

plant, or of a large number of items which together form a unified whole. A completely air-conditioned and automatically controlled wind tunnel for heat transfer tests is an example of the latter, sixteen firms having worked together to produce a unique plant of great value.

In addition to generous help from the local education authority, and from the University Grants Committee, the College has profited very greatly from the scheme for the acquisition of surplus government equipment in the development of which it played a leading part, and from loans from government departments.

In a Department which has been almost entirely equipped or re-equipped on a lavish scale within a few years, only a few sections can here receive special mention. The many problems relating to heat claim six laboratories, including extensive provision for the study of heat generation and transmission involving the use of a number of wind tunnels, of refrigeration and of instrumentation. The large new laboratory is devoted to the detailed examination of the various machining processes, to the structural and functional design of machine tools, and to advanced welding methods and the design of welded structures. The laboratory for the examination of the strength of materials contains much excellent equipment and has ample provision for the study of fatigue, and a very wide range of strain-measuring devices. A new laboratory for the study of problems in relation to hydraulic power transmission is being equipped to supplement the more normal work of the Mechanics of Fluids Laboratory. The excellence and range of equipment in the Engineering Metrology Laboratories place them in a unique position to aid in the development of the teaching of the subject up to the highest levels and to serve precise researches in many branches of engineering. Though less spectacular, the work of the Department on the close study of teaching methods in the laboratory and the teaching of machine design is of considerable interest.

The Department of Mechanical Engineering is very happily supported in its work by associated Departments of Electrical Engineering, Metallurgy, Physics, Chemistry and Mathematics, to which it contributes in its turn.

The College can indeed be congratulated on having achieved a unity of purpose by a process involving adaptability and constructive compromise, and for the part which it is playing in the development of the study and teaching of technology in Great Britain.

## COMMITTEE ON INDUSTRIAL PRODUCTIVITY

### REPORT FOR 1949

**T**HE second report of the Committee on Industrial Productivity\*, which covers the activities of the Committee during 1949, is also the final report, for in it the Committee reaches the conclusion that no further purpose would be served by its continuance, as the tasks hitherto entrusted to it can in future be better performed by other existing bodies. In a written statement to Parliament on July 24 the

\* Second Report of the Committee on Industrial Productivity. (Cmd. 7991.) Pp. 10. (London: H.M. Stationery Office 1950.) 4d. net.

Lord President of the Council announced that the Government had accepted the Committee's own recommendation for its discharge; the Lord President said further that, since the time when the Committee and its panels were set up as a short-term measure to bridge the gap between the winning and application of knowledge in both the natural and the social sciences, the importance of increasing industrial productivity has become generally accepted and productivity is increasing at a most encouraging pace.

The Committee in its report refers to the work of the Anglo-American Council on Productivity which has already sent twenty-four productivity teams, representative of the management-, technical- and workshop-levels in selected sectors of British industry, to visit the corresponding sectors of industry in the United States, and to the action taken by more than twenty trade associations, encouraged by the Engineering Advisory Council of the Ministry of Supply, to work out mutual aid schemes or increase efficiency and reduce costs. The General Council of the Trades Union Congress has decided to establish a productivity department and has asked the British Institute of Management, which is steadily increasing its activities, to prepare a handbook on productivity techniques for workshop representatives, etc.

Besides work on standardization and simplification in industry and the establishment of the National Research Development Corporation in June 1949, good progress has been made in the development of joint consultation and works information in industry, while the Technical Assistance Scheme of the Economic Co-operation Administration has made possible visits to the United States by a number of specialists and technicians from Government departments and research associations to examine particular problems in the United States from the point of view of increasing production and efficiency in Great Britain. Arrangements can also be made for teams of experts from a number of countries to go to the United States to study, for the benefit of European industry as a whole, particular advances in American technology, and the United Kingdom has already participated in several such projects.

Available figures indicate that productivity has been steadily increasing during the past two years, and the Committee on Industrial Productivity regards it as reasonable to assume that the increased production is due chiefly to an increased annual output per worker. It emphasizes that, while the part played by science and technology in promoting productivity is clear and well recognized, but subject for achievement to such conditions as an ample supply of power and of capital for improvement, it is doubtful whether the importance of the human side of the problem is yet sufficiently appreciated. Technical improvements cannot achieve their full effect if the necessary human relations are lacking. The Committee believes that scientific investigation can help the promotion of good human relations, and that it is necessary to develop the social sciences side by side with the physical sciences; the approach to the human aspects of this problem must not be too narrow, but should be based on a study of all relevant parts of social environment. Furthermore, the Committee is of the opinion that it is not always enough, in considering possible improvements in productivity, to examine human factors alone or in isolation; human and technological factors in industry tend to be intermingled or intimately related and to react so

decisively on each other as to call for a joint consideration of the two aspects.

