Barnett and Fisher[1] state: "It is concluded that it is unjustifiable to infer the whereabouts of ascorbic acid within the cell from the site of silver precipitates obtained by the silver nitrate method". The bases for this statement are the results obtained on the staining of mixtures of gelatin and ascorbic acid and olive oil or ground glass with acid silver nitrate.

The authors have apparently assumed, but have produced no evidence, that the vitamin C in such mixtures is evenly distributed. They feel, therefore, that the presence of granules of silver scattered in the mixture and the deposition of silver granules on the surfaces of oil droplets, pieces of ground glass, etc., is an indication that the granules of silver are deposited independently of the distribution of vitamin C. In the first place, the vitamin might well be distributed unevenly in such mixtures; in particular it might aggregate at surfaces, and, in the absence of proof of its even distribution, this suggestion is as likely to be right as any other. In any event the possibility that some of the granular silver deposits seen in cells after the silver nitrate technique may occur, even if the vitamin C is evenly distributed in cells, was made so long ago as 1933 by me[2], but Barnett and Fisher make no reference to this paper.

The presence of granules of silver in Barnett and Fisher's mixtures is the main basis for the argument that there is not sufficient evidence for the existence of vitamin C in the granular mitochrondria of some organs. They do not adduce important evidence in favour of its presence in these organelles. Thus it has been found[3] that in adjacent frozen sections of the same pieces of tissue stained with Janus green B to demonstrate mitochondria and with acid silver nitrate to demonstrate vitamin C, there was an exact correspondence between the mitochondrial and the silver granules. The organs used for this purpose were adrenal cortex and anterior pituitary. Similar results with the adrenal cortex, the anterior pituitary and the corpus luteum were obtained by Leblond[4] and by Giroud[5]. The latter found the morphology and dimensions of the silver granules the same as those of mitochondria and makes the comment, "Leur disposition correspond entièrement à celle du chondriome". Barnett and Fisher have also omitted to mention the results obtained by ultracentrifugation of cells[6].

Barnett and Fisher state that localization of silver granules in the region of the Golgi material in cells is due to the fact that such granules will in any event tend to aggregate at surfaces. They do not explain why, therefore, in vitamin C preparations, silver granules never aggregate on the surfaces of filamentous mitochondria, but say simply that they present "a different type of interface to that of the Golgi apparatus", as though the Golgi apparatus is a surface at which granules of silver will easily aggregate. In fact, Silver[7] has explained the well-known fact that reduced silver will not aggregate on the Golgi surface unless the cell has been first treated with salts of certain heavy metals such as uranium. This paper is not referred to by Barnett and Fisher, yet it is particularly relevant to their discussion. Even if we assumed, for the sake of argument, that the Golgi material presented such a surface, they still need to explain why in the cells of some tissues the

Golgi region accumulates silver granules after treatment with acid silver nitrate, and why in those of other tissues it does not; and why the Golgi material in the cells of the one tissue will accumulate silver granules at one time and not at another; while they do not refer at all to Hirsch's[8] comments on the relation of the staining of the Golgi material of cells with the acetic acid silver nitrate reagent and the production of secretory droplets.

If the results of Barnett and Fisher[1] are significant, one would expect that in organs such as the adrenal cortex and the corpus luteum, where there are large numbers of small fatty and lipoidal droplets in the cells, thus paralleling the oil droplets in their preparations, the application of the acid silver nitrate would cause these droplets to become surrounded with black granules, but in fact it does not. In this organ and in other organs containing fatty droplets, Giroud[5] has stated that he has never seen black granules deposited on the surface of the droplets.

One is forced to conclude that Barnett and Fisher's results quoted above need further support than they have given.

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Role of Phosphate in the Methylene Blue Reduction by Dehydroascorbic Acid

WITH reference to the recent publication, by Penney and Zilva[1], on "The Chemical Behaviour of Dehydroascorbic Acid *in vitro* and *in vivo*", I wish to direct attention to my paper "On the Methylene Blue Reducing System of Palestine Orange Peels"[2], the conclusions of which, arrived at by a different method, are supported by the results of the above authors.

While investigating the methylene blue reducing system of orange peels, which was afterwards identified with dehydroascorbic acid (or its irreversible product, diketogulonic acid), it was found that this substance reduced methylene blue, the rate of reduction increasing with increasing *p*H as from 6·5 to 8·5. But this reaction (which seems to involve the disappearance of diketogulonic acid[3]) proved to be dependent upon the presence of phosphate (which could not be replaced by acetate). I suggested that this explained the discrepancies between Borsook *et al.*[3], who worked with McIlvaine buffer, and Ball[4], who used acetate buffer.

It is interesting to note that Penney and Zilva likewise observed that when they used phosphate buffers (McIlvaine or phosphate-NaOH) "above *p*H 6, it was found that diketogulonic acid began to decompose, the rate of disappearance increasing with increasing *p*H", and when they worked with borate buffer, *p*H 7·4, "the resulting diketogulonic acid was relatively stable and no indophenol-reducing substance was formed from the mutarotating solution".

It is therefore surprising that Penney and Zilva did not note the part played by phosphate, as pointed out in my paper, which is supported by their own experiments, and, as mentioned above, suggests a likely explanation of the discrepancies between Borsook *et al.* and Ball.

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Number of Configurations of Molecules Occupying Several Sites

THE number of possible configurations of a mixture of molecules some occupying two sites, the remainder one site, was obtained by Chang[1]. The corresponding number for a mixture of molecules some occupying p sites, the remainder one site, was correctly stated by Miller[2] by analogy, but without proof. By using a technique considerably simpler than that used by these authors, I have been able to generalize these results to a mixture of any number of distinct types of molecules each with its own geometric properties.

Let the molecules of type i be N_i in number; let each such molecule occupy p_i sites; let the number of sites which are neighbours of one site be z; let the number of sites which are neighbours of a molecule of type i be $q_i z$; and let C_i denote the number of distinct configurations of a molecule of type i when one of its elements is fixed on a given site. The p_i's and q_i's are related by $z(p_i - q_i) = 2(p_i - 1)$.

The number of distinguishable arrangements $g(N_i)$ of this system is found to be given by

$$\log g(N_i) = \tfrac{1}{2}z \log (\Sigma_i q_i N_i)! - \Sigma_i \log N_i! - (\tfrac{1}{2}z -) \log (\Sigma_i p_i N_i)! - \Sigma_i N_i \log C_i.$$

Details of the derivation of this formula and its use to derive thermodynamic properties will be published shortly.

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[1] Chang, *Proc. Camb. Phil. Soc.*, **35**, 265 (1939).
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Origin of the Solar System

THE criticisms of Alfvén's theory[1] of the origin of the solar system contained in Lieut.-Colonel Edgeworth's letter[2] seem to be based on a summary of the theory given by its author in an earlier letter[3]. This summary was clearly designed to illustrate the application of the theory to the newly discovered non-solar planetary systems, and it did not bring out what is perhaps the most attractive feature of the theory, namely, that it explains why a large part of the angular momentum of the solar system resides in the outer planets.

In a recent paper[4] Alfvén has shown that a cloud of ionized matter in the neighbourhood of a rotating magnetized conducting sphere is acted upon by electromagnetic forces which tend to make it take

part in the rotation. The sphere becomes electrically polarized due to its rotation, and a system of currents carried by charged particles moving in close spirals around the magnetic lines of force will flow between the ion cloud and the surface of the sphere. The interaction of these currents with the general magnetic field retards the rotation of the sphere and accelerates the cloud. The effect is thus an electromagnetic analogue of viscosity—with this difference, in the case of the solar system : that the mechanical forces involved are large enough to transfer a considerable part of the angular momentum of the sun to the cloud in a time of the order of 10^5 years. This transfer will begin to take place immediately after the ionization described in Alfvén's letter[3], and during the accumulation of the ions near the critical distance, which is identified with the distance of Jupiter. The planets and planetary satellites which afterwards condense from the cloud will, of course, retain the accrued angular momentum after formation.

It is interesting that this hypothesis not only accounts for the distribution of angular momentum among the members of the solar system, but also simultaneously explains the fact that the sun at the present time does not rotate as a whole. The detailed discussion shows that the electromagnetic retardation is greatest at high heliographic latitudes, and it is, of course, well known that the sun rotates more slowly near its poles than at its equator.

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Total Colour Blindness of Hysterical Origin

A CAPABLE and energetic motor mechanic and lorry driver aged thirty woke up one morning unable to remember who he was or his recent doings, or to recognize his wife or objects about him.

