sidering some parts" of that policy, so that "postdocs have the rights they deserve ... and everyone knows the rules of the game." And although McCullough says that "we would be very happy to listen to a group of postdocs," Seeling says that postdocs want formal representation on the committee that sets policies that affect them. "We're looking for rights," she says. "We want to be acknowledged as part of the university."

Many postdoc groups would like help from NIH and other federal agencies in their push for recognition. In particular, they believe that supporting more postdocs on fellowships and traineeships, and fewer on research grants, would improve conditions by reducing the number of principal investigators tempted to exploit the labors of their postdocs for their own scientific advancement. "You have a PI whose career depends on the labor force in the lab, and yet he is also designated to look out for the postdoc's interests [as a mentor]. That can represent a conflict of interest," says Bresnahan. NIH should also require PIs to follow clear and binding training mandates as a condition for receiving NIH funds to pay for postdocs, argues Cincinnati's Kasturi. "NIH has absolutely abdicated its responsibility on this subject," she says. "Basically, they just hand out this money, and they ask nothing in return except that the research be published."

Not so, says Wendy Baldwin, NIH's director for extramural research. NIH expects universities with training grants to offer postdocs educational and career experiences as well as the opportunity to conduct research, she says, but it's very hard to separate the two: "It's hard to learn about research without doing research." She also recognizes the temptation for a PI to ignore the training component: "If I need a technician, but I can get a postdoc for the same price, someone who is highly motivated and eager to learn, then it's hard to say no."

Although the current system has flaws, Baldwin says, she would not want NIH to lay down rules about how universities should treat postdocs. "I'm not convinced that we should be setting internal hiring policies [at universities]," she says. "I think we have to be very careful about how heavy-handed the government is about what you can do and what you can't do. ... There are labor force issues that are not NIH issues."

One issue that clearly falls within NIH's control is its treatment of the 2230 postdocs—half visiting fellows from other countries—on its Bethesda, Maryland, campus. NIH began to look more closely at their situation 5 years ago, says Michael Gottesman, head of NIH's $1.5 billion intramural research program, "when we were trying to figure out how to run NIH on a steady-state budget." Although recent healthy increases have eased that worry, he says, NIH director Harold Varmus and others still saw a need to help postdocs "gain their independence." Toward that end, NIH created $1000 awards for postdocs to present their work at meetings and an internal committee to hold workshops on career-related skills. Several institutes also offer postdocs a chance to compete for funding that they can take with them to their first "real" job. And this spring, NIH issued its first guide on training and mentoring, which acknowledges that postdocs and graduate students "could benefit from a more explicit set of expectations."

But given the reluctance of federal officials to intervene in the affairs of their constituents, the task of reshaping U.S. postdoctoral training is likely to rest with postdocs, faculty, and research administrators themselves. At Johns Hopkins, Watkins says he is beginning to get calls from deans at other universities who have heard about how his institution has improved its culture for postdoctoral education. "It has been very important to me personally and to the university," he says, "that the postdocs are full-fledged members of our medical family—that they are, in fact, on the front of the bus."

–DAN FERBER

Dan Ferber is a writer in Urbana, Illinois.

NEWS

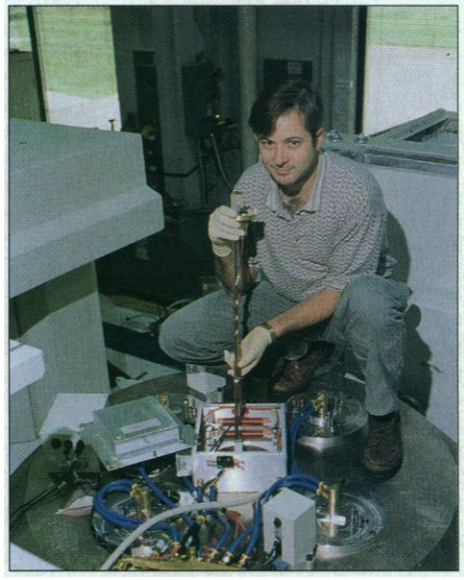
Will the Job Market Ever Get Better?

Although predictions of scientific supply and demand are notoriously unreliable, there are trends that contain both good and bad news for postdocs

Tony Mendez wanted to teach and do research at a major university. But only a few such positions were advertised when he finished his Ph.D. in nuclear physics at Florida State University in 1993, and the market hadn't improved much when he completed a postdoc at the University of North Carolina in 1996. After failing to make the short list anywhere, he set his sights on small liberal arts colleges. Wrong again. "A lot of people, like me, had the perception that they can try for the small colleges," says Mendez. "But these places were being flooded, too." Today, Mendez works for a company in Tennessee that builds cyclotrons. He misses the classroom, but with a family to support he's glad that the pay is better in industry.

