The Postdoc Crisis

The first few postdocs were hired by Johns Hopkins University in 1876. They were poorly paid, but at the end of their brief training they went on to faculty jobs at elite research institutions. These postdoc positions were voluntary and remained so for almost 100 years.

> **"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."**
>
> —Embryologist Donald Brown of the Carnegie Institution (Science 285:1519, 9/3/99)

In the last quarter century there has been an enormous growth in the number of postdocs. Like their predecessors, they remain poorly paid, but now the average scientist will spend more time as a postdoc, will have a harder time securing a faculty position and will likely be required to do a postdoc if he or she decides to enter industry.[1]

A Growing Number of Postdocs

Two trends have fueled the massive growth of postdocs in the last two decades: a minimal increase in faculty and an over-production of PhDs in the 1980s and '90s.

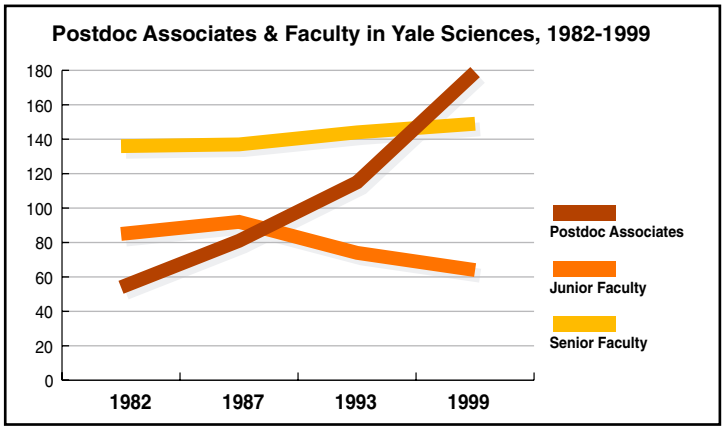

Figure 1: Ladder Faculty and Postdoc Associate Science Positions in FAS at Yale 1982-1999.[3]

While Figure 1 shows the general trend, it does not include all science researchers. Because of the difficulty in distinguishing between research and clinical faculty, it omits postdocs and faculty employed by the medical school. In addition, Yale employs both postdoc associates and postdoc fellows; Figure 1 doesn't include postdoc fellows because those numbers are not available.[2]

Figure 1 shows the increase of postdocs relative to faculty over the past two decades at Yale. The senior faculty in the sciences grew by 13 members, while the junior faculty shrank by 21.[4] In contrast, postdocs have increased 231%.

From 1992 to 1999 the number of postdocs nationwide grew by 20%.[5] At Yale, the growth in postdoc positions was 30%—more than the national average. [YBON G-4] In every major field, the growth in postdocs outpaced the growth of PhDs.

At the same time, nationwide the number of science and engineering faculty decreased by 1,800 between 1991 and 1995.[7]

For instance, the American Institute of Physics Report [3/01] noted that nationally

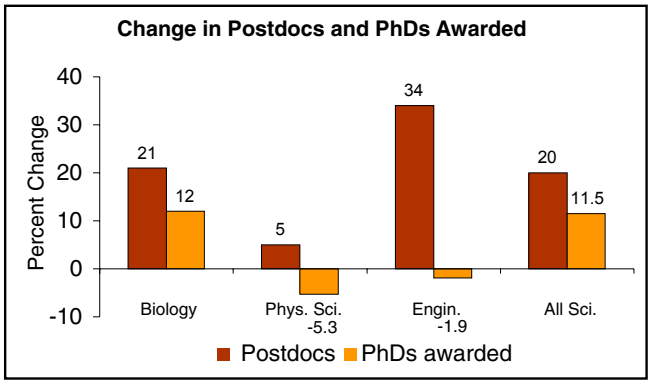

Figure 2: Increase in select fields 1992-1999.[6]

This report was researched and written by members of GESO <www.geso.org>

1,271 PhDs were awarded in Physics in 1999. However, only 335 ladder faculty hires were made in the 2000 academic year.[8]

The past two decades have seen a shift towards more and more people doing critical scientific research without job security or an institutional voice. And the chance of postdocs finding a faculty position has gotten slimmer, because more applicants are vying for fewer faculty slots.