Before the breakdown he had been totally colour blind : red, yellow, green and blue lights looked white to him. After the breakdown, he was able to name and distinguish some colours of flowers and rug wools. During treatment he was tested at intervals with the Edridge-Green Beads, the Ishihara Test, Stilling's Tables and with the eight Ilford Spectrum Colour Filters and magenta. During six weeks of recovery from the amnesia, his colour vision gradually disappeared again, and he came to see all the colour filters as white, and divided the beads into 'white' (light colours) and 'black' (dark colours). Colours became dazzling and painful to his eyes, although he could not distinguish them. Meantime his normal memories slowly returned.

He was hypnotized by Dr. K. M. Abenheimer and given suggestions that he would be able to see all colours both then and after the trance. Tests during the somnambulic state and after it was over proved him to be an ordinary photerythrous red-green blind. His brother was found to have the same type of colour blindness, and his mother, father and two sisters showed small colour weaknesses.

Under hypnosis he re-lived the scene when he first became afraid of seeing colours. At the age of six he had a sore throat and his mother wrapped a multicoloured scarf round his neck. Later, when lying in his cot, he felt it choking him and cried out to have it removed. After this he had become afraid of the colours in the scarf and lost the ability to see them and all other colours.

He showed a strong emotional identification with his father in many ways, especially in liking hard work, and as a boy he had thought of colour vision as the opposite of his father, who was a coal miner and "could not see colours in the dark". Thus the total colour blindness made him like his father, according to a child's ideas, and saved him from a childish fear of his mother at the same time. It may have been chosen unconsciously as the basis of the child's hysterical reaction against his mother and towards his father because of sensitivity to the existing red-green defect. The amnesia was precipitated by a violent quarrel with a fellow lorry driver who had irritated him by being lazy on a busy day. It was like a childish outburst against his father's influence, and it started a period of amnesia with regression towards his dependence on his mother in early childhood. With this regression his partial colour vision returned, but disappeared again as the regression passed away, and was recovered under hypnosis.

I am indebted to Dr. Angus McNiven, Dr. K. M. Abenheimer and Mr. G. H. Haydock for their help, and to the patient and his wife for their co-operation.

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Grassland Improvement

THE Aberystwyth experiments, devised by Sir George Stapledon, on mechanical deep ploughing and reseeding with selected species and strains of grasses, have brought grassland management into line with arable-land experiences and have achieved considerable improvement in ley farming and hill pastures.

Recent exploratory work on rough pasture, moorland[1] and bracken-land[2] has shown that further progress is possible in this direction. The treatment of the area under investigation with calcium cyanamide (10 lb. per rod) and manganous sulphate (4 oz. per rod) during autumn, followed in the spring by reseeding with selected grasses in presence of soil containing nodule bacteria, adds new important features to grassland development. Thus we find that : (1) this method is applicable to areas where a steep gradient or shallow soil based on uneven rock (or clay) makes tillage impracticable ; (2) the addition of lime and extensive humification favour the retention of moisture and the formation of a slimy surface, thus making the soil suitable for reseeding without ploughing ; (3) calcium and nitrogen are added in a form and quantity corresponding to a long- and short-term fertilizer, benefiting both light and heavy soil (with the introduction of phosphorus and potassium when necessary) ; (4) parasiticidal activity and rapid humification add considerably to the fertility of the soil by their combined action upon the flora and fauna ; (5) during this treatment the nitrogen-fixing and nitrifying bacteria are regenerated. Nitrification, nitrate and trace element (Cu) assimilation are also catalysed by the manganous sulphate[3], which as an anti-chlorotic agent[4] participates in the chlorophyll metabolism, and (6) the loss of nitrogen, accompanying the nitrous acid reactions in the soil, is greatly reduced by the carbohydrates abundant in the humifying bracken rhizomes[5].

The development of the Highland hydro-electric

scheme should make calcium cyanamide readily available in Great Britain, and the destructive action of this material upon parasites, ranging from viruses and fungi to wireworms, leather jackets, etc., should provide an important problem for parasitology.

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Origin of Indo-European Languages

PROF. ALEXANDER JÓHANNESSON, whose article appeared in NATURE of February 5, is, I believe, the first philologist of high academic standing who has systematically studied the sounds of speech from the point of view of the gestures of articulation which produce them, and has thus discovered for himself the pantomimic structure of human speech. His conclusions coincide generally with my own, which were originally drawn from the acoustic study of speech sounds.

There are, however, a few items in Prof. Jóhannesson's statement which seem open to question. He considers the Indo-European *R* sound as "originally cacuminal, hard and vibrating". I would have suggested that the Indo-European *R* was more probably produced by a backward curvature of the tongue tip, so as to produce a sound like the Wessex 'burr'. Its pantomimic meaning would be to bend or bend back, surround, cover, draw back, as in rake (heap up), ramp, rape, rim, ring, rend, ream, rib, reef, reel, rest, roost, rick, ride, rig (bind), rob, roll, roof, room, rope, round, rug, rump.

As to the vowels: *E* (as in men) is the result of a mid-height tongue posture; the pointing at oneself in ego is, I suggest, due to the *EG* gesture. I do not think that *EU* represents a 'circulating movement'; it is rather a forward movement (*U*) at mid-height (*E*).

Prof. Jóhannesson considers *S* as primarily an imitation of sounds in Nature. I would suggest that the *S* gesture generally denotes extension to a fine point or edge or limit. Thus, *SK* denotes extension from a forward point (*S*) to a backward point of closure (*K*); hence, skin, skim, skein, skid, scalp, skull (with hollow *U*), scoop. *SL* denotes sliding back or down; for example, slant, slip, slide, sleek, sleep, slope, slum, slump. *SM* denotes a sliding action towards a forward (lip) closure *M*, as in smear, small, smooth. *SN* is an in-drawing gesture, commonly associated with in-breathing through the nostrils, as in sneeze, snore, snout; or an inward or upward movement, as in snug, snag (projecting point). *SP* denotes drawing to a terminal point or fine edge, as in spear, spire, spout, spit, spade, spoon, spur, and asp, wasp, wisp. *STR* represents an elongated fore and aft movement, as in strong (extended hand drawn up towards the shoulder and terminating with a clenching of the fist), straight, stream, string, strand, strake (of timber), stretch, etc. *SW* is a forward motion, as in swell, swim, swift, swirl, swoop, swoon.

As to the symbolism of abstract ideas, I would suggest that in speech—as in sign language—the original meanings of all gestures have been concrete, and that the corresponding abstract interpretations have come later. It was the poetical faculty in man that enabled him to express his hitherto inexpressible sensations by concrete gestures, so that a shrinking gesture such as that of fear, fright, could be used to express the inclination to shrink, or the full-mouthed gesture 'good' to represent anything that was felt to be satisfying.

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Two of Prof. Jóhannesson's works—his "Grammatik der urnordischen Runeninschriften" and his "Islenzk tunga í fornöld"—are well-established handbooks for the Germanic philologist. But, in his recent article in NATURE[1] (and more fully in the Icelandic work to which he there refers), he has embarked for more unconventional regions. There is, in fact, no doubt that Prof. Jóhannesson has contravened that ancient and famous minute of the Société de Linguistique which prohibited discussion of the origin of language. There was—and always will be—a sound basis for that excellent minute, and for a simple reason. In all languages known to us—whether ancient (like Sumerian) or modern (like modern English)—we observe that, for the great majority of words, the connexion between sound and sense is random; thus there is no reason known to us why, in English, the word for "7" should begin with *s* and that for "10" with *t* rather than vice versa. We may suppose that, in the very distant epoch when language originated, either the sound-sense relation was random or it was not. But the linguistic changes which must have operated in the long period intervening would certainly have quickly reduced a non-random sound-sense relation to a random one, similar to that which we have in known languages.

Therefore to accept Prof. Jóhannesson's theory is to disbelieve in the heterogenizing effect of continuous linguistic change, and to do this would be to go against all that we know of language. There is implicit in Prof. Jóhannesson's views the suggestion that reconstructed Indo-European preserves an original non-random sound-sense relationship (cf. his remark in para. 4: "The roots beginning with dentals have a similar meaning, as the first man either pressed his teeth together . . ."). Reconstructed Indo-European is usually attributed to the third millennium B.C. and was presumably the language of a people at a fairly high level of civilization; thus long vistas of masking sound-change must separate its dentals from the original state of affairs envisaged by Prof. Jóhannesson.