Renee Williard could see the storm clouds gathering in 1995 as she finished her Ph.D. in pharmaceutical chemistry at the University of California, San Francisco (UCSF). Realizing that the academic job market was so tight that her chances of getting a university position were almost nil, she chose a postdoc involving research on health policy. "I felt like I was jumping off a cliff into the unknown," she says. It turned out that grants and permanent jobs in that field were equally scarce. Today Williard holds a part-time job coordinating pharmacy benefits for San Francisco's department of public health and also works as a consultant and free-lance medical writer.

Anecdotes abound of disenchanted postdocs whose dreams of becoming a research professor at an elite university have been ground to dust by today's tight job market. And even those who get their wish don't have an easy time of it. Although unemployment may be low—1.5% in 1997 for those 1 to 3 years post-Ph.D., according to the latest figures from the National Science Foundation (NSF), below even the 1.9% for a similar cohort in 1995—the job search can be long and harrowing, says Charlotte Kuh, executive director of the Office of Science and Engineering Personnel at the National Research Council (NRC). "We educate graduate students, they go into postdocs, stay there longer and longer, and then at the end, it's not at all clear that there's a real career for them," she says.



Industrial grade. Physicist Tony Mendez abandoned plans for an academic career and joined a company that makes cyclotrons.

CREDIT: TERRY RABY/SITEWORKS PHOTOGRAPHY

That sense of disillusionment, if not despair, has stirred many scientific organizations to take a closer look at the job market for

their members. But the slew of reports in recent years tends to be heavy on hearsay and opinion, mixed with data that are often incomplete or out of date. Particularly embarrassing was a short, internal 1987 report by NSF, whose warning of a massive shortfall of Ph.D. scientists in the 1990s was disseminated widely by scientific leaders. As tens of thousands of postdocs can bitterly attest, that "prediction" failed to materialize.

This article will not attempt to forecast the job market for scientists, nor handicap the most promising alternatives to academe for those with Ph.D.-level skills. But ceding prognostication to the disciples of Nostradamus still leaves plenty of room to explore recent career trends affecting postdocs that may inform their decisions. Here are some that seem especially striking or significant.

Postdocs have become a major force in the U.S. scientific community. From just under 14,000 in 1979, the number of postdocs has nearly tripled, to 38,050, in 1997, according to NSF data. Between 1995 and 1997 alone, postdoc ranks swelled by 2665. A flattening in the number of Ph.D.s awarded, dating from the mid-'90s, could begin to affect the size of the postdoc workforce, however, although the overall numbers are likely to remain large.

As federal dollars are concentrated at a relatively small number of universities, so too are postdocs: NSF statistics show that 50 universities employ 67% of the postdocs working in the United States, and the 20 universities with the largest number of postdocs are all ranked in the top 25 universities for federal funding, topped by Harvard, with 2505.

More fields expect graduates to do a postdoc, especially some of the life sciences, and the amount of time spent as a postdoc is increasing. NSF figures show that, for all science and engineering fields, the percentage of Ph.D.s who go on to do postdocs has risen from 25% for the pre-1965 cohort to 41% for the 1992 to '94 group, the most recent surveyed, and that the median time served has stretched from 20 to 29 months, a 45% increase. The greatest rise in popularity is in engineering, which jumped from a mere 8% of the pre-1965 cohort to 28% in the most recent group, although the average stint is only about 15 months. At the other end of the spectrum, 71% of those who earned a U.S. Ph.D. in the biological sciences between 1992 and '94 did a postdoc, up from 40% for the pre-1965 cohort, a percentage that has been stable since the mid-'80s. And they spent an average of 46 months in that category.

The numbers may be even higher as you move up the pecking order: A study of Harvard Ph.D.s. from 1988 to '93 found 59% to 68% in the natural sciences took postdocs after graduation. In one subfield, biochemistry, Maresi Nerad and Joseph Cerny at UC Berkeley found that 86% of a cohort of 654 who earned Ph.D.s from 61 research universities in 1983 to '85 did postdocs.

Postdocs feel that the competition for academic positions, always intense, has grown worse. A survey of 1996–97 graduates by the American Society for Microbiology found that more than twice as many microbiology Ph.D.s considered the job market "bad or hopeless" as considered it "good or excellent." A 1996 survey of 1322 Canadian postdocs found that "confidence in finding a job in their chosen field in Canada is strikingly low," although the 16% of Canadian postdocs working in the United States were considerably more optimistic than their counterparts who remained in Canada. The survey also found that only 13% would "unreservedly recommend" that young people take the same career path, which for two-thirds of the postdocs is headed toward a tenured faculty position. A sobering 25% said they would not recommend that a student follow in their scientific footsteps.

