

Too Casual Too Blue

Science Research at Yale

September 2003

Ad Hoc Committee on Research in the Sciences
GESO (Graduate Employees & Students Organization)
425 College Street, New Haven, CT 06511 (203) 624-5161 • www.yaleunions.org

Introduction

The 1980s and 1990s have seen an unprecedented expansion in the role of the sciences, particularly the life sciences, in the American university. From 1991 to 2001 total academic research and development spending nationwide increased by 51.8% in constant dollars.² Since 1998, the budget for the National Institutes of Health has doubled.³ This funding boom has coincided with an increase in academic-industry partnerships. In 1980, the Bayh-Dole act created a process for the commercialization of discoveries developed with federal grant money and gave universities incentives to transfer technology to the private sector. Inventions made during the course of federally-funded research are assigned to the university where the invention was made: the university and inventors are allowed to keep or assign the profits from their discoveries.⁴ Bayh-Dole has meant that universities have access to revenue they would not otherwise have had, since without it the discoveries “would have been in the public domain.”⁵

“To be one of the world’s best universities fifty years from now, it will not be sufficient to excel in the humanities, fine arts, the social sciences and the law; we will need to be among the very best in science and technology.”
— Yale University President Richard C. Levin¹

Between the potential revenue from discoveries and the increase in federal funding for life science research, large research universities have emphasized the sciences, especially the life sciences, in developing the financial and educational future of the American academy.⁶ The purpose of this report is to investigate how one university, Yale University, has changed as a result of the expanding market for life science research. In addition to explaining Yale’s financial commitment to the sciences, this report explores the career paths of science researchers in the evolved structure of academic science research.

The report will examine:

- How funding for life science research has become more important to Yale: NIH funding has increased 175% since 1971, and funding from industry increased 3850% since 1982.
- How the research population at Yale has grown over the past decade: from 1993-2000, the number of postdoctoral associates increased by 83% and the number of faculty by only 9%.
- How graduate alumni of Yale’s science departments fared since graduation: 17% of women in the biological sciences are full-time mothers as while only 19% are tenure-track faculty.
- How unionization of scientists generally and graduate researchers specifically will ensure that academic scientists have good, secure jobs and that scientists control the direction of science.

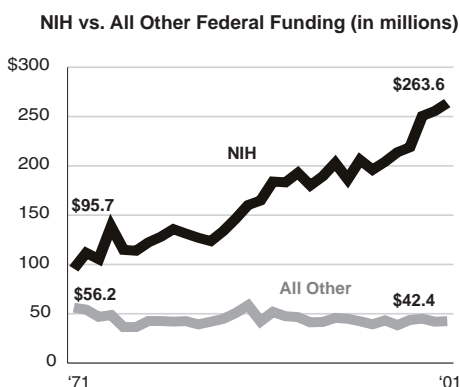
The Sciences at Yale

Traditionally, Yale University focused on excellence in the liberal arts, law and medicine. During the past decade, the university has placed greater emphasis on becoming a center for scientific inquiry, particularly in the life sciences. In 1996, Yale University President Richard C. Levin stated that “We consistently rank among the nation’s leaders in grants awarded by the National Institutes of Health, and our M.D. and Ph.D. programs stand among the nation’s

best. As our fourth century begins, we must aspire to continuing leadership in the life sciences.”⁷ The impact of this stated commitment to the life sciences can be seen on the ground in three ways.

First, Yale has successfully increased the amount of federal funding it receives in the sciences through competitive research grants to faculty. This growth has come primarily from a rapid increase in funding from the National Institutes of Health (NIH). Other areas of science at Yale have not fared as well.

From 1971 to 2001, funding from the NIH increased 175% in real dollars while funding from all other sources decreased slightly.⁸ From 1983 to 2000 the biological and medical sciences faculty increased by 41%.⁹



However, since 1988 external funding in real dollars for the physical sciences at Yale has decreased.¹⁰ The expansion of sciences at Yale is uneven among different disciplines, reflecting federal government funding priorities.