Two special points call for comment. In his third paragraph Prof. Jóhannesson offers some discussion of ablaut; it is, at the least, remiss of him not to have taken cognizance of the views of Kuryłowicz, who succeeded, in the years before the War, in tracing the history of the Indo-European vowels to an earlier stage than had been reached up to that time. On p. 172 Prof. Jóhannesson says that "Philology must become a scientific study". To most philologists the question whether philology is a science or an art will scarcely seem important, but admirers of the great masters of scientific philology—Brugmann, de Saussure and, above all, Meillet—will find it hard to condone the implication that these men were at fault in their method.

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[1] NATURE, **153**, 171 (1944).

RESEARCH ITEMS

Transfusion into the Bone Marrow

WORKERS who are studying the intravenous administration of blood and other fluids will be interested in the method of delivering such parenteral fluids into the manubrium of the sternum which is described by Mr. Hamilton Bailey, of the Royal Northern Hospital, London (*Brit. Med. J.*, 181; Feb. 5, 1944). Referring to the work of L. M. Tocantins and J. F. O'Neill (*Surg. Gynæc. Obstetr.*, 73, 281; 1941), Mr. Bailey says that he considers the manubrium as good a receptor as a vein for infusions of all kinds and for pentothal anæsthesia. After local anæsthesia with novocain, a special trochar is introduced between the two plates of the manubrium, the depth to which it penetrates being controlled by two wings on the instrument. To make sure that the bone marrow has been reached and to avoid such possible accidents as the injection of the fluids into the superior mediastinum, sodium citrate is first injected with a syringe fixed to the cannula. If this syringe then withdraws bone marrow, which looks like blood, easily and liberally, it is known that the cannula is in the bone marrow. It is then quickly linked to the transfusion apparatus. A possible danger is the production of osteomyelitis, but this has not occurred in Mr. Bailey's sixty cases. Whole blood cannot be introduced as rapidly as it can be given into a vein by gravity, but this difficulty is being overcome. Advantages of the method are that it is relatively painless, that thrombosis or phlebitis cannot occur, and that the apparatus is on the sternum and so is out of the way of the surgeon during operations and can be controlled by the anæsthetist. The method is also free from the difficulty, which is often considerable, of getting a cannula into the veins of severely shocked patients, whose veins may be also so severely collapsed that satisfactory reception of the parenteral fluid is difficult; in dehydrated infants the method is certain and safe. It can, moreover, be carried out in a poor light, so that fluids can be given more easily and quickly under black-out conditions.

Inheritance of Awn Barbing in Wheat

THE beards or awns of wheats are normally rough, due to short, thick-walled, unicellular hairs with fine points which are directed towards the tip. Among 'smooth'-awned durum wheat selections, it has been found that two different, true-breeding types may be distinguished (P. F. Knowles, *Canad. J. Res.*, 21, C 198; 1943). In the first type, termed 'smooth', the upper half of the awn is free from barbs and the lower half very slightly scabrous, increasing in intensity towards the base of the awn. In the second or 'intermediate' type, barbs are found from the tip to the base of the awn, but in the upper part they are few in number and reduced in size, whereas in the lower portion they are very numerous and intermediate in character between the 'smooth' and the normal 'rough' types. The types are shown to be due to the expression of two pairs of alleles, designated *Rr* and *Ss*. *RRSS*, *RRSs*, *RrSs*, *Rrss*, etc., are 'rough'-awned, *rrSS* is 'intermediate', *rrSs* is a non-true breeding 'near-smooth' and *rrss* is the true-breeding 'smooth'-awned type. The segregations obtained for the characters of glume colour, glume pubescence and awn colour, showed that the inheritance of each is determined by the action of one pair of factors, that glume pubescence is linked with awn colour and that the inheritance of all these is independent of awn barbing. It is a pity that the symbols *R* and *S* have been used in accordance with the notation first used for barley but now discarded for that species: *R* is usually reserved for the three grain-colour factors and *S* has been used for the spring habit. Furthermore, the smooth-awned gene originally designated *S* in barley is a dominant.

Physiology of Incompatibility in Plants

IN the third paper of this series, D. Lewis (*J. Genetics*, 45, 171; 1943) describes his investigations on incompatibility in autotetraploids. It will be remembered that in diploids a style carrying S_AS_B will inhibit the growth of either S_A or S_B pollen grains. In tetraploids there are complications such as the pollination of $S_AS_CS_CS_D$ by S_AS_B pollen. Using synthesized tetraploids of *Œnothera organensis*, the author has investigated this and similar phenomena. Pollen heterozygous for different *S* factors can be shown to differ by their reaction to temperature and growth. The fact that a pollen tube carrying an incompatible and a compatible gene in relation to those of the style show different reactions according to the specific genes involved indicates that competition is taking place for some substance. The author suggests the similarity between incompatibility in plants and the phenomena of antigens and antibodies in animals. The effects of incompatibility upon survival of tetraploids and economic selection are discussed.

Effects of Banana Selection

K. G. DODDS (*J. Genetics*, 45, 113; 1943) has examined the cytology of some diploid parthenocarpic bananas. Three of the five examined are structural hybrids, a fourth shows little bivalent formation while the fifth exhibits a single reciprocal translocation. Parthenocarpy and sterility of the female flowers is genetic in origin. The author shows that parthenocarpy and female sterility arose by gene-mutants in fertile diploids; the resulting edible types were taken into cultivation and propagated by clones. By selection, and in course of time, parthenocarpy became established, and with the absence of selective control on the sexual process the evolution of structural hybridity took place. This was favoured probably by the selection of more sterile forms. Hence male sterility was added to female sterility. Later, polyploidy arose, but this is considered to be of less importance in the evolution. Possibly the larger size of polyploids may have attracted the early selectors.

Electric Polarizations in Extremely Dilute Solutions

THE abnormal behaviour sometimes found in the polarization curves at high dilutions on plotting polarizations against mol fractions has been supported by some investigators and denied by others. R. Davis, H. S. Bridge and W. J. Svirbely (*J. Amer. Chem. Soc.*, 65, 857; 1943) have made some measurements in benzene and dioxane solutions and computed the molecular polarizations by Hoecker's method. This involves p'otting the product of polarization and mol fraction of the solute P_2N_2 against N_2 and taking the slope of the resulting line as P_∞. This will be equal to P_∞ only if P_2 is constant. Large-scale plots showed that the P_2N_2 against N_2 plot was linear under proper conditions, and the conclusion was reached that the

abnormal behaviour in polarization curves encountered in very dilute solutions is due to experimental error in measuring P_1 and has no physical significance.

Solubility of Silver in Mercury

An interesting study of the solubility of silver in mercury has been published by D. R. Hudson (*Metallurgia*, Sept. 1943). The author has determined the solubility over a range of temperatures up to 450° C., the materials being sealed in a glass bulb. The measurements, combined with those of previous workers, with which they are consistent, afford information extending over a temperature range exceeding 950° C. Measurements quoted in the highest range up to the melting point of silver were made by Murphy using the usual metallurgical methods. The existence of the peritectic temperatures of formation of Ag_5Hg_4 and Ag_5Hg_8 produces no noticeable effects on the graph of log N_{Ag} plotted against $1/T$ (where N_{Ag} represents the molecular fraction of silver in the saturated liquid solution, and T represents the absolute temperature). At two other temperatures, however, sudden changes of slope of the graph occur, and may be roughly predicted from purely physical properties of silver and mercury by using an equation due to Hildebrand. The equation may be modified so as to allow for the solid solubility of mercury in silver, and in this way a somewhat closer approximation to the experimental determinations can be obtained. Although the equations used by Dr. Hudson exhibit the main features of the experimental determinations, the shape of the liquidus curve of a binary metallic system cannot in general be closely predicted from a knowledge of relevant physical properties of the pure components.

Carbon Monoxide 'Cool Flame'

At a temperature just below the ignition point, a mixture of carbon monoxide and oxygen shows a pre-ignition glow or 'cool flame', the spectrum of which has been studied by A. G. Gaydon (*Proc. Roy. Soc.*, A, 182, 199; 1943). Photographs were got of the spectra with carbon monoxide and oxygen or nitrous oxide. The cool flame shows the same faintly banded spectrum as the normal flame, but this band structure is more clearly developed. The OH bands are absent from the cool flame, which, however, shows strong sodium emission. Cuprous chloride appears very readily as an impurity, and the band systems of CuCl show a markedly different intensity distribution in the cool flames with oxygen and with nitrous oxide. The application of the results to the theory of the combustion mechanism is briefly discussed. The paper is the third in a series on the flame spectrum of carbon monoxide.

