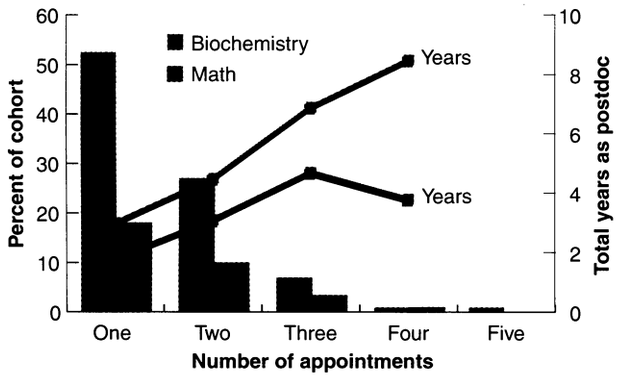


Marking time. Biochemists are much more likely than mathematicians to do postdocs, and to do more stints for a longer period of time.

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

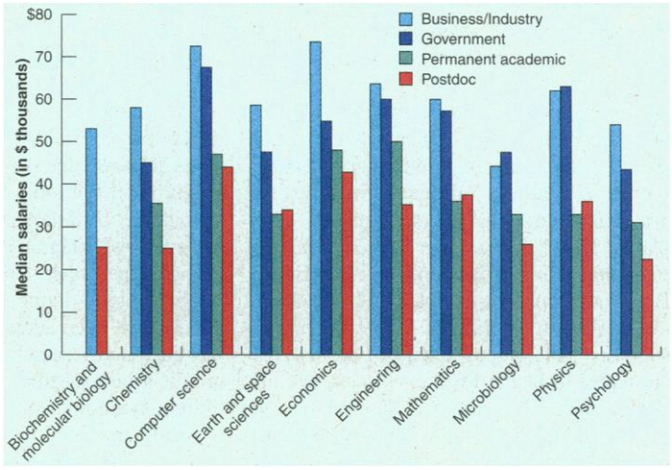
Cheap Labor Is Key to U.S. Research Productivity

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."

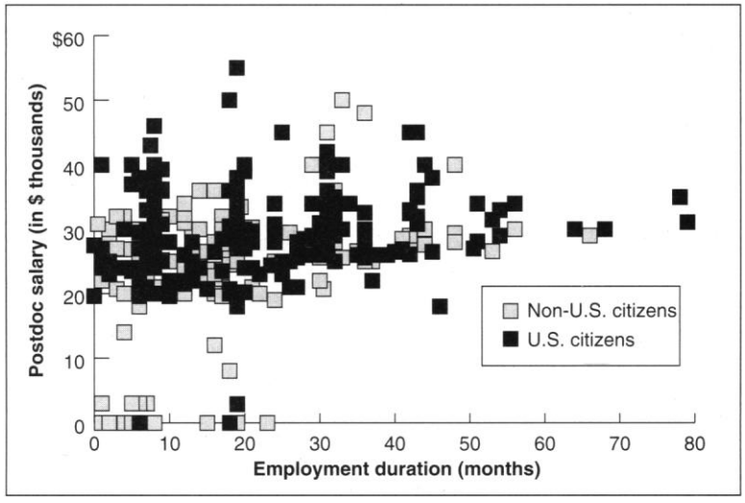
Postdocs' expertise and commitment are crucial to the research enterprise, as most senior scientists freely admit. So economic



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

theory suggests that market forces—supply and demand—should set their pay levels. But the reality, at least in the United States, is that the decision is more likely to be made by a government bureaucrat based on how much an agency is willing to spend on these unsung heroes. That remuneration, adjusted only infrequently, then becomes a standard for the rest of the community—by turns a ceiling for universities trying to pinch pennies, a benchmark for those schools who want to be in the academic mainstream, and a springboard for agencies and organizations hoping to attract an elite clientele by offering considerably more. Pay scales also vary by disciplines and by support mechanism—whether the postdoc receives a competitive fellowship, an institution-based traineeship, or is funded on an investigator's grant. But whatever the number, the odds are good that it will be a lot lower than what graduates in fields outside science—especially those with a business or law degree—earn.

When it comes to low postdoc pay in the sciences, economists may be the exception that proves the rule. A 1998 report by the Commission on Professionals in Science and Technology, based on a survey of the members of 14 professional societies, found that economics postdocs typically earn 70% to 80% more than their counterparts in the life sciences, and that only computer scientists topped economists on median salaries in academia and business (see graph). In a playful article this summer in the *Journal of Economic Perspectives* entitled "It's Better Being an Economist (But Don't Tell Anyone)," Harvard economist Richard Freeman suggests that natural scientists themselves are partly to blame for their low wages, including levels for postdocs. The reason, he explains, is that so many young scientists are more committed to their work than to financial rewards. They refuse to bail out even when the job market tightens, creating an excess supply that holds down wages. And postdocs are on the bottom of that heap. "It's a little embarrassing," admits Freeman, who is working with the American Society for Cell Biology to gather data on career paths of students from some of the country's top biology labs, "because physicists and mathematicians are so much smarter than we are."



