9 January 1981, Volume 211, Number 4478 **SCIENCE**

Shortages of Scientists and Engineers

For the next decade this nation will have great needs for scientists and engineers. Already there are shortages in such fields as petroleum and chemical engineering and computer science. The shortages are likely to spread to other fields and to worsen. Faculty members are being recruited by industry, and fewer students are seeking the Ph.D. degree in some disciplines.

There is a particularly acute shortage in computer science. Advances in electronics have made computation and memory comparatively cheap. Many companies perceive attractive opportunities to apply the new hardware. These applications require development of systems of software by computer scientists. Eager bidding for computer scientists has pushed salaries to $30,000 per year for students at the baccalaureate level.

We are also experiencing an expanding need for scientists and engineers brought on by the decreasing availability of oil and by its higher price. Merely to maintain our limited production rate of petroleum will require employment of more experts for planning exploitation of the new wells and for tertiary recovery. Research, development, and engineering entailed in synthetic fuel plants will employ an even larger number of trained people.

As prices for energy escalate, most of the nation's existing processes, equipment, plants, and buildings are becoming obsolete. As prices for oil go even higher, there will be great incentives for research, development, and design and construction of new facilities. In the chemical industry, the need to minimize the hazards of toxic substances is also leading to major efforts involving highly trained personnel, including toxicologists.

The United States has lagged in achieving standards of quality control. The Japanese, who have been exemplary in this regard, employ a much higher ratio of engineers to blue-collar workers than do we. To identify and correct the factors that lead to manufacturing defects often requires unusual skill and ingenuity. Restoration of the reputation of American products will demand the deployment of more scientists and engineers in production facilities.

There will be other major demands for trained personnel. This country has lost its lead in many areas of technology. Who is to innovate? Who will create and develop alternative energy sources? The world will face terrible shortages of food, and we will need to change our style of agriculture to slow soil erosion. Who will develop more productive and pest-resistant plants? Who will exploit the opportunities of the revolution in biology based on recombinant DNA?

The universities, traditionally a source of new knowledge and trained people, will try very hard to fulfill their function. However, they are in relatively poor shape to do so. In most schools, equipment for training and research is antiquated or absent. Opportunities for young faculty members have become limited. At the public universities, state funds for support of research and teaching have diminished. Flexibility in the use of funds has been curtailed. The gross total of federal research funds in constant dollars has remained about the same. But federal intervention in universities has entailed substantial costs. For this and other reasons, the net sums actually available for research in universities have declined substantially.

One of the few bright spots in the situation is an improving relationship between industry and the universities. Leaders of industrial research are enthusiastic about the quality of the young people they are hiring. An increasing number of companies are supporting fellowships and research at the schools. They could and should do more. They could serve their long-term interests by helping to improve the level of equipment for teaching and research. They should be more emphatic in expressing their admiration for the training that young people are receiving. They should be prepared to intervene if federal budget cutters should propose to deal another blow to universities by chopping federal research funds.—PHILIP H. ABELSON