Electron Diffraction of Amorphous Polymers

Whereas some polymeric substances give characteristic crystalline diagrams under X-ray or electron diffraction examination, others show such diagrams only when stretched under suitable conditions of temperature. Normally, in their unstretched form they give an 'amorphous' pattern, retained in several cases even on stretching. Special attention has been given to 'amorphous' polymers by G. D. Coumoulos (*Proc. Roy. Soc.*, A, 182, 166; 1943). The configurations of polyvinyl acetate and the acrylate and methacrylate polymers revealed by electron photographs suggest a zigzag carbon atom chain for the long main-chain, which has the 1,3 structure, with the side-chains alternately on the right and the left of the zigzag chains and on planes approximately perpendicular to the axis of the main chain. These side-chains are subject to lateral cohesive forces which group them in clusters. In the clusters, the side-chains tend to lie parallel to one another. In the lenses the clusters consist of a few side-chains showing no recognizable arrangement. The multilayer pattern suggests a certain orientation of the side-chains with perhaps more grouping together. The patterns indicate an 'amorphous' character due to the close packing of the side-chains in clusters, producing distortion of the main-chain and preventing adlineation. On the basis of this configuration, some of the elastic properties of these polymers are discussed and a note is made on the occurrence of high elasticity.

Production of Penetrating Showers

L. Jánossy and G. D. Rochester have reported (*Proc. Roy. Soc.*, A, 182, 180; 1943) the results of an experimental study of the nature of the shower-producing radiation suggested by an earlier investigation by Jánossy. It is shown that about one third of the radiation producing penetrating showers is non-ionized and more penetrating than photons. The total intensity of this non-ionizing radiation, named N-radiation, is found to be about 0·001 per cent of the full cosmic radiation near sea-level. The N-radiation is possibly the energetic part of the penetrating non-ionizing component of cosmic radiation. It is suggested that this radiation consists of neutrons.

Direction of Rotation in Spiral Nebulæ

Unambiguous determination of the direction of rotation of extra-galactic nebulæ with respect to their spiral pattern needs three data: the sense of the rotation, the sense of the spiral pattern and the sense of the tilt. The first can be obtained from spectrograms, the second from direct photographs, but there is still considerable controversy over the determination of tilt, which cannot be observed directly but must be inferred from observations which may be interpreted differently by different people. A recent paper by Edwin Hubble (*Astrophys. J.*, 97, 112; 1943) uses dissymmetry of obscuration with respect to the major axis as a criterion of tilt in fifteen spirals in which the arms can be traced. He finds that the arms are either all trailing or all leading the nuclei. In four critical cases, he claims, lanes of obscuration silhouetted against the nucleus show unambiguously which is the nearer side of the nebula; and applying this criterion of tilt, he finds that the arms are trailing. As a working hypothesis he therefore assumes that the arms trail in all spirals. In recent papers, however (*Stockholm Ann.*, 14, Nos. 1, 3, 4; 1942), Lindblad and Ohman come to the opposite conclusion by assuming that the dark matter is distributed more or less uniformly through the nuclear region. The heavier obscuration should then occur on the farther side of the nucleus, where the light rays are absorbed most. Unfortunately, in the one case where the Swedish school agrees with the American as regards the direction of tilt, they disagree on the sense of the spiral pattern. The matter is of great importance in discussing the evolution of spiral nebulæ, and further independent evidence is badly needed.

CHEMICAL STRUCTURE AND ANTI-FIBROMATOGENIC ACTIVITY OF STEROID HORMONES

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LIPSCHÜTZ and Iglesias[1] showed that subserous fibroids scattered in the abdominal cavity (gastric, splenic, mesenteric, uterine, parametric and fibroids of the abdominal wall) can be induced in female guinea pigs to which œstrogens have been administered for a sufficient length of time. These fibroids infiltrate into surrounding tissues, especially smooth and striated muscle. All œstrogens, natural or artificial, free or esterified, have been found to be fibromatogenic. Localization of these abdominal fibroids follows a certain pattern independent of the œstrogen used[2] (for summary, see ref. 3). In the course of our work we have also established that certain steroid hormones, when administered simultaneously with the fibromatogenic œstrogen, prevent formation of fibroids. Progesterone, desoxycorticosterone[4], dehydrocorticosterone[5] and testosterone[4] were shown to be antifibromatogenic. Fibroids which have already been induced by œstrogenic action begin to regress when about three months later an antifibromatogenic steroid (progesterone) is given and allowed to act simultaneously with the œstrogen[6,7].

All the four natural antifibromatogenic steroids mentioned were 3-keto-steroids with a double bond Δ^4 in ring I. Progesterone and seemingly also desoxycorticosterone were more active than testosterone, and it was assumed that the side chain of two carbons at C_{17} enhances antifibromatogenic action[8,9,10]. On the basis of these findings and assumptions, a systematic search for antifibromatogenic steroids was made among known artificial steroids with the purpose of relating antifibromatogenic activity with chemical structure. So far, a total of ten different artificial steroids, that is, steroids not occurring in the body, and some esters of these have been studied[11]. The results are summarized in the accompanying table.

Three artificial 3-keto-steroids were tried. Δ^{16}-dehydroprogesterone, which differs from progesterone by a double bond in ring IV, showed no antifibromatogenic power even when considerable quantities were used. The antifibromatogenic activity of testosterone is abolished by oxidation at C_{17}; Δ^4-androstene-3-17-dione failed to prevent fibroids even when huge quantities were absorbed. Prolongation of the side chain in position 17 also was detrimental: cholestenone was not antifibromatogenic.

Dihydrotestosterone lacking the double bond Δ^4 was found to be no less active than testosterone. On the basis of this finding, two compounds lacking the double bond Δ^4 but having the side chain at C_{17} like progesterone were tried; but both these artificial steroids, allo-pregnanedione prepared by Dr. K. Miescher from cholesterol and pregnanedione prepared by Dr. A. S. Cook from urine, were found to have no antifibromatogenic faculty.

All steroids, natural or artificial, having a hydroxyl group at C_3 failed to show antifibromatogenic activity, whether the side chain of two carbons at C_{17} was present (acetoxypregnenolone, substance *H* of Kendall) or not (androsterone, androstanediol, androstenediol).

As to the relation of antifibromatogenic action to the *physiological* activities of steroid compounds, the following statements can be made. All 3-keto-steroids which we found to be antifibromatogenic are known to be *progestational*, though in a varying degree; but all 3-keto-steroids which were found not to be antifibromatogenic, are not known to be progestational, with the possible exception of androstenedione. *Masculinizing* activity is not concomitant with the antifibromatogenic one, as shown by two different facts: there was no masculinization of the genital region in the guinea pig (transformation of the clitoris into a hypospadic penis) with antifibromatogenic quantities of progesterone, desoxycorticosterone and dehydrocorticosterone, whereas masculinizing quantities of androstenedione were not antifibromatogenic. Neither was there full parallelism between antifibromatogenic and *antiœstrogenic* activities. Though the vaginal opening closed often definitely under the influence of antifibromatogenic steroids, proliferation of the basal epithelium of the vaginal mucosa was not fully inhibited. The growth of the nipples and of the mammary glands was not inhibited but rather enhanced by antifibromatogenic steroids.

The statements referring to the correlation of the antifibromatogenic activity of steroids with their chemical structure and with certain physiological activities, conflicting as these statements are so far, may serve as important starting points for further experimental work in the field of research on antitumoral actions of steroid compounds, natural or artificial.

Our work with tumorigenic and antitumorigenic steroids was aided by grants from the Rockefeller Foundation and the Jane Coffin Childs Memorial Fund for Medical Research. It was greatly furthered by the application of the ingenious technique of subcutaneous implantation of steroid tablets advised by Drs. R. Deanesly and A. S. Parkes[12]. Thanks are due for steroids to Dr. E. C. Kendall of the

	Antifibromatogenic (3-keto-steroids)	Not antifibromatogenic (3-keto-steroids)	Not antifibromatogenic (OH at C_3)
Occurring in the body	With Δ^4: progesterone (15)* desoxycorticosterone (90) dehydrocorticosterone (100) testosterone (200 ?)		androsterone [240]
Not occurring in the body	Without Δ^4: dihydrotestosterone (110 ?)	With Δ^4: Δ^{16}-dehydroprogesterone [160]† androstene-3, 17-dione [570] cholestenone [160] Without Δ^4: allo-pregnanedione [150] pregnanedione [260]	androstane-3, 17-diol [220] Δ^5-androstene-3, 17-diol [175] Δ^5-acetoxypregnene-3-ol-20-one [320] Kendall's compd. *H*. (17-ethyl-androstane-3, 21-diol-11,20-dione [160]

* Figures—subject to rectification—in brackets ( ) indicate the antifibromatogenic threshold or the *minimum* quantity (in μgm.) absorbed per day which was still *sufficient* to prevent production of abdominal fibroids in about 80 per cent of animals.