Second, during the 1980s and 1990s, Yale entered into many scientific partnerships with industry. These partnerships fit into President Levin's vision of the Yale:

“To finance the needed investments, with the prospects for Federal support uncertain, we must must obtain increased support for both capital improvements and operating expenses from non-governmental sources: individuals, corporations, and foundations, as well as income generated from the transfer of university-owned technology to commercial use.”¹¹

Yale started its Office of Cooperative Research (OCR) in 1982, with the goal of “extending and expanding Yale University's interaction with the private sector.”¹² This includes screening inventions for potential commercial value, overseeing the patenting of discoveries and inventions, and seeking out commercial partners to license them.¹³ Over the past ten years, the OCR more actively sought out partners, licensing technology to 41 new companies based on Yale discoveries.¹⁴ Yale generated licensing revenue of over \$46 million in 2000 alone.¹⁵

Since the creation of the OCR, direct funding from industry, although still a small percentage of the University's research budget, has grown 3850%.¹⁷

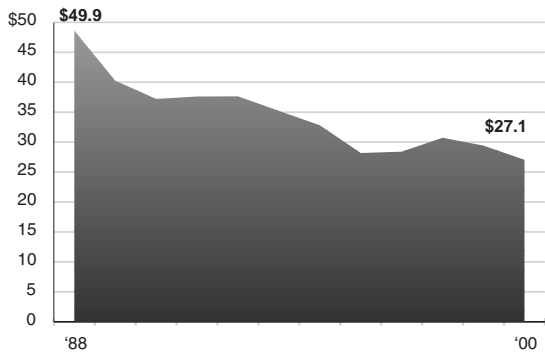
Third, the University is investing a significant amount of capital in the creation of new science facilities and the renovation of existing facilities. In February 2000, Yale announced \$1 billion in new construction to overhaul the university's science infrastructure.¹⁸ So far, this investment has led to the construction of two state-of-the-art buildings which will house life sciences research, with a third

building due to begin construction in fall 2003.¹⁹

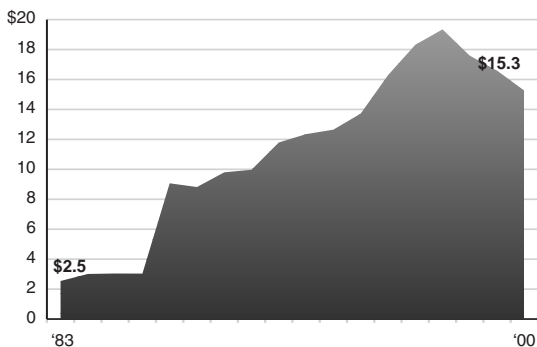
One of these buildings—the Anlyan Center for Medical Research and Education, which opened in March 2003—is devoted to biomedical research. \$60 million of the \$176 million cost of the building was paid with licensing fees from the Yale-discovered AIDS drug Zerit, marketed by Bristol-Myers Squibb.²⁰

The increase in funding to the life sciences has led to a rapid expansion in the population and resources of these areas. Yale's investment in scientific infrastructure has not been matched by a similar investment in the lives and careers of the scientists working in these buildings. Rather than expanding vertically by proportionally increasing the size of the research faculty and diversifying the kinds of research being done, research labs have expanded horizontally, relying heavily on graduate researchers and postdoctoral researchers to perform externally funded research.

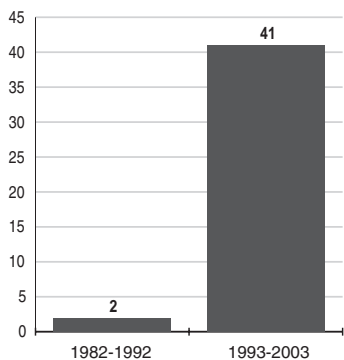
Physical Sciences Grants to Yale (2003 Dollars, in millions)



Yale Funding from Industry (2003 dollars, in millions)



Startups Based on Yale Inventions¹⁶

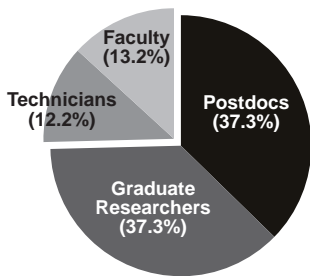


Who does the research at Yale?

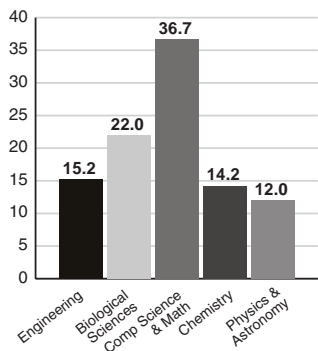
Over the past ten years, Yale has increasingly relied on postdoctoral researchers. The number of postdoctoral associates on the Yale payroll jumped 83% from 1993 to 2000,²¹ while the number of tenured and tenure-track faculty in the sciences increased only 9%.²² Today, 75% of the University's research population in science departments that receive NIH funding are graduate and postdoctoral researchers.²³ (see graph on following page) Graduate

and postdoctoral researchers can be expected to spend 40-60 hours working in laboratories every week and have limited control over the direction and application of their research.²⁴ These jobs are poorly compensated: Yale graduate students make between \$22,500 and \$28,000²⁵ a year, and Yale requires that postdocs make a minimum of \$34,200 a year unless a waiver is obtained for a lower salary;²⁶ both groups have limited health care benefits,²⁷ and lack job security.²⁸

