Who Will Do Science in the 1990s?

The next 10 years should be a good time to be a scientist or an engineer looking for a job, but not so good for employers looking to hire scientifically trained personnel

SCIENCE IN THE '90s

Ninth in a series

ROBERT DAUFFENBACH's crystal ball is a little cloudy today. The Oklahoma State University economist forecasts the U.S. labor supply for the National Science Foundation, and although he is working with the most up-to-date NSF econometric model, he is skeptical. The simulation predicts only 10,000 new jobs for biological scientists over the next decade—a growth rate of only 15%, no more than the increase of the work force as a whole. "I don't even believe those numbers," Dauffenbach says. The real growth rate is likely to be higher, he explains, because increasing commercial applications for biotechnology should make biology a fast-growing field in the 1990s.

Dauffenbach's difficulties show just how hard it is to predict the future of the scientific job market. Yet he and other prognosticators provide a vital service to anyone making plans related to science: college students thinking about careers, managers at research labs or universities, and government planners. Furthermore, in spite of some uncertainties, forecasters agree surprisingly well on what the major trends of the 1990s are going to be. Perhaps the most striking will be a sharply increasing demand for scientists and engineers as the decade wears on. Indeed, if more U.S. citizens do not start going into science careers, the nation could face a serious shortage by the early part of the next century.

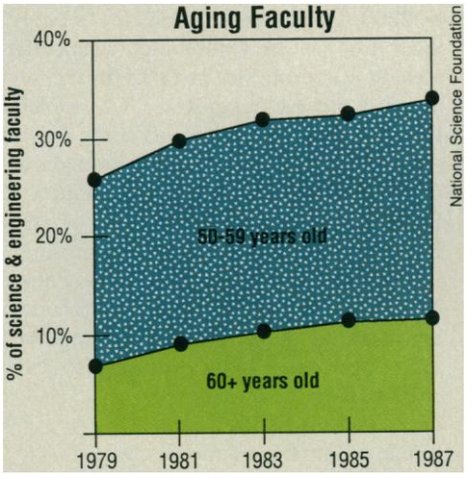
For the student considering a career in science, this is good news. "The number of jobs for scientists and engineers should grow at about two times the rate of the rest of the economy," Dauffenbach says. And although making predictions for specific disciplines is tricky, it is possible to point to several likely "hot fields."

Engineers will be in great demand during the 1990s as technology plays an increasingly important role in the production of goods and services. The Bureau of Labor Statistics predicts that there will be 350,000 new engineering jobs from 1988 to 2000—a 25% rise. The NSF, working with a slightly different model, foresees a 30% jump for engineers.

But within engineering, there will be some sharp variation in job opportunities. Electrical and electronic engineers will be hot; chemical engineers will not. And then there are some fields where the predictions depend mostly on who is making them. The NSF thinks aeronautical and astronautical engineers will be the most popular folks around, with a 48% job growth from 1988 to 2000; the Labor Department sees them as wallflowers, with a measly 13% rise. Although economic forecasters at the NSF and BLS could not pinpoint the reason for the inconsistency between projections, it may have been caused by different assumptions concerning how much defense funding will be cut in the 1990s.

This variability emphasizes how important the current political changes in Eastern Europe could be. "Our set of projections included a 15% decline in real defense expenditures," says Ronald Kutscher, associate commissioner of the Office of Employment Projections at the BLS. "This may underestimate the shift away from defense." Since 10 to 20% of the country's engineers are involved in defense work, "the markets for some engineers are likely to soften in the 1990s," he says.

A college student who wants to go into science instead of engineering will have to be a little pickier about choosing a specialty.



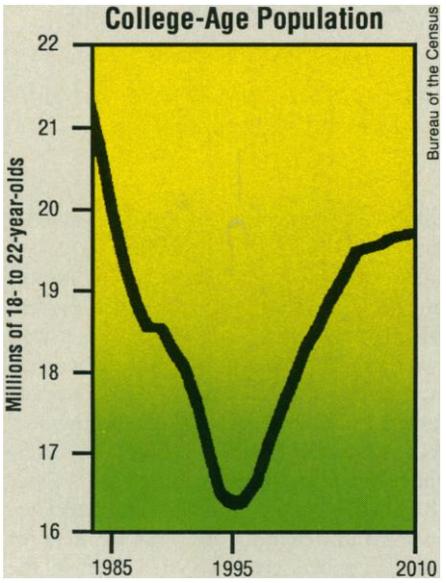
In general, the physical sciences—physics, chemistry, and earth science—won't grow any faster than the rest of the economy. One exception: materials science. New technologies will require new materials, and salaries for trained materials scientists—now in short supply—can only go up. Within this field, the hottest topics are likely to be electronic and optical materials, superconductivity, composites, and materials analysis using such tools as synchrotron radiation, lasers, or scanning microscopes.