† Figures in brackets [ ] indicate the *maximum* quantity (in μgm.) absorbed per day which was *insufficient* to prevent production of abdominal fibroids.

Mayo Clinic, Rochester, Minn.; to Dr. Karl Miescher of Ciba, Basle; to Dr. E. Oppenheimer of Ciba Pharmaceutical Products, Summit, N.J.; to Dr. A. S. Cook of Ayerst, McKenna and Harrison, Montreal; to Dr. E. Schwenk of Schering Corporation, Bloomfield, N.J.; to Dr. M. Tausk of Organon, Holland; to Dr. O. Kamm of Parke, Davis and Co., Detroit; to Dr. F. Giral of Laboratorios Hormona and Instituto Politécnico, Mexico.

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[11] Unpublished work in collaboration with Drs. S. Bruzzone, F. Fuenzalida, R. Iglesias and others.

THE PULSATION THEORY OF CEPHEID VARIABLES

PROF. SVEIN ROSSELAND delivered the George Darwin Lecture of the Royal Astronomical Society, on September 10, 1943, on "The Pulsation Theory of Cepheid Variables", and the address is now available (*Mon. Not. Roy. Astro. Soc.*, **103**, 5; 1943).

In the introduction, Prof. Rosseland refers to different types of stellar motions, the simplest type of large-scale motion being rotation round a fixed axis; this particular problem must be considered to be still in a preliminary stage both from the theoretical and observational points of view. The expansion and contraction of a star as a whole is a second type of large-scale motion, and this can be said to be represented in the sun by the outward motion of the corona; but it is most conspicuous in Wolf-Rayet stars and novæ, where direct observation of the expansion is possible. In the case of Cepheids and other periodic variable stars, it is believed that a *periodic* type of expansion and contraction is at the root of the phenomena.

The problem of interpreting the behaviour of Cepheid variables was responsible for the idea that stars may perform spherical pulsations, and it is interesting to notice that Goodricke, who announced the variability of δ Cephei in 1783, was cautious enough not to attribute its variability to eclipses in a binary system, like β Persei. It was not until 1879 that August Ritter developed a rudimentary theory of the pulsation hypothesis and suggested that Cepheids might owe their light-variation to pulsation. He made the important discovery that the slowest mode of pulsation of a homogeneous star has a period inversely proportional to the square root of its density, and also found that this mode of pulsation becomes unstable when the ratio of specific heats falls below 4/3—a result which holds, not only for the Cepheids, but for other gaseous stars as well. Unfortunately, Ritter's suggestion received little attention, and in 1894, when Belopolsky discovered the periodic variation in the position of the lines in the spectrum of δ Cephei, this fact was interpreted as a confirmation of the binary star theory of Cepheids.

Plummer was the first to show that the binary hypothesis was very doubtful, and in the following year, 1914, Shapley ruled out the hypothesis by an analysis of observational data, suggesting the pulsation hypothesis as an alternative. His most convincing argument was that if a companion to a Cepheid were responsible for the light-variation, the size of the orbit would be so small that the companion would necessarily move well inside its primary. Eddington took up the subject of the pulsating hypothesis in 1917–18 and raised it to the rank of a mathematical theory in which quantitative issues are involved. A few observational facts about Cepheids were definitely established by that time; thus the periods, the general form of the light-curve, the velocity-curve, and the period-luminosity relation were known. More information is now available on the correlation between the period and the mean density, enabling a preliminary check to be made on the theoretical law, and in addition, much more material can be utilized concerning the form of the light- and velocity-curves.

The problem of the pulsation theory is beset with many difficulties, and it has been found necessary to approach it in successive steps. In the first step, the theory was developed within the framework of ordinary acoustics, and in this case wave motions are linearly superposed to form compound waves, the oscillations being assumed adiabatic. Within the acoustic limit the relation

$$P\sqrt{\rho} = K$$

holds, where P is the period and ρ the mean density, K being a constant for each stellar model, but differing for different models. When $\log P$ is plotted against $\log \rho$, the plot should reduce to a straight line forming an angle of 45° with the axis, for stars of the same model, and stars of the short-period and Cepheid type fall very closely along a line which is parallel to this line, but well to the right of it, thus confirming theoretical expectations. The long-period stars fall widely off the line, still farther to the right, and the only group that conforms to expectations is the small group of short-period variables in Messier 3, discovered by Schwarzschild. Two possible ways of overcoming the difficulty are suggested. If it is admitted that different groups of stars have different values of the ratio of specific heats, a drop from 1·6 to 1·4 would suffice to bring the theoretical line into coincidence with the observed Cepheid line, but a considerably greater alteration would be necessary to bring the theoretical line into coincidence with the observed long-period line. No physical basis exists for such an assumption regarding the alteration in the specific heats ratio. Another suggestion is that the stellar model should be altered so that the central density would be 10 times instead of 54 times the mean density, but even such a drastic alteration would not explain the position of the long-period variables in the diagram.

After discussing these difficulties, Prof. Rosseland deals with his own work, in which the acoustic approximation is abandoned. In the case of an ordinary pendulum, infinitely small oscillations are sinusoidal, and the period is independent of the amplitude, like small oscillations of a star. When the swings of a pendulum increase, the oscillations cease to be sinuosidal and are represented by elliptic functions, the period increasing at the same time. If a curve is plotted giving velocity against time, the change in its shape enables us to infer the length of the period, and we might expect, in a general way, that the

same situation holds for the pulsations of a star. As the velocity curve differs more and more from a simple sine curve, so the period may be expected to lengthen relative to the period computed from the elementary theory. Eddington dealt with the subject of an extended pulsation theory in 1918, and showed that theory predicts a faster rise of the velocity to a maximum than the subsequent drop to a minimum, and in 1937 Miss Kluyver extended the investigation to include a dependence of period on amplitude. Prof. Rosseland develops his theory of 'anharmonic pulsations' in an appendix, and finds that the semi-amplitude of oscillation would have to be a quarter of the radius of the star—a value 4–5 times too great for most of the Cepheids. He admits that there is a considerable discrepancy to bridge, and it does not appear that this can be done by varying the model. It can probably be done if the calculations are extended to include more coupling terms in the equations.

In conclusion, Prof. Rosseland points out the incompleteness of the pulsation theory in its present stage, and even the 'anharmonic theory' must still be considered to be in its infancy. As already pointed out earlier in this summary, there is a problem connected with the separation of the Cepheids, long-period variables and the *M*3 group, and no solution has yet been attained. It is suggested that inherent physical differences between the stars of these three groups exist. Regarding the phase retardation of luminosity, the pulsation theory has little to say, though it is admitted that Eddington's suggestion about the hydrogen convection zone may finally lead to a solution of this problem. In this connexion further work on the anharmonic pulsations may be important, and the same applies to the period-luminosity law, an interpretation of which has not yet been afforded. The fact that the pulsation theory has survived for nearly thirty years against hard tests is an indication of the soundness of its basic assumptions, and it will remain a fruitful field of work in the future development of astrophysics.

NATIONAL RESEARCH COUNCIL OF CANADA

THE annual report of the National Research Council of Canada*, 1941–42, includes the report of the president, the financial statement for the fiscal year 1941–42, as well as the reports of the directors of the various divisions, the Gauge Measurement Laboratory, the Radio Board, the Section on Codes and Specifications and the Research Plans and Publications Section. Practically all the activities of the National Research Council in 1941 were directed to the study and solution of problems immediately connected with Canada's growing war effort, and the Council has been officially designated as the Research Station of the Royal Canadian Navy, the Army and the Air Force, and is shown as a civil establishment in the records of the Department of National Defence.

