NATURE

No. 3784 SATURDAY, MAY 9, 1942 Vol. 149

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Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number : Whitehall 8831
Telegrams : Phusis Lesquare London

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad

ORGANIZATION OF PRODUCTION

THE interest with which the recent debate in the House of Commons on production was followed indicates how thoroughly the importance of the issues is understood in Great Britain, and the anxiety that there shall be no further weakness in either administration or in policy. The limitations of man- and woman-power, and also of materials, are much too severe for there to be complacency over waste either through individual slackness at the level of the operatives or through inefficiency at that of management. The speech made by Mr. Oliver Lyttelton as Minister of Production was clear and encouraging. He has an exact notion of what is to be accomplished, and he made the new arrangements sound more reasonable than they did in the Prime Minister's formal announcement.

The Minister of Production faces three major tasks. One is to ensure that the domestic production programme of Great Britain is both balanced and efficient. The second is to integrate it with the programmes and needs of the other united nations, and particularly with those of the United States. The third is to ensure "a complete fusion between military plans and thought and production plans and thought", not only in the realm of strategy, but also in that of battle tactics. It is this task, probably the most urgent, that has for some time been the special concern of scientific workers. It has been the burden of conferences arranged by the Association of Scientific Workers on science and the war effort. It was voiced by Sir Henry Tizard at the annual luncheon of the Parliamentary and Scientific Committee, and it was the main theme of Prof. A. V. Hill's long speech in the House of Commons on the war situation on February 24.

Mr. Lyttelton's statement that to accomplish this purpose there is to be what he described as a general staff of war production goes some way to meet Prof. Hill's plea for a general staff with executive functions, including a full-time technical section of able officers of all arms who have grown up with modern weapons and equipment, to deal with the general strategy of the War. The body described by Mr. Lyttelton is designed to be an exact parallel to the Chiefs of Staff Committee on the military side. It will consist of his Chief Adviser on Programmes and Planning, Sir Walter Layton, the assistant chiefs of staff of the three Services, together with the highest technical officers of the three Production Ministries, and will be the servant on war production matters of the Defence Committee.

The Joint War Production staff will be served by a Joint War Production Planning Group concerned with the planning of what is to be produced, and composed of Navy, Army and Air Force officers and representatives of the Production Ministries working together in the same office. These proposals forestall some of the recommendations in the Eighth Report of the Select Committee on National Expenditure, dealing with the organization of production, which has since appeared, particularly those relating to a balanced plan, to an adequately staffed

Intelligence and Programmes Branch, and to the examination as a matter of urgency of means of formulating with precision, and so far as possible in advance, the demands of the Fighting Services. The Joint War Production Staff with the Programmes and Planning Division will work in close touch with, and supply information required by, the combined Anglo-American organization. Arrangements are being made to include a study of the war production and requirements of the Empire, and Mr. Lyttelton was at pains to stress that the object of the new organization is to ensure that production is closely and continuously related to strategical requirements as well as battle tactics.

This section will be in the charge of Sir Walter Layton, and will also be intimately concerned with such combined problems facing the United Nations as the dovetailing of the British supply of raw materials and British manufacture of munitions into the programme of the United States. A special Raw Materials Division will deal with general policy on the development of raw materials, on the control of import of raw materials, the allocation and releases of stocks of raw materials, with an Empire clearing-house and with the relations between the British Raw Materials Committee and the committee in the United States which deals with the combined raw material requirements and supplies of the United Nations. A further Production Division will be a small technical division in the charge of an industrialist with wide general experience. To him will be attached a technical officer from each of the three Production Departments, so that the closest touch will exist between the Production Division and the Department. The main functions in the industrial field of this Division will be those subjects which affect all three Production Departments simultaneously.