> **"As long as people continue to work for those wages, and you get quality people, why raise the wage?"**
> **—Anonymous foundation director [quoted in JHM, p. 59]**

To quote the President of USC, "One of the reasons postdocs have become increasingly popular is because a postdoc is less expensive than a PhD student—you have to pay the PhD students' tuition plus a $15,000 stipend....And the postdoc spends 80 hours a week or more on research while the PhD has to go to class." [Quoted in JHM, p. 57]

Longer Time in Postdoc Positions

In addition to the rapid increase in the number of postdocs, there is also a large increase in the length of time a scientist spends in such positions before getting a ladder faculty job.

Figure 3 illustrates what sorts of jobs people had 3-4 and 5-6 years after earning their PhD. In 1973, for example, 11% of those who had earned their degree 3-4 years earlier held a postdoc position. Only 1% of those 5-6 years out held postdocs. By 1995, however, fully one-third of the PhDs 3-4 years out were in a postdoc position, and 17% of those 5-6 years out were still postdocs.

This graph does more than show the increasing number of PhDs occupying postdoc positions long after graduation. It also shows that postdocs are getting longer. During this 20-year period, the percentage of people in postdoc positions 3-4 years out rose by a factor of three. During that same time, the percentage of people in postdoc positions 5-6 years out rose by a factor of seventeen.

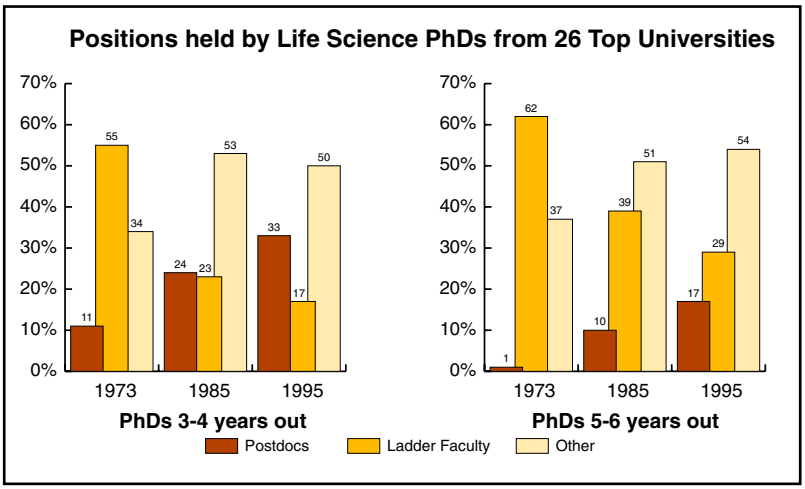

Figure 3. Positions Held by Life Science PhDs from 26 Top Universities. [9]

This graph also helps to show the difficulty recent PhDs may have securing faculty positions. In 1973 55% of PhDs secured a tenure-track faculty position within 3-4 years of their graduation. In 1995 that's down to 17%.

More PhDs are suffering through longer postdocs, while fewer are securing faculty jobs within six years of graduation.

And according to Gary Ostrander, Associate Dean of Johns Hopkins School of Arts and Sciences, "For people to be in postdoctoral positions for seven or 10 years is not uncommon." [Quoted in JHM, p. 56]

Faculty Positions Elusive

Not only do scientists spend more time as postdocs, but they also find that the longer their postdoc position, the smaller the likelihood of their ever getting a facul-

ty position. Figure 4 shows that for non-biological sciences the longer one remains a postdoc, the less one's chance of becoming a ladder faculty member.

In the biological sciences the likelihood of getting a faculty position peaks—seven to eight years after graduation—at 20%.