The Divisions of Chemistry and of Applied Biology have been engaged largely in selecting and testing suitable materials for the use of the armed forces, and in the Physics, Electrical and Mechanical Engineering Departments, the design and development of new detecting devices to locate aircraft, submarines, mines, and other enemy equipment have been carried forward with much success. Engines, aircraft and other items of equipment used in mechanized warfare have been tested on a large scale, and additional staff and facilities have been provided to meet the new requirements, the staff of the Council working in the Ottawa area numbering 803 on March 31, 1942, as against 308 in July 1939, the greatest increase in numbers being in the Division of Physics and Electrical Engineering. New buildings have been constructed to house the aeronautical and hydraulic laboratories and the work of some of the other divisions. A radio field station has been established near Ottawa, and owing to the large increase in the staff of the radio section, a Radio Board has been established for the general direction of all radio research and development work in connexion with the Council's war activities. An important war service has been rendered by promoting the development in Canada of optical glass manufacture for precise optical parts of military equipment.

The Division of Biology and Agriculture, which has been renamed the Division of Applied Biology, has devised methods for converting large insulated cargo holds into refrigerating space without delaying the vessel to provide an immediate solution for the acute bacon transport problem, and a standard curing practice has been developed in Canadian package plants which yields a more stable product. Other work in progress in this Division relates to the treatment of shell eggs to prevent deterioration during shipment at ordinary temperatures, tests on the quality of dried eggs and the preparation of specifications for shipping, investigations on drying pork, canning poultry, vitamin content of flour and the development of rapid growing, easily propagated forest trees; vegetative propagation has reached the stage when cuttings of Norway spruce, white spruce and white pine can be successfully rooted on a practical scale.

In the Division of Chemistry, the Plastics Laboratory of the Colloidal Section, which was being equipped at the outbreak of war, has carried out a survey and experimental work on the use of laminated wood in aircraft construction in co-operation with the Division of Mechanical Engineering. In the physical chemistry section investigations on the development of de-icing fluids, prevention of frost deposition on aircraft, resolution of aerial photographs, etc., have continued, while the organic chemistry section has continued its general programme of research on alkaloids and has synthesized indicators for war gases and chemicals for other war purposes; in the preparation of some special organic chemicals, production has been advanced to semi-pilot plant scale. In addition to investigating products used by almost every branch of the armed forces, including surgeons' gloves, ground sheets, gas-mask components, etc., the rubber laboratory has given much attention to rubber conservation problems and to the study of processes for synthetic rubbers. The refractories laboratory continued its investigations of high-temperature furnace linings. Experiments on the production of metallic magnesium have been pushed forward until a process worked out in the laboratory has been sponsored in a more detailed study embodying pilot-plant operation by a group of industrialists.

Activities in the textile laboratory were largely devoted to acceptance test work and specifications. An explosives laboratory was established late in 1941 to carry out testing under the Explosives Act and conduct research on explosives and related compounds.

* Twenty-fifth Annual Report of the National Research Council of Canada, 1941–42. (N.R.C. No. 1089.) Pp. 33. (Ottawa.)

Under war-time conditions, the demand for searches of scientific literature in planning laboratory research have increased; research workers in all fields of science have made increasing demands on the trained personnel of the Council staff who prepare bibliographies and abstracts or digests of the literature. Although ten of the Council's numerous associate committees have been disbanded and others will remain inactive until after the War, many new committees have been established to give advice or organize and direct research on important problems, in addition to the twenty-eight associate committees of the Council in existence at the end of the year. Special reference is made in the report to the associate committees on medical research and on aviation medical research. Subjects selected for investigation by these sub-committees have included problems in fatigue, vision, hearing and related subjects, wound infection studies, including work in chemotherapy, treatment of shock, development and provision of blood substitutes for transfusion purposes, treatment of burns and other war injuries, dietary studies, problems involved in high-altitude flying and the improvement of oxygen breathing-systems, and protective clothing to counteract effects of cold, fatigue and high accelerations.

The Council has also been particularly active in maintaining the most effective liaison possible in the scientific work going on in Great Britain, Canada and the United States.

SEAWEED PRODUCTS IN AUSTRALIA

By E. J. FERGUSON WOOD and VALERIE MAY JONES

Fisheries Div., Council for Scientific and Industrial Research, Australia

PRIOR to 1940, little had been done in Australia to develop any industries using seaweeds as the raw material. In the last century, a company was formed to make agar from the red alga, *Eucheuma speciosum* (Sond), J.Ag. at Dongarra in Western Australia; potash was produced from Macrocystis and Ecklonia in Tasmania during the War of 1914–18, and several attempts were made at different times to utilize the fibres of *Posidonia australia* Hook. F., which is prolific in South Australian waters and elsewhere. With the death of each of these schemes, seaweed research for industrial purposes languished, and even taxonomy was so neglected that for some years prior to his death, A. H. S. Lucas was the only person in Australia working with the marine algæ of the Continent.

The need for agar in Australia stimulated seaweed research, and the discovery of a quantity of *Gracilaria confervoides* (L.) Grev. at Bateman's Bay and Botany Bay in New South Wales revived interest in the Rhodophyceæ. Studies on the method of production of agar from Gracilaria, carried out at the laboratory of the Fisheries Division of the Council for Scientific and Industrial Research, have culminated in the undertaking of agar production by a Sydney firm. *Gracilaria confervoides* is known to occur in large beds in shallow water in a number of areas in New South Wales and southern Queensland, and is very easily harvested and dried. It is estimated that there will be sufficient raw material in New South Wales to produce at least 100 tons of agar per year, even allowing for fluctuations in the growth of the seaweed. Gracilaria has been found along the coast from Tuross Lake in New South Wales to Urangan in Queensland, a distance of 850 miles. It occurs on shallow flats, in lagoons, estuaries and bays, where conditions are favourable. There is a seasonal rhythm in its abundance, though it appears that this may vary in some seasons. The spores appear to adhere often to shellfish (usually whelks, sometimes cockles and mussels) or to a polychæte worm cast (Eunice), and occasionally to sticks, rocks, etc. Experiments are being made with a view to the cultivation of Gracilaria.

The seaweed is harvested by special grapnels or, in very shallow water, by hand, then loaded into dinghies and taken ashore and dried on wire-netting racks. When dry, it is pressed into bales, and is ready for the manufacturer.

The cardinal features of manufacture are boiling with live steam in open vats, and keeping the *p*H below 7 and preferably below 6·5, but above 5·0. Owing to the difficulty of procuring the necessary materials, the agar has been made in iron or copper equipment, and this results in discoloration and in a high ash residue. Efforts are being made to overcome this. Gracilaria agar tends to be viscous and to have a high setting point, but these are no detriment in the food industries. For bacteriological purposes, Jensen has shown that although these qualities are a disadvantage for poured plates, slopes made from Gracilaria agar will grow most organisms as well as, if not better than, the slopes made from Japanese agar. Two British bacteriologists have also expressed satisfaction with Gracilaria agar in private communications to one of us.

Agar is also manufactured in Western Australia from *Eucheuma speciosum*, which appears to grow in quantity on reefs in the Dongarra district, and to some extent elsewhere. Detailed surveys of these beds are projected. The agar is more easily extracted from Eucheuma than from Gracilaria, but collection of the seaweed from reefs will prove more difficult. This agar also is used for meat canning, and has the same disadvantages for bacteriological purposes as Gracilaria agar.

Hypnea musciformis (Wulf) Lam. is moderately widespread in occurrence, though not occurring in large quantities in any one part of Australia. It makes a very good bacteriological agar with a low viscosity and setting point. It is not used commercially so far.

At the present time, Australian agar production is far below local requirements, but there appears to be no technical reason why these requirements should not be met within the next twelve months, and there is every indication that the raw material will prove adequate.

The production of alginates, potash and iodine have been studied also, and alginates of excellent quality can be prepared from Ecklonia from New South Wales, or from Macrocystis from Tasmania. Abundant growth of Macrocystis occurs in southern Tasmania, which would be the logical centre of the industry. Unless produced as a sideline from an alginate plant, potash and iodine production could be made payable only in war-time. No commercial production of these substances has yet begun.

The commercial development of agar has stimulated systematic and distributional studies of the Rhodophyceæ, and this work is progressing steadily.

FORTHCOMING EVENTS

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

Saturday, February 26

SCHOOL NATURE STUDY UNION (at the Central Club, Y.W.C.A., Great Russell Street, London, W.C.1), at 2.30 p.m.—Thirty-eighth Annual Conference; at 3 p.m.—Prof. W. B. R. King: "The Evidence of Fossils".

Monday, February 28

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. E. B. Bailey, F.R.S.: "Natural Resources of Great Britain", 2: "Underground Water". (Cantor Lectures, 2.)