At the same time, NSF's Mark Regets points out that it has always been tough to get these jobs and that academia has been a tight market for a long time. Indeed, the Berkeley study shows that only 35% of biochemistry grads hold tenure or tenure-track jobs in academia 10 years after their Ph.D., a number equal to the share working in a combination of the business, government, and nonprofit world. NSF figures show that only 20% of life scientists with Ph.D.s in 1992 to '94 held such positions 3 years later, a figure less than half that of the 1968 to '70 cohort.

Even for those who do obtain tenure-track jobs, the long trajectory has meant that many young scientists marry and start families before they have a clear picture of their professional future. Figures from the Harvard survey, by the Graduate School of Arts and Sciences, show that to be the case even for those starting out at the top. Whereas roughly 60% of those in the natural sciences who graduated before 1990 had secured nonpostdoc academic jobs by 1996–97, only 44% of the 1992–93 class had enjoyed such success.

There are weak signs that the strong U.S.

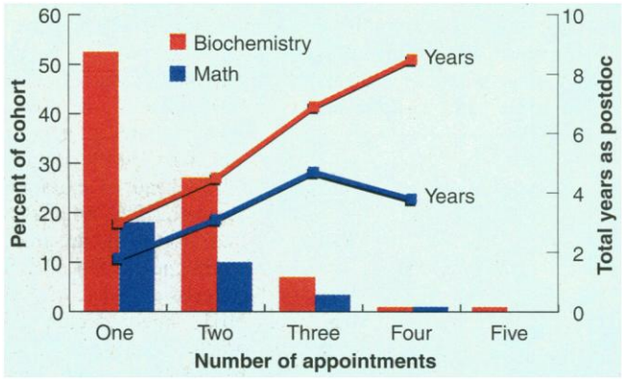
TOP SCHOOLS FOR POSTDOCS, 1997

Academic Institution	Total	Science	Engineering	Health
Harvard University	2505	1064	42	1399
Stanford University	1231	619	92	520
Univ. of Calif., San Francisco	1133	341	0	792
University of Pennsylvania	1052	616	27	409
Univ. of California, Berkeley	964	775	112	77
University of Washington	933	522	32	379
Johns Hopkins University	929	382	35	512
Univ. of California, San Diego	901	463	60	378
Univ. of Calif., Los Angeles	735	320	81	334
University of Michigan	675	335	67	273
Washington University	666	324	13	329
University of Colorado	635	370	43	222
Cornell University	560	344	42	174
Univ. of NC, Chapel Hill	549	333	1	215
Univ. of Wisconsin, Madison	547	356	53	138
University of Minnesota	519	367	80	72
Mass. Inst. of Technology	514	343	126	45
Columbia University	503	328	20	155
Yale University	499	202	0	297
Univ. of Southern Calif.	461	230	27	204
Duke University	453	231	8	214
Calif. Inst. of Technology	446	380	66	0
Total for all institutions	**38,043**	**23,972**	**2,945**	**11,126**

SOURCES OF JOB ADVICE FOR GRADS

	Biochemistry				Mathematics			
	Postdoc		No Postdoc		Postdoc		No Postdoc	
SOURCE	Used	Best	Used	Best	Used	Best	Used	Best
Postdoc mentor	59%	41%	<1%	<1%	31%	16%	<1%	<1%
Job notice in prof. journal	57%	38%	22%	14%	51%	31%	47%	31%
Ph.D. adviser	42%	25%	36%	18%	60%	39%	58%	35%
Sent unsolicited	21%	7%	22%	13%	37%	13%	24%	11%
Other faculty	39%	16%	35%	18%	56%	27%	40%	18%
Former prof. contacts	25%	16%	30%	22%	40%	28%	19%	12%
Job ads on campus	13%	3%	4%	2%	13%	6%	24%	11%

CREDITS: (TOP TO BOTTOM) NATIONAL SCIENCE FOUNDATION; "PH.D.S—TEN YEARS LATER," NERAD, CERNY



Marking time. Biochemists are much more likely than mathematicians to do postdocs, and to do more stints for a longer period of time.

economy is creating more job opportunities outside academia, causing new graduates to reduce or avoid their reliance on postdoctoral positions. Recent NSF figures show that 1997 Ph.D.s took fewer postdoctoral positions than their 1995 cohorts, says Regets. For instance, in the biological sciences, the percentage holding postdocs 1 year after graduation dropped from 70% to 58%; in physics the numbers shifted from 57% to 38%. Although Regets is quick to point out that the number of people taking postdocs does not directly reflect the health of the job market, "when we see this much of a change in physics and biology [the two fields with highest percentages going on to do postdocs], it's easy to speculate that the improved job market is a factor."