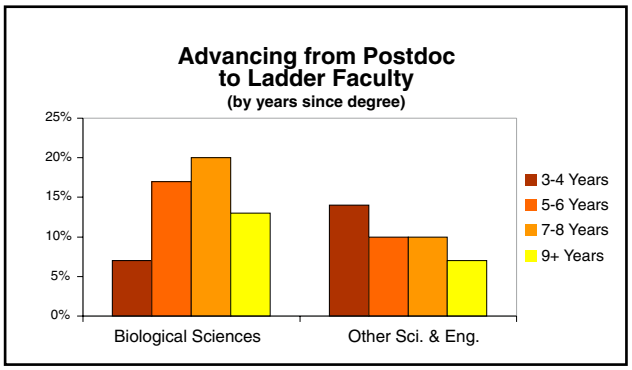

Figure 4: Transition rates, data from 1995.[10]

Other Temporary Scientists

Postdocs are not the only temporary workers in academic science. There are other classes of non-ladder researchers. At Yale, temporary researchers (including postdocs) now account for almost 60% of the scientists in FAS.

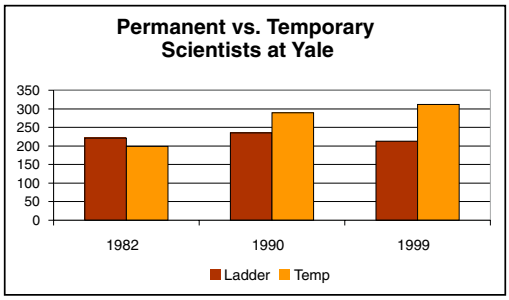

Figure 5: Scientists in Yale's Faculty of Arts & Sciences.[11]

This follows a national trend in which there were 30% more non-faculty research scientists in 1999 than 1992.[12]

Industry and Government Postdocs

In the past, industry offered an escape route for scientists in which they could find well-paid, secure work. Now, a glut of overtrained, underpaid researchers has convinced industry that it does not need to offer well-paid, secure jobs in order to hire the people it needs.

Now, when academic science offers so few opportunities for young scientists, industry has followed suit and is hiring postdocs at a faster rate than universities.

In 1981, 91.4% of all postdocs were academic positions. In 1997, 80.3% were academic and the rest were industry and government. In fact, while there was a 125% increase in academic postdocs during that time, governmental postdocs increased 421% and industry postdocs increased 652%.[14]

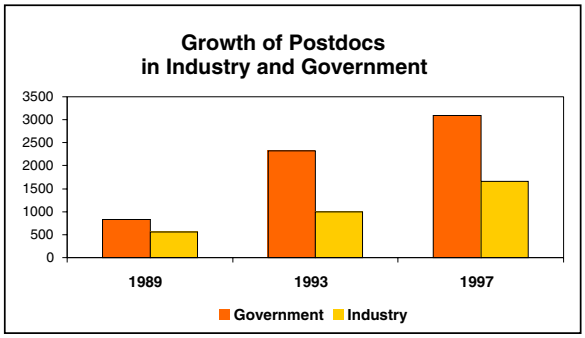

Figure 6: Industry and Government Postdocs.[13]

Whether in universities, industry or government, the trend is inescapable: recent PhDs work as low-paid postdocs.

Why So Many Postdocs?

The reason employers prefer postdocs over faculty is clear when salaries are compared. In a recent survey, *Science* reported the median salaries of life scientists:

Professor	$108,000
Associate Professor	$72,000
Industry Postdoc	$36,000
Academic Postdoc	$31,000

Chart 1: Median Salaries[15]

And even though 65.8% of postdocs are married and 36.8% have children,[16] only 10% of the top 25 research universities provided medical insurance that included families. An additional 26.7% of these institutions required only that the postdoc be provided medical coverage by either the institution or the advisor.

Less than one third of these universities reported that they provided any of the following benefits for postdocs: dental, disability, maternity/paternity leave, cost-of-living adjustments, merit pay increases, child care, retirement plan, life insurance, or travel expenses when going to a conference.[17]

To summarize: when scientists receive their PhD, they will spend longer in post-doc positions and have a lower chance of securing a faculty position than ever before. Even those who enter industry or governmental positions will probably have to spend time as a low-paid postdoc.