The Panel on Human Factors in Industry has continued to sponsor the nine research projects mentioned in the first report of the Committee, and in addition has been concerned with the training of field-workers for research into social problems in industry, the effects of compulsory National Service on the training and attitude to work of young industrial workers, and arrangements for ensuring the effective dissemination of information acquired in the course of research into the human aspects of the production problem. Reports on the research projects are expected to be ready in the latter half of this year, and the Committee thinks that their completion should be made the occasion for a full review of the Panel's work. This review, the Committee recommends, should be carried out by the Medical Research Council, and the Government should then consider whether the scheme which that Council is working out with the Department of Scientific and Industrial Research for undertaking wider programmes of work in the field of human factors will adequately cover the national needs in this field.

The statement on July 24 by the Lord President of the Council indicates that appropriate arrangements to this end are being made, and also that the Panel on Imports Substitution is being re-formed to deal with technical aspects of the development of natural resources, whether to save imports or not. The Committee's other recommendation that the work of the Panel on Technology could be adequately provided for by the appropriate production departments and by the Department of Scientific and Industrial Research calls for no specific action, but, as recommended by the Committee on Industrial Productivity, the Advisory Council on Scientific Policy has taken over, as a matter of long-term concern to science and industry, the responsibility for following up the work of the Panel on Technical Information Services (see *Nature*, August 26, p. 323). Here, as generally, the main reason for the termination of the work of the Committee is that the keener and more general interest in the wide range of problems with which it has been concerned has diminished the value of its own contribution, and has made it more important for the main responsibility for studying these problems to be placed on more specialized bodies and on those in day-to-day touch with particular industries.

## STOCHASTIC PROCESSES

THREE papers, which have already appeared in the *Journal of the Royal Statistical Society* (Series B (methodological), 11, No. 2) and which were read at a symposium on stochastic processes held on June 9 last year, have now been published together in one volume\*. While in no sense a complete exposition of this thriving field of research, they provide a lucid introduction to three different aspects of the theory, together with important original contributions.

The first and longest paper, by J. E. Moyal, begins with a survey of statistical theories in theoretical physics, which is followed by a long and systematic

account of stationary and additive random processes. These two subjects are both well known to specialists in each; but few are acquainted with both, and the main purpose of Moyal's paper is to demonstrate the very great importance which the theory of random processes is beginning to assume in many different branches of physics. This is done in the third part of the paper where the previously developed theory is applied to a variety of subjects such as the theory of quantum-mechanical wave packets, various aspects of the Brownian motion, the shot effect, the theory of noise and the theory of turbulence. The paper concludes with an elaborate and original discussion of the differential equations of motion for the distribution functions of physical processes with applications to classical kinetic theory, the thermodynamics of non-uniform states and quantum theory.

The second paper, by Prof. M. S. Bartlett, is concerned with evolutive processes which are either additive as in the problem of the random walk, or multiplicative as in more complicated situations. Bartlett describes various special additive random processes such as those which occur in the theory of insurance risk and in industrial renewal theory, and unifies his discussion by basing it on Wald's fundamental identity in the theory of sequential analysis. This section concludes with a very pretty application of random walk theory to Kolmogoroff's theory of cumulative sample distribution functions.

Multiplicative and other non-additive processes are described in the second part of Bartlett's paper. These have arisen in a variety of problems, the earliest being that of the probability of extinction of surnames, which was proposed by Galton. Such processes also occur in physics and genetics. Bartlett considers problems of a more complicated type concerned with what he calls "mixed" processes, and discusses, in some detail, the application of such a theory to the epidemiology of measles.

D. G. Kendall's paper is mainly concerned with those multiplicative processes with a continuous time variable which are the natural probabilistic generalizations of the usual deterministic formulation of population growth, but he also gives a very interesting account of the history of the 'surname problem' mentioned above. Kendall gives a lucid account of earlier work on stochastic population models and the related physical problems considered by Furry and Arley. This is followed by an account of some further new contributions of his own. These deal with the problem of the estimation of parameters from an observed process, with the stochastic formulation of the 'problem of the two sexes' which has already been discussed deterministically by Karmel, and lastly with the stochastic fluctuations in the age distribution. Much remains to be done on these problems, especially the last.

Not the least interesting part of this volume is the verbatim report of the discussion which followed the three papers. This included a simple demonstration of the solution of the equations of the simple type of 'birth and death' process by N. Arley, discussions of the application of stochastic processes to the mutation of bacteria by Coulson and Armitage, and further original contributions by Good, Prendiville and Le Couteur. The most impressive feature of the whole symposium is the very wide range of application of these theories, and it is clear that every person interested in the application of mathematics to other sciences should read this volume carefully.

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\* Symposium on Stochastic Processes (Contributions by J. E. Moyal, M. S. Bartlett and D. G. Kendall, and a verbatim report of the subsequent discussion). Pp. 132. (London: Royal Statistical Society, 1949.) 12s. 6d. net.