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Upgrading the Work Force In Science & Engineering



By Erich Bloch

In the last decade, the overall employment of scientists and engineers increased three times faster than total U.S. employment and twice as fast as total professional employment. And the employment of minority scientists and engineers increased at twice the rate of white technical employment.

Underrepresented minorities accounted for under 5 percent of the science and engineering work force in 1987. And Blacks alone accounted for 2.5 percent of the total—a welcome improvement over 1.6 percent a decade earlier, but by no means sufficient.

Women and underrepresented minorities will be major sources for the technical personnel we need for the future. But while they are becoming larger fractions of the university population, women and minorities are not taking up science and engineering in corresponding proportions.

At its peak, in 1976, total minority enrollment at the undergraduate level was about 14 percent of the college population. By 1984 it had fallen to about 12 percent. At the graduate level, the situation is worse. Today, Blacks and Hispanics *each* earn only 2 percent of all science and engineering Ph.D. degrees.

Overwhelmingly, both Black and Hispanic graduates in the science and engineering categories at all levels—bachelor's, master's, and doctoral—concentrate in the social sciences, life sciences, and psychology. Far fewer go into the physical sciences and engineering, where there is a greater need. Of 4,614 doctoral degrees awarded in the physical sciences and engineering in 1987, 41 were awarded to Blacks. Not only is the number low, it is

declining, down from 60 such physical science doctorates a decade earlier. *These trends are alarming and unacceptable.*

Elements of a Solution

As we assess minority participation in the sciences and engineering, we are looking at the convergence of two needs: One is the need for a well educated work force to meet the challenges of the future. The other is the need to assure all groups in our society access to quality education and careers.

We can't accomplish one without the other. On both counts, we must develop strategies that affect all levels of the educational process, beginning with the elementary level and continuing through the graduate level. When you consider that the Ph.D. recipients of the year 2000 are already in high school, it becomes clear that we have no time to lose.

In the course of the educational process, there are several key points at which students make decisions that either build their eligibility for inclusion in future technical programs or limit their options.

These points—which include selection of coursework at the junior high and high school levels, enrollment in college and selection of a college major, and the decision to go on to graduate study—minorities fall away from the sciences, mathematics and engineering at a steeper rate than the general population.

If we examine student interest in the natural sciences and engineering—excluding social, behavioral, and medical sciences—we can see that at the sophomore level in high school, 20 percent of all students, but only 10 percent of minorities, express interest

in these areas. At the bachelor's level, 66 percent of the general student population expresses interest in technical fields as compared with 33 percent of minorities.

And if we look at Ph.D. recipients as a fraction of the high school population we began with, and at the end of this process, 1 in 400 high school students from the general population receives a Ph.D. in the physical sciences or engineering. Among minority students, the ratio is 1 in 2000.

Our high schools, which play a critical role in laying the foundation for future studies in technical areas, are not doing their job. Consider the facts:

- Nearly 30 percent of the nation's high schools offer no courses in physics, 17 percent offer none in chemistry, and 70 percent offer none in earth or space science.
- Even students who have benefited from coursework in the sciences and mathematics are poorly prepared. In a recent international science achievement survey covering 13 nations, American high school science students placed among the bottom few in all fields surveyed.
- In the U.S., one of 4 individuals does not finish high school—the rate for Blacks and Hispanics is almost double that for whites.

The dropouts, the unprepared, and the underprepared seriously limit the pool of individuals available for further study and careers in the sciences and engineering. They also limit their own options and opportunities.

There is no single action that will solve this problem. The issue must be addressed at all levels of education and of government, in all arenas, and by all organizations and communities. Improvement at the primary and sec-

24 onorary levels of our educational system demands:

- Better prepared teachers.
- A better reward system for teaching—salaries and other recognition.
- A better curriculum and delivery system that takes advantage of developments wherever they occur.
- Instructional equipment, and access to well-equipped laboratories.

These are the sorts of improvements that a bigger budget can help. But improvements will take more than money. They will also require:

- More demanding requirements.
- Higher standards.
- Better communication between science and mathematics teachers and university faculty.
- Intensive teacher involvement.
- Parental support and commitment.
- A conviction in our communities that education is the key to personal success.

These strategies must be applied across the board. But there are special needs with respect to motivating and retaining minority students in technical fields.