Indeed, the latest survey results from the American Chemical Society found that fewer Ph.D. chemists who graduated in 1997–98 took postdocs than did the previous class—45% compared with 51%—and more found permanent jobs—44%, up from 35%. The American Institute of Physics has found a similar shift away from postdocs and toward more permanent employment—primarily in industry—in a follow-up survey of recent degree recipients.

Universities are expected to boost faculty hiring in preparation for the children of the baby boomers, who will be filling college classrooms for the next 10 to 20 years. This demographic Tidal Wave 2, as it's called, is predicted to result in a 26% rise in incoming freshmen over the next 12 years. It will be strongest in Western states—fueled by immigration as well as birth rates—and weakest in the north central region, where population is stagnant or declining.

At the University of California, a new campus will open in Merced in 2005, and university planners project 3000 new faculty positions, across all fields, throughout the university system, in addition to the need to replace retiring professors. Although the characteristics of those posts have not yet been determined, Sandra Smith, assistant vice president for planning and analysis in the office of the UC president, says that "it's quite likely that we will be hiring tenure-track faculty."

Whatever the number, the NRC's Kuh and others believe strongly that students must be better informed about career prospects in these uncertain times. And postdocs aren't the only ones struggling to keep up with these changes. Many faculty members seem to take a very narrow view of where their students are headed. When Nerad and Cerny asked young scientists about their mentors' career expectations for them, 55% said their adviser encouraged them to pursue academic jobs, and only three (less than 1%) reported advice aimed mainly at obtaining posts in industry, government, or the nonprofit sector. In addition, very few universities offer career counseling or job placement services for postdocs. "With the world changing and many more postdocs going into industry, the need for this kind of office has grown tremendously," says Catherine Connor, who directs the University of Illinois Biotech Placement Center, one of the few to serve postdocs.

For the most part, postdocs in the 1990s have had to blaze their own career path, a route crowded with competitors and strewn with economic boulders. And that seems like good advice for the upcoming generation as well. As Williard, who as a graduate student at UCSF organized a Women in Science group to explore nonacademic career options, puts it, "I had to re-create myself." **–KAREN SCHMIDT**

Karen Schmidt is a writer in Washington, D.C.

CREDITS: (TOP TO BOTTOM) "PH.D.S—TEN YEARS LATER," NERAD, CERNY; COMMISSION ON PROFESSIONALS IN SCIENCE AND TECHNOLOGY, 1998

NEWS

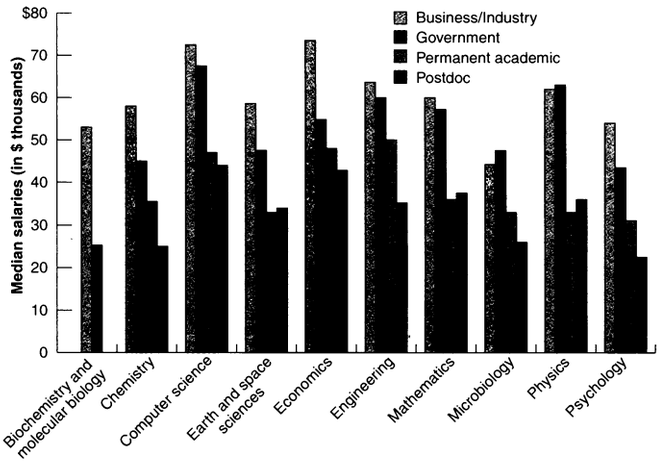
Cheap Labor Is Key to U.S. Research Productivity

The low pay for postdocs has been a boon to U.S. research universities. But why are their salaries so low? And is it fair?

In 1876, Harvard-trained zoologist William Brooks was awarded all of $500—worth $7630 today—for a year's advanced study at the brand-new Johns Hopkins University. Brooks was one of 20 scholars, and the only American-trained Ph.D., chosen for what today would be called a postdoctoral fellowship. The slots were created to attract a cadre of what Hopkins's first president, Daniel Gilman, described as "men of mark, who show that they are likely to advance the sciences they profess." And the novel strategy worked: Brooks and three of his colleagues joined the Hopkins faculty and never left.

Today, Brooks would have many more choices of where to do his postdoc and much more competition for slots in the best labs. He would probably also find it quite a bit harder to land a tenured job at a top-notch university once his postdoc ended. But one thing hasn't changed much—the low pay. Embryologist Donald Brown of the Carnegie Institution of Washington sums it up this way: "What's the most economical way to fund high-quality research? There's no question that you get the biggest bang for your buck by using postdocs."

Postdocs' expertise and commitment are crucial to the research enterprise, as most senior scientists freely admit. So economic



Poor choice? The salaries of 1997 Ph.D.s who did postdocs are generally much lower than those taking other types of jobs.