Pay patterns. A new survey of Johns Hopkins postdocs shows salaries are concentrated in the mid to upper 20's regardless of experience, and several people, mostly noncitizens, are working for little or no pay.

SOURCE OF SUPPORT FOR FIRST POSTDOCTORAL APPOINTMENT

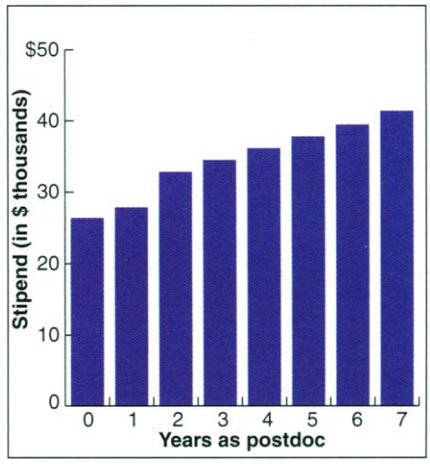
	Biochemistry		Mathematics	
	Male	Female	Male	Female
Fellowship	12%	12%	12%	11%
Internship	25%	20%	81%	67%
Research grant	63%	68%	7%	22%

In the United States, the de facto salary standard for academic postdocs in the life and health sciences has become what the National Institutes of Health (NIH) pays recipients of its National Research Service Award (NRSA) traineeships. For a first-year postdoc, an NRSA comes with a stipend of $26,252, up from $20,292 only 2 years ago and the first sizable hike in many years. (NIH doesn't call postdocs employees because they are supposed to be in training. As a result, their pay is not considered a salary and, thus, not subject to cost-of-living increases. Nor does it include benefits, although most institutions offer at least limited health coverage.)

That amount, which one faculty member calls "barely livable" and which NIH officials acknowledge was behind the times, actually applies to only 7000 NRSA postdocs at outside institutions. The 2230 intramural scientists working on the NIH campus enjoy a higher pay scale that factors in the area's higher cost of living. However, the NRSA levels have been adopted by many U.S. universities and research labs as the first rung on the salary schedule for all postdocs, most of whom are funded through grants to faculty members. "NIH has done a good job standardizing salaries and keeping them low," says physicist Peter Fiske, who in 1996 moved from a postdoc to a staff scientist position at Lawrence Livermore National Laboratory in California and has been active in the lab's postdoc association.

It's not a role that NIH officials embrace, however. "Sometimes things are used in ways that are not appropriate," says Wendy Baldwin, NIH's head of extramural research. She emphasizes that institutions are free to supplement the NRSA stipends and that they, not NIH, must decide how much to pay postdocs supported on research grants. In addition to the NRSA postdocs, NIH funds about 6500 postdocs a year on extramural research grants, more than any other government agency. [The National Science Foundation (NSF) supports about 4650 postdocs annually on research projects, plus another 150 to 200 as postdoctoral fellows, at stipends that vary but are generally higher than NRSA awards.]

Unintended or not, NIH's policies toward postdoc pay affect the entire community. The recent across-the-board 25% boost in NRSA stipends, which rise to $32,700 after 2 years and top off at $41,268 for postdocs with seven or more years of experience, creates pay inequities between those hired at the new levels, which went into effect 1 July, and existing staff. University officials and lab chiefs say that a dual pay scale is bad for morale and difficult to justify, but that they don't have the money to make things right. And some think NIH should make up the difference. "We have a policy that says all postdocs should get the



Small steps. NIH's pay scale for those with a National Research Service Award has become the de facto standard for U.S. postdocs in most fields.

CREDITS: (TOP) JOHNS HOPKINS POSTDOCTORAL ASSOCIATION; (BOTTOM LEFT) "PH.D.S—TEN YEARS LATER," NERAD, CERNY; (BOTTOM RIGHT) NIH

NRSA recommended levels, but there's no mechanism to bring up the rest," says Trevor Penning, director of postdoc programs at the University of Pennsylvania, who sees it as part of NIH's duty to meet the full cost of sponsored research but who admits that the idea has gotten a chilly reception from NIH officials. "I don't know how much it would cost, but NIH has to step up to the plate and address the issue."

Of course, the more NIH or any other agency pays postdocs, the less money it has for the rest of its research portfolio. Unless their budget rises sharply—as NIH's did last year, allowing director Harold Varmus to boost NRSA's $430 million budget by $81 million—agency officials must either shrink other portions of a grant or make fewer awards. Neither scenario is appealing to researchers, who say grants are already too small and success rates too low.