Role models are critical. But there are not enough people like Dr. Mae Jamison, one of NASA's new astronaut-trainees;—or like Dr. Walter Massey, vice president for research at the University of Chicago, president of the American Association for the Advancement of Science, and a former member of the National Science Board.

Closer to home, the percentage of minority teachers is declining as attractive opportunities open up in

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other, frequently better-paying fields. There are similar problems with the retention of talented women teachers. Data on the ethnic composition of primary and secondary school teachers are hard to come by, but some estimates suggest a sharp decline of minority teachers by the year 2000, perhaps by as much as 50 percent.

Recent studies of minority student attitudes suggest another problem. Among Black students, peer group pressure, far from supporting academic achievement, works against it.

State and local governments are beginning to make important improvements in teaching standards and curricula at the precollege level and there is evidence that teachers' salaries are beginning to go up in some places.

The Federal Input

Obviously, there is a federal role, and the National Science Foundation (NSF) is a part of it. But we are a small player with a small part of the federal budget in an enormous arena. NSF

represents 3 percent of the federal R&D budget, and 10 percent of the budget of the Department of Education. Our strategy with respect to human resource development is to attack critical points in the pipeline and we are moving ahead aggressively.

The NSF FY 1989 budget provides a 23 percent increase for education and human resources and a 32 percent increase for precollege education alone. In fact, since 1984, that part of our budget has doubled at the same time that the total NSF budget increased by less than half.

At the precollege level we are continuing our programs in teacher preparation and enhancement and materials development. We are increasing our programs in research in teaching and learning in providing the best students with research experience. Under these programs, there is special attention for inner city schools and districts.

At the undergraduate level we fund programs to develop new undergraduate curricula and are expanding research experiences for undergraduates. We are doubling expenditures for instrumentation while expanding access to more schools, and initiating new programs to enhance undergraduate teaching. At the graduate level we are in the process of doubling our Graduate Fellowship Program from 500 to 1000 per year, with special consideration for minority applicants and women in fields where they are severely underrepresented.

Just as in the precollege area, it will take more than dollars to achieve the improvements we need. Attracting students to doctoral programs depends on the university environ-

ment, career and research opportunities, instrumentation, and facilities. Today, there is a perception that law and business students are better off in their future careers and earning power than science and engineering majors. We must change this perception—and whatever reality lies behind it—if we want to attract the most qualified people and not be outclassed by other countries.

In addition to its broader efforts in the human resource area, the NSF has a number of programs to broaden the participation of underrepresented groups in the sciences and engineering, using both established and less traditional approaches in reaching minority students. These programs have substantially increased support for minority fellowships, improvements of research capabilities at minority institutions, planning grants for minority applicants, and research assistantships for minority high school students. We have also significantly increased our support for Historically Black Colleges and Universities.

The Minority Research Centers of Excellence Program, as of this year, is providing six awards of \$5 million each over five years to leading minority institutions to enhance the participation of minority researchers in areas of vital scientific and engineering importance.

Another important initiative is the *Career Access Opportunities Program*, whose \$700,000 awards are going to establish comprehensive regional centers for attracting underrepresented groups to all levels of science, math, and engineering.

The NSF is also looking for new, non-traditional ways to reach students, such as a collaborative effort between NSF's National Science and

We will not achieve our goal unless all of us . . . work together.

Technology Week and some major minority organizations to improve student motivation by reaching families directly.

Conclusion

Education and the development of our human resources is our first priority at NSF. But in addressing the problems of the educational system and increasing the number of scientists and engineers, we all face an enormous challenge. Our educational system is complex and decentralized, and the primary responsibility located at the state and local level. There is no simple solution. We must push on all cylinders.

Moreover, creating programs and opportunities is just half our chal-

lenge. We must weave a strategy of many strands—a strategy that places existing programs in a larger context that establishes a clear sense of direction, develops the leadership for the task, and insures continuity of effort.

We must be consistent and persevere. None of the problems I've mentioned can be solved overnight. None of the programs will bear fruit within one congressional session.

We will not achieve our goal unless all of us—the private sector, federal government, states, local communities, and academia—work together. □

Erich Bloch is the director of the National Science Foundation. The above was excerpted from a paper prepared for a symposium on Minorities in Science & Technology, sponsored by the Congressional Black Caucus and Howard University's Institute on Science, Space and Technology.