For those who prefer DNA to moon rocks, the expected biotechnology boom—the NSF model aside—should generate plenty of jobs in the 1990s. The BLS predicts 15,000 new jobs for biological scientists—a 26% increase.

Job Opportunities in the 1990s

Occupation	Employment 1988	Employment 2000 (est'd)	% Change
MANAGEMENT – ENGINEERING, MATH & NATURAL SCIENCES	258,000	341,000	+32%
ENGINEERS	1,411,000	1,762,000	+25%
AERONAUTICAL/ASTRONAUTICAL	78,000	88,000	+13%
CHEMICAL	49,000	57,000	+16%
CIVIL	186,000	219,000	+17%
ELECTRICAL/ELECTRONIC	439,000	615,000	+40%
INDUSTRIAL	132,000	155,000	+18%
MECHANICAL	225,000	269,000	+20%
LIFE SCIENTISTS	154,000	189,000	+22%
BIOLOGICAL SCIENTISTS	57,000	72,000	+26%
COMPUTER & OPERATIONS RESEARCH ANALYSTS	503,000	763,000	+52%
PHYSICAL SCIENTISTS	184,000	215,000	+17%
CHEMISTS	80,000	93,000	+17%
EARTH SCIENTISTS	42,000	49,000	+16%
ALL OCCUPATIONS	118,104,000	136,211,000	+15%

Bureau of Labor Statistics



And the biggest growth industry of the last decade should be big for the 1990s, too. According to the NSF, 260,000 new positions will open up for computer specialists by 2000, a 52% jump. "I think the boom [in jobs] now will be with computer scientists seeking out problems in other areas," says Stanford provost James Rosse, who explains that many of the departments at the university are developing their own computer expertise. Computer specialists can expect to find job openings in a number of fields besides computer science, he says.

This increasing demand is the good news. The bad news is that the crystal ball doesn't say where all these scientists and engineers are going to come from. According to Richard Atkinson, chancellor of the University of California at San Diego, the United States could experience a shortage of as many as 150,000 Ph.D.'s from 1995 to 2010 (see also p. 425). Estimates of the deficit in science and engineering baccalaureates range as high as 650,000. Although supply is much harder to predict than demand, there seems to be good reason to worry about not having enough trained workers in the late 1990s and beyond.

The shortage of Ph.D.'s could hit especially hard at colleges and universities, where a "retirement wave" may hit at about the same time as a sharp increase in student enrollments. Over the past 10 years, the average age of faculty steadily increased, and many of the teachers who were hired in the 1960s to teach the Baby Boomers will reach retirement age in the 1990s. This wave will break at an awkward time: college enrollments, which have been falling over the past decade, are expected to start back up in 6 or 7 years as the children of the Baby Boomers reach college age.

Adding to the problem is the fact that the number of U.S. citizens getting science and engineering doctorates has been declining since 1970. Foreign students have taken up the slack. In 1988, foreign students with temporary visas earned 18% of all life science Ph.D.'s awarded by U.S. colleges and universities, 30% of all physical science Ph.D.'s, and a staggering 45% of all engineering doctorates. The result: a surge in the percentage of jobs going to foreigners, since about half of all temporary residents earning doctorates stay in the United States after they graduate.

