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THE EXPANDING ROLE OF MATHEMATICS

BY

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Today, mathematics and mathematicians play an ever more significant role in American society. Three causes may be cited to explain the current growth of mathematical studies. The demand for mathematics has been enlarged, in part, by the widespread development of all branches of the physical sciences; in part, by a great increase in the use of mathematics in various departments of the sciences; and, finally, by the increasing importance of mathematics in applied science and technology.

Until a few years ago, the mathematical physicist was primarily concerned with problems related to differential equations. Recently more abstract techniques have come to the fore in such fields as crystal statistics and atomic theory. In quantum physics, for example, the theory of linear representations of Lie groups as operators on Hilbert space has become important; in nuclear physics, Laurent Schwartz's distributions are currently being considered. In all of the observational sciences, there is at present a marked tendency to design and evaluate experiments more carefully by applying the most recent results of statistics. Statistics is now as important in genetics as differential equations are in physics. Indeed, much of the progress in modern statistical theory has been sparked by biologists. In economics and sociology, also, not only the function of the statistician is expanding, but mathematical theories are emerging to deal with the subjects themselves. Economists are trying to apply Von Neumann's theory of games, and educational psychologists are interested in the development of a mathematical theory of rote learning.

In the area of applied science, large sums of money are, at this time, being spent for mathematical research. Both government and private industry now employ more mathematicians than ever before. Virtually every branch of the federal government, from the Bureau of the Census to the Department of Labor, sponsors statistical research, and in some departments —particularly the Department of Defense—there are more complex problems which require every facet of mathematical training. Moreover, the government subsidizes research in both pure and applied mathematics through contracts with colleges and universities.

In industry, modern techniques of quality control have proved to be money-savers. Today most large industries either employ full-time statisticians to supervise their control programs or retain the services of consultants. Moreover, the structure of corporation taxes makes it profitable for industries to invest money in research. As a result, more and more industrial concerns are establishing full-scale research departments which often employ mathematicians. Such subsidies from government and private industry have encouraged progress in various aspects of mathematics. Most of the recent work on game theory has been sponsored by the Department of Defense because of its relevance to military strategy; new achievements in information theory have grown from a general study of communications by mathematicians working at Bell Laboratories, one of the first large research organizations in private industry.

At least two recent developments have magnified contemporary interest in mathematics. The first, which affects not just mathematics, but all scientific studies, is the general stirring of the scientific world occasioned by the war. During the war years, many highly trained mathematicians and other scientists left the universities to work on practical military problems, ranging from the design of weapons to the evaluation of military operations. Their success with these problems was widely publicized and, perhaps, exaggerated. Still it was directly responsible for the government's post-war interest in scientific problems and its willingness to promote further research on a large scale. Industrial leaders also observed the wartime accomplishments of the scientists, and, encouraged by the tax structure, they initiated general research projects on a tentative basis to see what might be accomplished in their own field of interest. They were particularly attracted by operations analysis, the scientific study of efficiency. As for the scientists, some of them developed a genuine interest in practical problems and willingly remained in their new fields. Many of them, to be sure, were also enticed by the relatively large salaries offered by government and industry.

A second notable contributor to the current interest in mathematics is also an outgrowth of wartime research: the development of large-scale electronic calculators. Although they started out as glorified adding machines, computers have gradually been given more and more logical operations, until now they almost merit their popular appelation — "giant brain". When applied to such engineering problems as the design of aircraft, in which weight and safety must be neatly balanced, electronic calculators find answers which could previously have been obtained only by expensive experimentation. In the field of economics, also, linear programming (the maximization of linear forms on convex bodies in many dimensions) obtains results impossible without the aid of a machine. The effects of computers on industrial mathematics, however, are only beginning to be felt. While they were in the experimental stage, computers were available at only a few universities and government laboratories; today several companies advertise electronic calculators for sale or rent, and many large industries are installing them. The development and the increasing use of these computers has had its effect on the theoretical, as well as the practical, aspect of mathematics. By solving large numerical problems, the machines have not only increased the scope of applied mathematics, but also re-awakened mathematicians' interest in numerical analysis. Finally, it is safe to predict a continually increasing demand for mathematicians who specialize in numerical methods.

As yet this new interest in mathematics has not caused a major shift in the occupations of mathematicians. Traditionally, most mathematicians have been teachers. A recent survey shows that eighty-eight percent of the 1320 doctors of mathematics who answered questionnaires are, even today, employed by colleges and universities. The rest were divided about equally between government jobs and positions in industry or industrial research companies. These figures do not, however, present an entirely fair picture of the occupational distribution of American mathematicians. Many of the mathematicians who teach in our colleges also work on government research contracts or consult with industrial firms. Furthermore, the percentage of non-academic mathematicians is rapidly rising: more than one quarter of the over two hundred men who received doctorates in 1951 are now in government or industrial positions.

Recent developments in the field of mathematics pose both a challenge and a threat to the universities. The practical application of mathematics in many diverse studies must encourage us, as educators, to recruit and train more men to meet the increasing demand for mathematicians in all phases of American life. At the same time, we must be on our guard lest the high salaries offered by industry lure too many of our best men away from academic positions, and stop the flow of abstract mathematical research.

L'EXPANSION DU ROLE DES MATHÉMATIQUES

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Résumé.

Les mathématiques occupent un champ de plus en plus large dans l'économie des Etats-Unis. Les applications aux problèmes industriels et militaires ont augmenté la demande d'hommes formés en mathématiques. Vu que le gouvernement et l'industrie offrent souvent des salaires plus grands que les universités, il existe un danger que l'expansion du rôle des mathématiques retarde les recherches abstraites.