SOCIETY OF CHEMICAL INDUSTRY (PLASTICS GROUP) (joint meeting with the ASSOCIATION OF TAR DISTILLERS) (at Gas Industry House, 1 Grosvenor Place, London, S.W.1), at 2.30 p.m.—Dr. H. Levinstein and Mr. J. Idris Jones: "Plastics and the Coal-Tar Industry".

BRITISH ASSOCIATION OF CHEMISTS (NORTH-EAST SECTION) (in the Chemistry Lecture Theatre, King's College, Newcastle-upon-Tyne), at 5.30 p.m.—Prof. J. B. Speakman: "Protein Fibres, their Reactivity and Industrial Application" (Fifty-fourth Bedson Lecture).

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at Austria House, 28 Bryanston Square, London, W.2), at 7.15 p.m.—Mr. N. J. Radinger: "Rust, Acid and Heat Resisting Steels" (in German).

Tuesday, February 29

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. Clyde Higgs: "Mechanisation of the Mixed Farm".

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (joint meeting with the PHYSICAL SOCIETY OF MANCHESTER and the GEOGRAPHICAL ASSOCIATION) (at the University, Manchester), at 5 p.m.—Dr. E. C. Bullard: "Geological Time".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. J. Ramsbottom: "Fungi and Modern Affairs", 3. "Fungi in Harness".*

INSTITUTION OF CIVIL ENGINEERS (STRUCTURAL AND BUILDING ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Miss Letitia Chitty: "Modern Experimental Methods in connexion with the Design of Statically Indeterminate Structures".

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 6.30 p.m.—Mr. J. C. Gregory: "The Technique of Metallographic Examination".

Wednesday, March 1

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—The Rt. Hon. the Earl De La Warr: "Flax Production in War, and its Prospects in Peace".

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. A. J. Maddock: "Some Applications of Thiratrons in Radio Engineering".

INSTITUTE OF WELDING (at the Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Mr. W. K. B. Marshall: "Recent Developments in the Welding of Light Metals".

Thursday, March 2

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Jack Drummond: "Food Fads and Food Fallacies".*

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (in the Reid-Knox Hall, British Institute of Radiology, 32 Welbeck Street, London, W.1), at 5.30 p.m.—Dr. F. C. Toy: "Electron Microscope".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. A. E. W. Austen and Miss W. Hackett: "Internal Discharges in Dielectrics, their Observation and Analysis".

CHEMICAL SOCIETY (LEEDS AREA LOCAL SECTION) (joint meeting with the LEEDS UNIVERSITY CHEMICAL SOCIETY) (in the Chemistry Lecture Theatre, The University, Leeds), at 5.30 p.m.—Discussion on "The Mechanism of Oxidation-Reduction Reactions" (to be opened by Prof. H. S. Raper, F.R.S., Prof. M. G. Evans and Dr. W. A. Waters).

Friday, March 3

PHYSICAL SOCIETY (in the Physics Department of the Imperial College, Imperial Institute Road, London, S.W.7), at 4.30 p.m.—Mr. A. J. Philpot: "Physics and the Scientific Instrument Industry".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—The Rt. Hon. Lord Rayleigh, F.R.S.: "Pebbles of Regular Shape, and their Reproduction in Experiment".*

CHEMICAL ENGINEERING GROUP (joint meeting with the GLASGOW SECTION OF THE SOCIETY OF CHEMICAL INDUSTRY and the INSTITUTION OF CHEMICAL ENGINEERS) (at the Royal Technical College, Glasgow), at 7.30 p.m.—Mr. Frank Broadbent: "Centrifuges".

Saturday, March 4

BRITISH ASSOCIATION OF CHEMISTS (LONDON SECTION) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. T. J. Drakeley: "Training for the Chemical Industries".

GEOLOGISTS' ASSOCIATION (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Prof. H. H. Read, F.R.S.: "Meditations on Granite", Part 2 (Presidential Address).

APPOINTMENTS VACANT

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

GRADUATES (3, temporary) for MATHEMATICS and SCIENCE at the Hammersmith School of Building and Arts and Crafts, Lime Grove, London, W.12, and a GRADUATE (temporary) for MATHEMATICS and ENGLISH SCIENCE (CHEMISTRY, PHYSICS, MECHANICS) at the Clapham College Annexe, Nightingale Lane, London, S.W.4—The Education Officer (T.1), County Hall, Westminster Bridge, London, S.E.1 (March 1).

ASSISTANT MASTER IN MATHEMATICS AND SCIENCE in the Junior Technical School—The Principal, Royal Technical College, Salford 5, Lancs. (March 1).

DIRECTOR OF THE IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, Government of India—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. O.N.F. 2080A) (March 1).

RESIDENT ENGINEER (location, Northern Ireland), to take charge of Construction Work in connection with an important Power Station extension and High Voltage Transmission Lines, Switching Stations, etc.—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. D.759.XA) (March 4).

ASSISTANT IN THE HORTICULTURAL DEPARTMENT, with practical experience in Fruit Growing and Commercial Horticulture, to organize spraying operations and supervise the proper cultivation of orcharding—The Chief Executive Officer, Hereford War Agricultural Executive Committee, 4 St. John Street, Hereford (March 5).

ASSISTANT LECTURER IN THE MINING DEPARTMENT of the North Staffordshire Technical College—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (March 6).

EXECUTIVE ENGINEERS, Grade IV, for the Nigerian Government Public Works Department—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.773A) (March 6).

IRRIGATION ENGINEER by the Government of Northern Rhodesia—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.784A) (March 8).

PHYSICIST—The Registrar, University College, Hull (March 9).

SENIOR DIETICIAN (woman, temporary) by the Department of Health for Scotland—The Ministry of Labour and National Service, Appointments Office, 5 Rothesay Terrace, Edinburgh 3 (March 11).

PRINCIPAL—The Clerk to the Governors, Harper Adams Agricultural College, Newport, Shropshire (March 18).

PROFESSOR OF MECHANICAL ENGINEERING in the Benares Hindu University Engineering College—The Secretary, Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1 (March 18).

COMMISSIONS IN H.M. FORCES (a limited number) will be granted to candidates who are University-trained Biologists, preferably men with some experience of malaria or entomology—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. ONF.2057A) (March 18).

UNIVERSITY CHAIR OF ANATOMY tenable at St. Mary's Hospital Medical School—The Academic Registrar, University of London, c/o Richmond College, Richmond, Surrey (March 20).

WAYNFLETE PROFESSORSHIP OF METAPHYSICAL PHILOSOPHY—The Registrar, University Registry, Oxford (April 13).

PROFESSORSHIP OF ENGINEERING SCIENCE—The Registrar, University Registry, Oxford (April 30).

DIRECTOR OF THE INSTITUTE OF MEDICAL AND VETERINARY SCIENCE, Adelaide—The Agent-General and Trade Commissioner for South Australia, South Australia House, Marble Arch, London, W.1 (May 31).

TEACHER (part-time) OF ANIMAL PHYSIOLOGY in the Department of Biology—The Principal, Chelsea Polytechnic, Manresa Road, London, S.W.3.

ASSISTANT LECTURER (temporary) in AGRICULTURAL CHEMISTRY—The Registrar, The University, Reading.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial Agricultural Bureaux. Photoperiodism in the Potato. By C. M. Driver and J. G. Hawkes. Pp. 36. (Cambridge: Imperial Bureau of Plant Breeding.) 2s. 6d. [201

The Place of Science in China. By Yap Pow-Meng. Pp. 24. (London: China Campaign Committee.) 6d. [201

Institution of Mechanical Engineers. Rules for Examinations and for Submission of Theses. Pp. 16. Supplement to Rules for Examinations and for Submission of Theses. Pp. 16. (London: Institution of Mechanical Engineers.) [201

Other Countries

Universidad Nacional de La Plata: Publicaciones de la Facultad de Ciencias Fisicomatematicas. Serie 3: Publicaciones especiales, No. 23 (No. 169): Sanemiento Urbano en la Republica Argentina—Provisión de agua y desagües urbanos. Por Prof. Everisto Artaza. Segunda Parte: Desagües urbanos, Cuaderno No. 1: Centralizacion de los servicios de obras sanitarias; desagüe cloacal; naturaleza del liquido cloacal; bases de calculo; lugares de vertimiento. Pp. 118. (La Plata: Universidad Nacional de La Plata.) 4 dollars. [171

Report of the Anglo-American Caribbean Commission to the Governments of the United States and Great Britain for the Years 1942–1943. Pp. xi+94. (Washington, D.C.: Anglo-American Caribbean Commission; London: Crown Agents for the Colonies.) 3d. [171

The vacancies advertised in these columns are available only to applicants to whom the Employment of Women (Control of Engagement) Orders, 1942-3, do not apply.