Absent a sudden windfall, however, universities and faculty members must scramble to make up the difference. Johns Hopkins University is planning to match the new levels for all its postdocs over 3 years, for example, although Jeremy Berg, chair of the department of biophysics, says that "[researchers] are encouraged to meet those levels as soon as possible" for postdocs on their grants.

For investigators with large labs, that's not a big problem. "We use the NRSA pay scale as a starting point," says Cliff Tabin, a professor of genetics at Harvard Medical School in Boston with a current roster of 10 postdocs. "If someone is making less, I supplement them to that level. If somebody gets a fellowship that pays more, that's great. And since I don't want anyone to take a pay cut after 3 years [when the fellowship ends], I try to keep them at that level and raise up everybody else."

But smaller labs may have a more difficult time. "The Yale standard is the new NRSA levels, which is barely livable," says Marina Picciotto, an assistant professor of psychiatry at Yale Medical School, who has three postdocs and a mixture of NIH and private funding for her work in molecular neuroscience. "And they recommend that you supplement it. But some of my grants are expiring, so it could be tough right now to move anybody up."

Postdocs with their "own money"—the standard phrase used to describe those on any type of fellowship—often receive slightly higher pay. NSF's new bioinformatics fellowship for postdocs, for example, offers an annual stipend of $36,000 for 3 years to about 20 fellows a year, up from $28,000 for an expiring fellowship in molecular evolution. "An incentive needs to be a healthy one, and we had fallen behind the times," says NSF program officer Carter Kimsey, who also recommended to her bosses that the stipend of an existing award for minorities she runs be bumped up from $28,000.

The competition for good candidates comes from other organizations offering similar portable fellowships. The Burroughs-Wellcome Fund, for example, gives out about 25 fellowships a year that also cover the transition from postdoc to junior faculty members. The stipends are even more generous, growing from $38,000 to $44,000 over 3 years as a postdoc, plus $16,000 a year in research funds; junior faculty members get a total annual package of $120,000 for 3 years of salary and research funding. "We want to fund the cream of the crop and pay them commensurate with their expertise," says program officer Martin Ionescu-Pioggia. "As a foundation, we can make a decision that we're going to pay them at a reasonable rate."

But such generosity can sometime cause resentment, even outside the field. "We got some flak from biology and chemistry because we were offering higher stipends," recalls NSF's Alvin Thaler, who designed a postdoc fellowship in mathematics in the early 1980s to bolster the quality of those going into academia. "We wanted to keep it comparable to starting [faculty] salaries at major institutions," he says, a philosophy out of step with the much lower pay levels for postdocs in other fields.

A 1946 history of Johns Hopkins University applauded Gilman's approach to building up the fledgling school's research capacity. "Probably no expenditure of ten thousand dollars in American education has ever had so large and so enduring a return on investment," wrote Hopkins librarian John French. Perhaps not. But that investment may have also left another, less positive legacy: the creation of a corps of cheap scientific labor to fuel U.S. academic excellence.

—JEFFREY MERVIS

NEWS

Japanese Jump on Postdoc Bandwagon

Overcoming the stigma of temporary workers, postdocs have become an integral part of science in Japan. But there's a price to pay for their popularity

Plant scientist Yuji Kamiya expected some rough spots 8 years ago when he was setting up a new plant hormone laboratory at the Institute of Physical and Chemical Research (RIKEN) outside Tokyo. Although his generous Frontier Research Program grant provided funding for postdocs—then a relatively new idea in Japan—Kamiya knew that recruiting and utilizing them would be a challenge. But one problem came as a complete surprise: "The postdocs couldn't get credit cards," he says. Finance companies had never heard of anyone with the title of postdoctoral researcher, and Kamiya unintentionally made the problem worse by calling one company and explaining that the postdocs' decent salary was guaranteed for 3 years. Company officials recoiled in horror: As a matter of policy, they explained, nobody with temporary employment was issued a card.

Postdocs in Japan have come a long way since Kamiya's first attempt to hire them. The pioneering efforts of the Frontier Research and other programs proved so successful that the Japanese government decided in 1995 to raise the number of postdocs from the 3775 then employed under a few special programs to 10,000 by 2000, spread throughout the nation's entire research establishment. The government has just

Change agents. Part of the first group of postdocs at the University of Tokyo's Institute of Medical Science pose with oncology chief Tadashi Yamamoto, right. But old habits die hard. Todai's Atsushi Iwamae (*top*) ended his postdoc 3 years early to grab a permanent post at Kyoto University.

CREDITS: D. NORMILE