Can We Do Better?

The United States' investment in science has been tremendous. One indicator is the federal investment in research and development, which grew from $12.8 billion in 1955 to $74.4 billion in 1999 (in real dollars).[18]

The Federal commitment to science is just one source of funding for scientific research in the U.S. At Yale University, non-federal grants amounted to almost 25% of the income from research in 1999.

Yale has seen an incredible growth in income from research grants to the point where they now account for 28% of its income.[19]

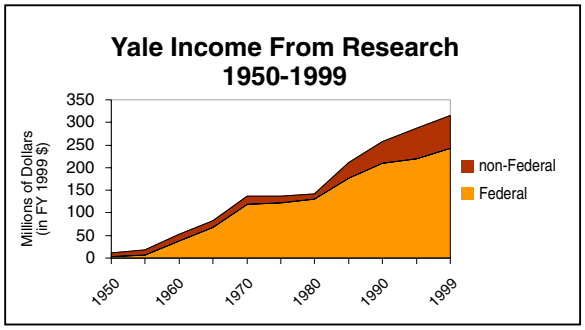

Figure 7: Yale Income from Research.[20]

Given this growth in money available for scientific endeavors, one would expect that scientists could expect a secure future. In fact, the opposite is true.

The Effect on Science and Scientists

The way the current postdoc system works for scientists means:

- Long hours, low pay and few (if any) benefits
- Less control over one's research—both the project and the results
- Less control over the direction science takes
- Less of an institutional voice in their own future.

Some postdocs face additional challenges. In 1999 international scholars accounted for 56% of U.S. postdoc positions, while earning only 38% of PhDs.[21] These scholars are often isolated and need additional services, including English language training. On average, it takes foreign postdocs without adequate language skills two additional years to secure a permanent job.[22] Visa issues add another layer of insecurity.

> **"Postdocs, overall, are the most important element of this academic environment."**
>
> —Levi Watkins, Jr., Assoc. Dean of Johns Hopkins Medical School [JHM, p. 54]

With only 5.5% representation among postdocs, and with no institutional voice, people of color also face more obstacles to success.[23] The scientific community has yet to address this structural problem adequately.

Similarly, women are often asked to choose between having a family and a scientific career. And the institutional sexism present in all areas of American society here manifests itself in lower postdoc salaries for women than for their male counterparts.[24]

There is also a downside for science, since quality researchers often leave their fields because they are unwilling to put off good pay and job security for several years after their degree. And, because of the need for instant results in order to

advance, researchers may prefer to do "safe" research rather than longer, more difficult, but potentially groundbreaking work.

Organizing for a better future

These problems are spiraling out of control because fewer and fewer scientists have an institutional voice that can shape the future of the discipline.

Unions are one way to gain such a voice. Typically at universities the first to organize are blue-collar workers, then white-collar secretaries or technicians. Once this happens, it is easier for graduate teachers and researchers to organize, creating a foundation for more transient workers—such as postdocs or adjunct faculty—to organize themselves, too.

At New York University, following on the heels of a successful unionization drive among graduate teachers, adjunct faculty began organizing. Now, as the adjuncts near a majority, other faculty at NYU have begun to organize.

Today there are over 30 graduate assistant unions on more than 60 campuses.[25] This activity has spurred postdocs and adjuncts to begin organizing.[26]

In 1992, the postdocs at Johns Hopkins formed the first postdoc association. Now there are more than two dozen such associations, some of which have negotiated with their universities on health care, childcare, salaries and other issues.[27]

At Stanford University postdocs are starting to discuss forming a union.[28] And in the United Kingdom postdocs belong to unions and have a voice in their futures and in the future of science.[29]

Notes

[1] Abbreviations:
EPESE-- Committee on Science, Engineering and Public Policy. Enhancing the Postdoctoral Experience for Scientists and Engineers. Washington D.C.: National Academy Press, 2000.

GSPD--National Science Foundation, Division of Science Resources Studies, Graduate Students and Postdoctorates in Science and Engineering: Fall 1999, NSF 01-315, Project Officer, Joan Burrelli (Arlington, VA 2001).