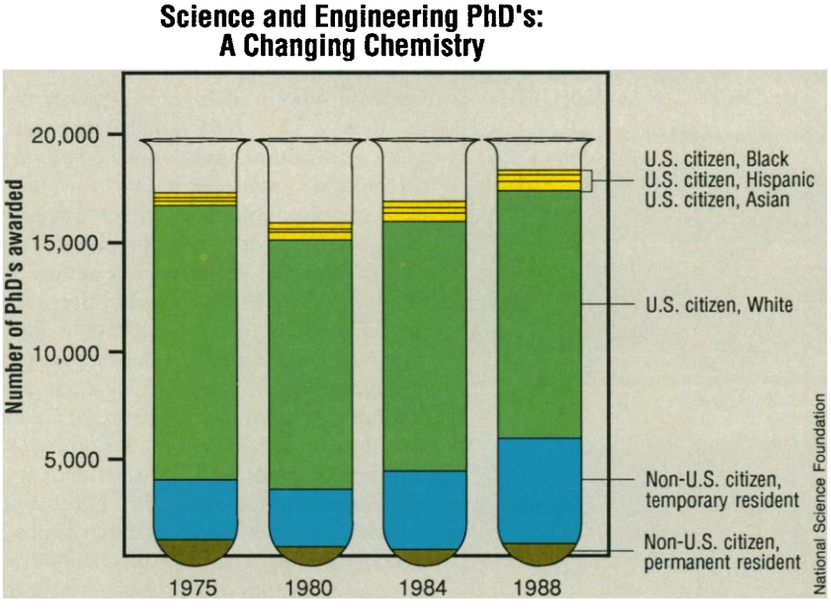
The effect has been particularly noticeable among engineers. In 1985, two-thirds of all postdoctoral positions went to noncitizens, and about half the assistant professors under 35 were temporary residents. In the general engineering work force, more than one-third of all Ph.D. positions were held by foreign-born workers. In 1988, the National Research Council reported that foreign students are crowding U.S. students out of positions in graduate schools and foreign engineers are taking jobs that would otherwise go to U.S. citizens. The council also worried that foreign-born teachers with poor English skills may be hurting university education. The situation is similar though not quite as dramatic in the natural sciences.

The growing dependence on foreign-born students and workers makes people particularly nervous because if those workers decide to go home, the United States could wind up with some disastrous labor shortages. "We have got to do a better job of growing our own," says Kay Hanson, director of the Consortium on Financing Higher Education, a Washington, D.C.–based group of 32 research universities and liberal arts colleges. "My guess is that [foreign] students who in the last 20 years would have stayed here may find it is equally rewarding to go somewhere else" because of improving economic and political conditions in the rest of the world.

But if the United States is going to recruit from its own ranks, it will want to look outside the group that has been the main source of scientists and engineers so far: white males. From 1985 through 2000, only 15% of the net new entrants to the work force will be white males. The rest will be women, minorities, and immigrants. For that reason, many people have argued that these are the people who should be recruited into technical careers. The trends today, however, suggest that that effort will be an uphill struggle at best.

Over the past 20 years, women have increased their participation in science and engineering dramatically. They now earn 45% of the bachelors degrees and 30% of the Ph.D.'s in those areas. But that progress seems to have ground to a halt.

"The percentage of women earning bachelors degrees in natural sciences and engineering stopped rising in 1982," says Betty Vetter, executive director of the Washington, D.C.–based Commission on Professionals in Science and Technology. And the percentage of women Ph.D.'s has been nearly steady for the past few years. What happened, Vetter explains, was that the number of women going to college rose dra-



matically in the 1970s, which led to women earning more degrees in every area, but the percentage of women choosing science as a major changed little. Furthermore, most women who go into science avoid the traditionally "masculine" fields. Females get only 8% of the Ph.D.'s in physics, 14% in computer sciences, and 15% in mathematical sciences. They are far more likely to go into the life sciences (35% of all Ph.D.'s) or the social sciences (half of all doctorates, including 60% of all psychology Ph.D.'s).

The reasons for such choices may be social, cultural, financial—even genetic. But whatever the underlying cause, the pattern doesn't seem likely to change soon. "I believe the reason lies in the socialization of children almost from the day they are born," Vetter suggests. "I don't see it changing appreciably until we change society." The gender makeup of the class of 2000 will probably look much like the class of 1990.

There are at least some bright spots in the picture of women in the sciences, but this is not true of underrepresented minorities—blacks, Hispanics, and American Indians. These groups have failed to come into the system in sizable numbers, and nothing seems likely to happen in the 1990s to increase the flow of underrepresented minorities into science much past the trickle that it is now (see box).