Mr. Lyttelton will address himself particularly to the problems of steady production in the face of changes in the enemy's strategy, in the geographical theatres of war, the accession of new allies, the appearance of new enemies, and the interruption of sources of raw materials, which may oblige us to substitute one type of munition for another. Moreover, he recognizes the importance of relieving the natural concern and anxiety of workers who may find idle time on their hands from such causes. The new Minister of Production is clearly resolved to see that enforced idleness, whether it springs from the loss of shipping carrying essential supplies, the necessity of substituting a new type on a sudden message from the battle-front, or delay or destruction due to enemy air attack on factories or communications, does not become the breeding-ground of suspicion and misgiving.

The importance of taking the workers into the Government's confidence in this respect, in order to achieve the extra production and with it the aggressive spirit in industry as well as in the Fighting Services, is not easily overstressed. It will go far to eliminate the bad discipline which is another source of inefficiency, and in itself it should be a spur to more efficient management where required. Mr. Lyttelton promised that no defects will be glossed over, and that where something is proved to have been wrong, such measures as are possible will be taken to put it right.

Mr. Lyttelton said little himself about management efficiency, but the whole tone of his speech implies that he is prepared to countenance disciplinary action against management as well as against worker where required. There is already the precedent of the War Agricultural Committees in dealing with inefficient farmers, and if similar measures were applied to the managements of workshops or factories where required, and in backward establishments there were enforced those simple rules upon which the health and efficiency of labour so largely depend, much would have been done to remove suspicion of unfairness and to create the conditions for effective team-work upon which so much depends. The new Regional Division, the most radical change announced by Mr. Lyttelton, is an attempt to raise the standard of organization of production among the many smaller firms, and like the works committees, will depend for its success largely upon such a spirit of co-operation. Local organizing ability will be given a chance to show itself, just as the works committee can be used as a clearing-house for explanations and suggestions and for levelling up practice in all the shops of one trade.

But team-work must be forthcoming from more than the workers and the factory management. Mr. Greenwood's observation that in the past there has not been the full team-work and co-operative spirit in the Production Departments without which maximum effort is not possible should be taken to heart at the very top as well as at the bottom. In this connexion the Seventh Report of the Select Committee on National Expenditure, which has since appeared, points out that so far the organization of labour supply has not been undertaken with that breadth of conception and firmness of execution which are necessary for the creation of our maximum military strength. The Minister of Production's spirit of co-operation and open mind must be widely shared if we are to solve all the difficult strategic problems of production and of man- and woman-power, perhaps especially those involved in the increasing use of women in industry and the exploration of the use of part-time labour.

Mr. Lyttelton's clear conception of the powers attaching to his office—his supreme authority over raw materials and over machine tools, and a co-ordinate authority over labour—and the machinery which he has superimposed on that already existing, interlocking the affairs of the workers with those of the fighters, have already engendered high hopes of the instrument in his hand. Whether he is to wield it effectively for the destruction of the enemy depends on more than Mr. Lyttelton's own personality and ability. It depends on the support and co-operation which he receives from the Cabinet downwards, and the more boldly he uses his authority the more loyally he will be supported.

Organization alone will not secure the full production that is desired, though that is no reason for

tolerating inefficient administration, bad management or defective organization. The shortage of efficient administration makes it essential, as Sir John Wardlaw-Milne insisted, to use the large number of men of fifty and above who have wide administrative experience but are largely unused. But to knit Government, management and workers into one harmonious team keyed up to its maximum effort and efficiency, we need a new spirit of aggressiveness.

There may be differences of opinion as to whether that new spirit will spring, at least directly, from the self-interest which Sir John Wardlaw-Milne stressed in this connexion. There is likely to be wider support for Sir William Beveridge's view in his plea for a new spirit in grappling with total war, that if war is to be waged offensively against evil, for the ideals of tolerance, fair play, freedom of thought and speech, kindliness and the value of the individual soul, it must be in the spirit and passion of a crusade, in a spirit of service, transcending the thought of duty alone.

