15 June 1984, Volume 224, Number 4654 SCIENCE

Renewing U.S. Mathematics

Mathematics research has been seriously underfunded despite the fact that research opportunities are at an all-time high. At present funding levels the mathematics community is losing its ability to renew itself, let alone maintain its essential contributions to the nation's technical activities. The situation has been obscured because in most published figures funds for mathematics research are merged with those for computer science.

Moreover, this underfunding has been happening at a time when advanced mathematics has never been more important to the nation's scientific and technological enterprise. In the span of just the last two years, advanced mathematics figured critically in no less than four Nobel Prizes awarded to U.S. scientists. The high technology era is the mathematical technology era. The fuel-conserving airfoils for the Boeing 767 and the European Airbus were designed almost entirely through mathematical techniques. The communications and computing revolution proceeds in large part on the basis of mathematical theory created by Wiener, Shannon, von Neumann, Bode, and their successors.

How have we reached this state, and what is to be done about it? These were the issues that quickly crystallized for the National Research Council's Ad Hoc Committee on Resources for the Mathematical Sciences.*

In its two-and-a-half years of study, the committee found enormous distortions and omissions in mathematics support. For example, in 1983 there were as many mathematicians as physicists or chemists in American universities, but only some 60 postdoctoral students in mathematics were receiving federal support compared with about 1200 in physics and 2500 in chemistry. Today, despite an important upturn in 1982 and 1983, federal support for mathematics research is still about two-thirds its 1968 level, in constant dollars, even though the number of researchers in the mathematical sciences has doubled. In mathematics, the country is still reaping the harvest of investments in human resources made in the middle to late 1960's. This is not obvious because increased funding for computer science masks the insufficient investment in mathematics.

The NRC committee concluded that mathematics research is badly out of balance with the rest of the research enterprise in this country. It is all the more out of balance given the increasing inability of the financially pressed universities to support mathematics. Industry support for university research is increasing, but it is likely to remain centered on engineering, computer science, and fields other than mathematics. The mathematics community must look to the federal government.

To rejuvenate mathematics research, the committee proposes a National Plan for Graduate and Postdoctoral Education in the Mathematical Sciences. The plan would bring annual support to the following levels: (i) grants to 1000 graduate students supporting 15 months of research on doctoral dissertations and two preceding summers of preparatory research; (ii) two-year postdoctoral positions or their equivalent for some 200 of the 800 Ph.D.'s earned annually in the mathematical sciences; (iii) 400 postdoctoral research grants for young investigators; and (iv) grants for 2600 established mathematical scientists, both to conduct their own research and to provide training for Ph.D.'s and postdoctoral students.

There has already been progress, primarily in National Science Foundation support. But to ensure that renewal becomes reality, the mathematicians are taking their case to the mathematics constituencies in the sciences, engineering, industry, and government. For the sake of their own enterprise and of the nation, the members of those constituencies should heed their call and help ensure that mathematics regains its essential place in the nation's research priorities.—EDWARD E. DAVID, JR., *president, Exxon Research and Engineering Company, Clinton Township, New Jersey 08801, and chairman of the Ad Hoc Committee*

*National Research Council, *Renewing U.S. Mathematics: Critical Resources for the Future* (Washington, D.C., 1984).