The one success story among minorities is the rise of Asian-Americans. If both U.S. citizens and foreigners with permanent visas are included, Asian-Americans account for about 6% of all Ph.D.'s in the natural sciences and 16% in engineering. Asians have long been well represented in the U.S. scientific work force, but they are too small a percentage of the total population to solve a possible shortage by themselves.

So the question of where the United States will find the scientists and engineers to take it into the 21st century doesn't have a simple answer. Yet surprisingly, representatives of industry don't seem too worried about it. "If you simply look at the demographics, it looks pretty bad," says Lloyd Friend, director of research and development personnel for AT&T Bell Laboratories. "But the supply of science and engineering students is really driven by students' views of job opportunities. If you create the demand, you'll have the supply."

Robert Armstrong, Du Pont's manager of professional staffing in Wilmington, Delaware, describes a study that compared the percentage of high school students going into engineering with the average starting salary of engineers. "The correlation is just beautiful," he says—when salaries rise, more students go into the field. The percentage can double in 5 to 6 years, he found out.

The upshot of all these numbers seems to be that the scientists and engineers coming into the work force in the 1990s will be a lot like those in the 1980s. The main difference is that there should be more of them. But that will happen only if high school and college students figure out that it will be worth their while to move out of business majors and prelaw and premed and into science and engineering. So pass the word. Tell them you heard it from a crystal ball.

■ ROBERT POOL

A Lost Generation?

It's been more than 20 years since the civil rights movement convinced this country that black students had the same rights to a good education as white students. And for more than a decade, many colleges and universities have been aggressively recruiting minority students and doing their best to keep them in school until they graduated. So you would expect that the number of minorities earning degrees in science and engineering would be rising sharply, right? Wrong—by a long shot.

The number of black males earning Ph.D.'s is actually less now than 20 years ago. And although the number of black women receiving doctorates has risen slowly, it has not made up for the decline among the males. From 1979 to 1988, the total number of blacks becoming Ph.D. scientists and engineers dropped 20%; they now earn only 1% of all doctoral degrees in natural sciences and engineering despite making up 11% of the working-age population. In certain fields, it is next to impossible even to find a black candidate to interview for a job opening. In 1988, for example, only one black U.S. citizen earned a Ph.D. in mathematics and only one in computer sciences.

More Hispanics have gone into the hard sciences, but the numbers are nothing to crow about. They currently account for about 2% of all natural science and engineering Ph.D.'s, much lower than their 7% of the working-age population. On the other hand, the number of Hispanics earning doctorates has been steadily growing, particularly among women, and should continue its slow increase.

The solution to these problems won't be easy, because the difficulties clearly don't begin in college or graduate school, but much earlier. The average score of black students taking the Scholastic Aptitude Test (SAT) in 1988, for example, was 200 points less than whites and Asians (on a range of from 400 to 1600 points). Hispanics scored on the average 130 points less. In a 1986 test of mathematical proficiency, 17-year-olds were judged on whether they could perform multistep problem-solving and algebra. The small percentage of high school students who can do such analysis are the ones most likely and most able to go into science and engineering in college. Among the students tested, 7.6% of the white students performed at this level, while only 1.2% of Hispanics and 0.3% of blacks did.

Ironically, the few minority students capable of doing science or engineering at the university level are highly sought after. Major universities recruit them aggressively, then work to keep them in school with various retention programs. Even small schools are getting into the act. In one innovative program, the University of Maryland–Baltimore County recruited 19 black males who had excelled in high school and who had an interest in science, offering them each 4 years of tuition, room and board, and books, as well as a personal computer. In exchange, the 19 agreed to get degrees in science or engineering and continue on to Ph.D.'s or M.D.'s. Vice provost Freeman Hrabowski, who developed the program, says the idea was to push the best students to excel and, in so doing, provide role models for other black males.

And after graduation, minorities find that both academia and industry come calling. "The competition is very ferocious," says Stanford provost James Rosse.

So the demand is there, but the supply is lagging. And increasing the supply of minorities in science and engineering is likely to be a long, arduous process, says Betty Vetter, executive director of the Commission on Professionals in Science and Technology. "We're losing a whole generation of children, and probably their children too," she says. ■ R.P.