There are few scientific workers who would not respond to Sir William Beveridge's noble plea in his recent article in *The Times* for the casting aside in this time, and for the building of the peace when victory is won, of the obsolete party allegiances and ideals, of profit and of selfish and money-making motives. These are the obstacles to full comradeship and trust, in production as in arms, and Lord Hankey's weighty words on the machinery of government in the House of Lords point to a weakness in government, to which Sir William Beveridge also referred, through the attempt to construct the Government more on the balancing of party considerations than on grounds of national efficiency. Service rather than gain should be the main motive of war effort in Government and in industry as in fighting. There can be no doubt of the response of the nation to great leadership; it is earnestly to be hoped that the new production machinery will be boldly and imaginatively used, that constructive ideas will come from above, and that inspired leadership will kindle a new comradeship and loyalty which shall carry us swiftly to full victory.

MODERN THEORY OF CHEMICAL REACTIONS

The Theory of Rate Processes

The Kinetics of Chemical Reactions, Viscosity, Diffusion and Electrochemical Phenomena. By Samuel Glasstone, Keith J. Laidler and Henry Eyring. (International Chemical Series.) Pp. ix+611. (New York and London: McGraw-Hill Book Co., Inc., 1941.) 42*s*.

PHYSICAL chemistry started with van t' Hoff's discovery (1884) of the reaction isochore, which, fundamentally, stood on the same ground as the gas theory of Maxwell and Boltzmann. In the field of reaction rates the ideas of this period produced the mass action law of Guldberg and Waage and the exponential equation of Arrhenius.

Planck's quantum theory (1900) led to a new departure in physical chemistry. Its application to thermodynamics resulted in the third law, which defined in principle the position of chemical equilibria in absolute terms. There occurred, however, no corresponding progress in the field of reaction rates; in fact, for the time being, the nature of chemical change became rather more obscure. Between the classical Maxwell-Boltzmann view of atoms in perpetual motion passing continuously through every conceivable configuration, and the rigid set of stationary states postulated by quantum theory, there was an essential contradiction which paralysed, rather than stimulated, inquiries into the ways by which atoms can pass from one molecular partnership into another.

Quantum mechanics opened a third phase of physical chemistry, in which the theory of reaction rates received a new stimulus. Heitler and London's theory of the electron-pair bond and London's treatment of the three-electron and four-electron problem gave a general— though to begin with naturally somewhat crude—conception of the way in which atoms may become engaged and disengaged in the course of chemical reactions. Since 1929 a steady development has been going on from this starting-point, in which the work of H. Eyring has played the most important part. "The Theory of Rate Processes" was written, as the introductory chapter tells, in the conviction that this last phase has now reached some conclusive results. The book is meant to demonstrate this.

We are thus presented here with a survey which attempts a synthesis of many single contributions in the light of one set of propositions. It is an authoritative effort carried out with vigour, skill and profundity, and its result is a unique achievement. There can be no doubt that all future inquirers in the field of reaction theory will have to start by consulting this work.

Yet there remains the question: Does the book, and the work reviewed in it, fulfil the desire for a theory of chemical reactions?

The answer is not simply affirmative. There is no single new law claimed here of the kind of the reaction isochore or the third law. We could predict all chemical reactions, if we could solve the quantum mechanical equations; but that, of course, is a truism. The purpose of the new theoretical apparatus is in fact to find approximate solutions for specific classes of integrals, often circumventing part of the problem by introducing empirical values for terms which cannot be evaluated from first principles. The quasi-empirical method for calculating activation energies, the theory of the activated complex, both in its statistical and its thermodynamical forms, represent a scaffolding by which the general theorems of quantum mechanics can be brought to bear on concrete 'rate processes'. The real question is, therefore, how far they have succeeded in this function.

One claim, I think, can now be made in this respect without much danger of a challenge to the contrary. The modern theory of reaction rates has finally succeeded in establishing itself as an indispensable method of thought. It has become the recognized tool for any detailed speculations in the mechanism of chemical change; in fact for any intelligent appreciation of the subject. I think that in addition to this a good deal of sound semi-quantitative confirmation has also been obtained. But I would hesitate to pronounce on its finality. In many cases we are clearly yet at the stage where we must be satisfied to account for the observed phenomena, without claiming much certainty for our explanation.