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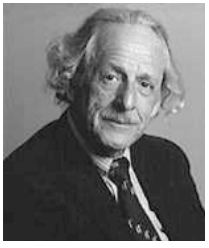

Promoting Undergraduate Science Students Should Participate in Basic Research

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One year ago the National Science Board, the policy-making arm of the National Science Foundation, issued its report on undergraduate education in science, mathematics and engineering in the United States. The study confirmed fears that the quality of instruction in these fields had eroded during the past decade. It described the situation as a "grave long-term threat to the nation's scientific and technical capacity, its industrial and economic competitiveness, and the strength of its national defense."

Contributing problems cited by the report included dull laboratory experiments, often using antiquated equipment, and poorly organized and unimaginative instruction by faculty, many of whom, the report said, were failing to keep abreast of the latest developments. Little wonder, then, that fewer and fewer undergraduates have been electing to major in science. In 1975 9.4 percent of all students receiving baccalaureate degrees chose majors in biology, chemistry, geology or physics, but in 1983 only 7.5 percent did so.

The report recommended that the NSF, which had allocated close to nothing in support of undergraduate science education in the early 1980s, spend more than $100 million on such programs by 1990. Acknowledging that the problem is too large for the NSF to address alone, the NSB study called for municipalities, states, and the private sector to contribute collectively nearly $1 billion per year towards the improvement of undergraduate science education.

All is not darkness and woe, however. Certain undergraduate science programs are thriving. A 1985 study by David Davis-Van Atta et al—*Educating America's Scientists: The Role of the Research Colleges* (widely known as the Oberlin Report, since it was presented at a conference in Oberlin, Ohio) described a group of 48 outstanding liberal arts colleges, which it called "research colleges" or "science-active colleges." These are producing not only excellent research but also, in percentage terms, over three times as many science graduates as all colleges and universities (24 vs. 7.7 percent) and, remarkably, nearly twice as many as the research universities most highly rated by the National Academy of Sciences (24 vs. 14 percent). Moreover, the four dozen colleges (including Harvey Mudd, Reed, Swarthmore and Williams, to name but a few) send more than their share of graduates on to pursue higher degrees in science.

What are these four-year colleges doing so well to interest undergraduates in scientific careers? For one, they are encouraging students to collaborate with faculty in basic research. The Oberlin Report states that even publication is in large measure a joint effort: of some 7,000 journal articles coming out of these schools over a five-year period, 32 percent were co-authored by one or more undergraduate students.

The importance of a close mentor-student relationship was well expressed by Robert R. Wilson, past president of the American Physical Society: "In some major way, the production of scientists is a 'laying on of hands' process. It is exposure of young people to older people who care about science, who do research, who have the research fever. When you see such scientists in action you see that they are intuitive, dedicated, sometimes aggressive, even occasionally logical, and that ambition, love, power, compassion as well as other human attributes play a role in the creation of knowledge. It is when students experience that excitement directly that they too might catch the research fever." ("Testimony Before the Committee on Undergraduate Science and Engineering Education of the National Science Board," *Council on Undergraduate Research Newsletter*, April 1986, pp. 38-39.)

In encouraging undergraduates to become involved in research, the United States lags behind other nations, in particular, the United Kingdom, where completion of a research project rounds off work toward an honors degree in science. So it comes as welcome news that two new initiatives, one public and one private, will give more undergraduates in the United States the chance to work with faculty and experience the excitement of research and discovery.

In December the NSF announced a new program—Research Experiences for Undergraduates (REU). In fiscal year 1987, this $9 million program will provide some 2,000 undergraduates with hands-on research opportunities through the establishment of special REU sites and add-ons to regular NSF research grants. In its fiscal year 1988 budget, the NSF proposes to spend over $18 million on this program as part of its total $68 million support for undergraduate science education. The NSF is now aggressively addressing the problem of undergraduate science education, in accordance with the recommendations of its NSB report and other studies, such as the Oberlin Report. The agency should be commended for once again recognizing that the business of educating our nation's future scientists is a significant part of its mandate.

And recently, the Pew Charitable Trusts, headquartered in Philadelphia, announced a grant of $8.6 million that will be disbursed over three years, beginning in 1988, to about 60 colleges and 17 universities. The Pew Science Program in Undergraduate Education aims to improve the quality of undergraduate instruction in science and mathematics by fostering cooperative projects and the sharing of resources between research universities and small colleges. In all, five or six "clusters"each comprising a research university and a number of colleges will receive funds for supporting faculty and expanding undergraduate involvement in research.

Both programs are practical in design and ought to have real impact. But, as the NSB report stated, much more support, from a variety of sources, is needed. As for exposing students to research early on, one wonders how something so vital was ever neglected. Clearly, the earlier we demonstrate the excitement of science to children, the more likely they are to become scientists. Science fairs in the United States and in other nations have introduced young minds to the joys of research and are effective in battling the perception that science is difficult or, even worse, boring. Along with improvements at the undergraduate level such as I have described, we need also to revitalize elementary and secondary science education. I'll be addressing that subject in future issues. ■