MURDOCH TRUST

For the BENEFIT of INDIGENT BACHELORS and WIDOWERS of good character, over 55 years of age, who have done "something" in the way of promoting or helping some branch of Science. Donations or Pensions may be granted to persons who comply with these conditions.

For particulars apply to MESSRS. SHEPHERD & WEDDERBURN, W.S., 16 Charlotte Square, Edinburgh. 2

CHELSEA POLYTECHNIC

MANRESA ROAD, S.W.3

A course of four lectures on POLYMERS and POLYMERISATION will be given by J. K. AIKEN, ESQ., Ph.D., on MONDAY EVENINGS from 6.30 to 7.30 p.m., commencing MONDAY, MARCH 6, 1944. Fee for the course 10s. Particulars on application to the Principal.

CHELSEA POLYTECHNIC

MANRESA ROAD, S.W.3

A course of five lectures on MODERN METHODS in PREPARATIVE ORGANIC CHEMISTRY will be given by A. H. COOK, ESQ., D.Sc., F.I.C., on THURSDAY EVENINGS from 6.30 to 7.30 p.m., commencing THURSDAY, MARCH 2, 1944. Fee for the course 10s. Particulars on application to the Principal.

MINISTRY OF LABOUR AND NATIONAL SERVICE

Required, well-qualified Metallurgist, to take charge of Research and General Laboratories, Heat Treatment, etc., in Sheffield Steel Works. Salary £800–£1,200 per annum. Applicants should write to the Ministry of Labour and National Service, Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2, for the necessary application forms, which should be completed and returned not later than March 31, 1944. The reference number F.2048 XA must be quoted.

MINISTRY OF LABOUR AND NATIONAL SERVICE

A limited number of commissions in H.M. Forces will be granted to candidates who are University trained biologists, preferably men with some experience of malaria or entomology. Age should not normally exceed 35 years. Service rates of pay. Application should be made in writing to the Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2, for the necessary forms which should be returned completed on or before March 18, 1944. The reference number ONF. 2057A must be quoted.

BEDFORD COLLEGE FOR WOMEN

(UNIVERSITY OF LONDON)
REGENT'S PARK, N.W.1

The Council of Bedford College invites applications for the following posts in the DEPARTMENT of BOTANY, open to men and women equally:

(a) Vacant as from October 1, 1944:
LECTURER.—Candidates must have a Special Degree in Botany. Salary £350–£500 p.a. plus war bonus. Initial salary may be higher than the minimum of scale if warranted by candidate's qualifications.
DEMONSTRATOR.—Candidates must have a Special Degree in Botany. Salary £250–£300 p.a. plus war bonus.

(b) Vacant as from April 1, 1944:
MUSEUM ASSISTANT.—Candidates must have a Special Degree in Botany. Salary £250–£300 p.a. plus war bonus.

Last date for receiving applications March 8, 1944. For further particulars apply to the Secretary.

INSTITUTE OF MEDICAL AND VETERINARY SCIENCE, ADELAIDE, SOUTH AUSTRALIA

Applications are invited from medical graduates for the office of Director of the Institute of Medical and Veterinary Science, Adelaide, South Australia, under the Council of the Institute of Medical and Veterinary Science. The successful applicant will be appointed by the Council of the University of Adelaide to be Keith Sheridan Professor of Experimental Medicine in the University of Adelaide.

The salary is £1,500 (one thousand five hundred pounds) per annum, payable in Australian currency. If a candidate from Great Britain, Canada, or America is appointed the salary will commence from the date of his embarkation, and a first class fare to South Australia will be provided, and, if he is married, for his wife also.

Provision for superannuation will be made on the lines of the Federated Superannuation system for British Universities, i.e., 10 per cent annually in addition to salary plus 5 per cent paid by the beneficiary, to be applied in payment of approved life assurance premiums.

The duties are the following:

1. As Director of the Institute of Medical and Veterinary Science he will be the principal executive officer of the Council of the Institute and will be responsible for the control and management of the Institute.

2. As Keith Sheridan Professor of Experimental Medicine, he will engage in the Institute in the active study and investigation of diseases of human beings and animals, and into problems connected with such diseases, and in postgraduate teaching and examining as directed from time to time.

The appointment in the first instance will be for a period of five years, subject to the Institute of Medical and Veterinary Science Act, 1937. A medical certificate of physical fitness is to be forwarded with the application.

Further particulars may be had from the Agent-General and Trade Commissioner for South Australia, South Australia House, Marble Arch, London, W.1, England, who has reports of the Institute, copies of the calendars of the University of Adelaide and copies of the Institute of Medical and Veterinary Science Act, 1937, and regulations.

Applications from medical graduates in Great Britain, the United States and Canada, including among other particulars the approximate date on which the candidate could begin work, should be sent to the Agent-General for South Australia at the above address before May 31, 1944.

(Signed) C. T. CH. DE CRESPIGNY,
Chairman of the Council, Institute of Medical and Veterinary Science.

THE BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION

Assistant required in Information Department for editorial and abstracting work. Qualifications in Metallurgy, Chemistry or Physics, and preferably some knowledge of languages. Salary in accordance with qualifications and experience.—Apply, stating salary required, to the Secretary, B.N.F.M.R.A., Euston Street, London, N.W.1.

UNIVERSITY COLLEGE OF HULL

TEMPORARY APPOINTMENT—DEPARTMENT OF PHYSICS

Applications are invited for a Physicist. Salary £275 to £350 per annum, according to qualifications and experience. Particulars of this appointment may be obtained from the Registrar, to whom applications should be sent not later than March 9.

Professorship of Mechanical Engineering, Engineering College, Benares Hindu University—applications to be made, not later than March 18, 1944, to The Secretary, The Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

THE LABORATORY, PLYMOUTH

Limited supplies of marine biological material are still available, but orders should be placed well in advance.

For prices and detailed information apply to:
THE DIRECTOR, THE MARINE BIOLOGICAL LABORATORY, PLYMOUTH.

Physics Master or Mistress required in May for post in West of England Public School for Boys. The duties of the post comprise responsibility for the organization and teaching of Physics throughout the School up to Open University Scholarship standard. Salary in accordance with qualifications and experience. The appointment may be for one term or for the duration of the war, but a permanent appointment might be offered to a suitably qualified man. Written applications, giving full particulars, should be submitted as soon as possible to Box 152, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

A further week-end course for doctors interested in Health in the Factory will be held at the London School of Hygiene and Tropical Medicine on Saturday and Sunday, March 25 and 26, 1944. Details of the programme and application forms may be obtained from the Secretary of the School, Keppel Street, Gower Street, London, W.C.1. The fee is £1 1s. with an additional 2s. 6d. if lunch is desired on Sunday.

Chemist required for research work in Non Ferrous Metals. Degree standard or equivalent in Inorganic Chemistry. Metallurgical experience an advantage. Age 25–35. Salary according to qualifications and experience. Permanent progressive position to suitable applicant.—Box 160, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

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Translations of Scientific and Technical Papers from Danish, Dutch, French, German, Italian, Norwegian, Russian, Spanish and Swedish originals. Thirty-five years experience.—George Borrow, 6 St. Stephen's Grove, London, S.E.13.

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1–10″ dia. × 80″ Curvature Spherical Mirror, metal or glass, high quality, purchase, hire or loan.—Please write Box 156, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

The Holder of British Patent No. 544630 wishes to get in touch with persons interested in Improvements in Weighing Balances.—Box 157, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Wanted: Petrological Microscope with synchronous rotation of polariser and tube analyser (not cap nicol). Preferably Leitz Model SY.—Particulars to Broughton Edge, Royal School of Mines, London, S.W.7.

Chemical Laboratories on work of National importance wish to obtain copy of "Die Methoden der Organische Chemie" by Houben-Weyl, also Beilstein any volumes and supplements.—Box 159, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Reflecting Telescopes: 10″ Mirrors of excellent quality £18 10s. Flat 7s. 6d.—Roland Lee, "Infield," Babell, Holywell, Flintshire.

Chemical, Physical, and Natural History Journals of every country urgently required. High prices paid. Please send particulars to The Scientific Book Supply Service, 5 Fetter Lane, London, E.C.4. (Phone: CEN 1294.)

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