JHM --Joanne P. Cavanaugh, "The Postdoc's Plight" in Johns Hopkins Magazine February 1999.

NYT-- Lee, Jennifer S. "Postdoc Trail: Long and Filled with Pitfalls." New York Times, August 21, 2001.

SEDA--National Science Foundation, Division of Science Resources Studies, Science and Engineering Doctorate Awards: 1999, NSF 01-314, Author, Susan T. Hill (Arlington, VA 2001).

YBON--A Yale Book of Numbers, 1976-2000. Prepared by Beverly Waters, Office of Institutional Research. August, 2001. http://www.yale.edu/oir/pierson_update.htm.

[2] A rough estimate suggests there are about 600 fellows at Yale.

[3] YBON, Tables I-1 and G-4.

[4] In the Medical School, postdoc associates have increased almost 450% in the same period (YBON Table G-4). Ladder faculty in the Medical School has increased 44%, but many of those faculty members are MDs who teach medical students and don't perform any research (YBON Table I-1).

[5] GSPD, Table 48.

[6] GSPD, Table 1 and SEDA, Table 1.

[7] NYT.

[8] *American Institute of Physics Report* 3/2001, p. 5 and SEDA Table 1.

[9] Committee on Dimensions, Causes, and Implications of Recent Trends in the Careers of Life Scientists, *Trends in the Early Careers of Life Scientists.* Washington, DC : National Academy Press, 1998, Table F.4F.

[10] National Science Foundation, Division of Science Resources Studies, *What Follows the Postdoctorate Experience? Employment Patterns of 1993 Postdocs in 1995*, NSF 99-307, Author, Mark C. Regets (Arlington, VA 1998), Fig.1.

[11] YBON, Tables G-4 and I-1.

[12] GSPD, Table C-27.

[13] EPESE, p. 128.

[14] EPESE, p. 128.

[15] *Science* 294: 399-401 (12 October 2001).

[16] EPESE, p.133.

[17] EPESE, p. 146, 150.

Dental Insurance	27.6%	Disability	27.6%
Maternity/ Paternity Leave	31.0%	Cost of living adjustments	3.4%
Merit increases	24.1%	Childcare	6.9%
Vacation time	51.7%	Sick leave	44.8%
Parking	44.8%	Retirement plan	24.1%
Life Insurance	31.0%	Travel expenses to conferences	10.3%

[18] National Science Foundation, Division of Science Resources Studies, *Federal R&D Funding by Budget Function: Fiscal Years 1999-2001*. Arlington, VA (NSF 01-316) 2/2001. Tables 25a-h. www.nsf.gov/sbe/srs/nsf01316/historic.htm.

[19]YBON, Table G-1.

[20] YBON, Table G-1

[21] GSPD, Table 49; SEDA, Table 4.

[22] EPESE, p.82-83.

[23] See EPESE, p.33, 36.

[24] On the difficulty for women to pursue academic careers and motherhood, see EPESE, p. 37 and Robin Wilson, "For Women With Tenure and Families, Moving Up the Ranks Is Challenging," *The Chronicle of Higher Education*, November 9, 2001. On women being paid less see EPESE p. 33.

[25] See the Coalition of Graduate Employee Union's report, *Casual Nation*, p. 5. www.cgeu.org/Casual_Nation.pdf

[26] See, NYT and Konigsmark, Anne Rochelle. "California University's Postdoctoral Researchers Consider Forming Union." *San Jose Mercury News*, March 9 2001 and Magner, Denise K. "'Postdocs,' Seeing Little Way into the Academic Job Market, Seek Better Terms in the Lab." *The Chronicle of Higher Education*, August 7, 1998.

[27] JHM, NYT

[28] See, NYT and Konigsmark, Anne Rochelle. "California University's Postdoctoral Researchers Consider Forming Union." *San Jose Mercury News*, March 9 2001.

[29]http://nextwave.sciencemag.org/cgi/content/full/2001/10/16/5