Life Science & Chemistry Researchers at Yale²⁹



PhDs with tenure or tenure-track jobs at 4-year institutions 4-6 years after degree (1999)



Graduate researcher and postdoctoral positions were originally intended to be transitory jobs where young scientists got the training and skills they needed to succeed as independent tenure-track researchers. In the past decade, across the nation, the vast majority of graduate students and postdocs do not find a secure tenure-track job in academic science shortly after receiving their degrees.³⁰

Research facilities like the Anlyan Center, where large laboratories filled with low wage, low benefit researchers focus their energies on clinical, applied biomedical research are the centerpiece of Yale University's expansion in the sciences. While this type of research facility may enhance the University's ability to get federal funding from the NIH and increase the possibility of licensing laboratory discoveries to industry, it also contributes to the growing problem of casualization in the research sciences. Casualization is the replacement of high-wage, secure jobs that have some control over the direction of research, with low wage, transient positions that have little or no control over what is being investigated. The trends of casualization and the increased length of postdoctoral research are well documented.³⁵ As casualization worsens, talented, young scientists are pushed out of the academy because they find it impossible to get good academic jobs.

Life after Yale?

Despite the demographics of lab populations and the increasing casualization of academic research, most graduate students today enter their Ph.D. programs at Yale expecting to one day find jobs as tenured faculty members. If other universities follow President Levin's vision for the future of the sciences at Yale, the graduate student scientists at Yale have a good chance of finding postdoctoral positions at universities, but many have a poor chance of reaching tenured faculty positions. Many scientists who begin their careers at Yale excited to become academics leave the academy after completing their Ph.D.s.

In order to investigate the career paths of graduate student scientists after earning their Ph.D.s at Yale, we surveyed approximately 200 alumni who graduated between 1983-1999.³⁶ Among the respondents, 69% said that while earning their degrees they wanted to become academic research scientists. However, only 30% of them successfully became tenure-track academic scientists. This difference between expected careers and real careers is even starker for women who earned degrees in the biological sciences. While 77% of them expressed a desire to become tenure-track academics, only 19% have been able to accomplish their goal.

The Anlyan Center for Medical Research and Education

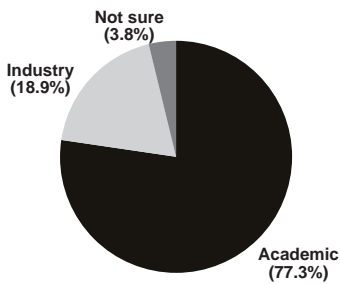
Heralded by Yale president Richard C. Levin as, "the largest single investment in a facility in Yale's history," and as "the beginning of an important period of investment in the School of Medicine,"³² the Anlyan Center was built using licensing income from the Yale-discovered AIDS drug, Zerit.³³

The employment trends in this building are disturbing: fully 51% of personnel in the Anlyan Center are postdoctoral researchers and only 12.5% are faculty.³⁴

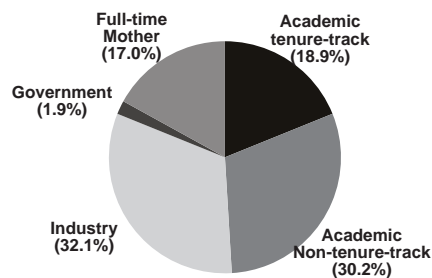
The Anlyan Center unfortunately represents the way Yale contributes to the trend of expanding the postdoctoral and graduate researcher positions which have no institutional or representational voice.

Remarkably, among life science Ph.D.s, women were almost as likely to become a full-time mother as to become a tenure-track faculty member.³⁷

Goals of Women Yale PhDs



Current Positions of Women Yale PhDs



Among alumni who wanted to go into academic careers, most respondents who left the academy did so because it was not economically viable for them to remain in the university system, not because they lost interest in pursuing academic careers.

The majority of alumni we surveyed graduated prior to 1993. Thus there were very few who were still postdoctoral researchers. In fact, part of the reason for surveying older alumni is the difficulty con-

tacting recent alumni, who may not stay in a single postdoctoral appointment for several years, but rather move from lab to lab.

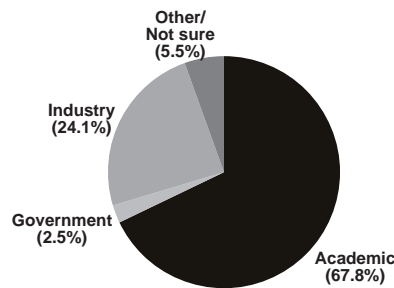
Fifty-five percent of alumni reported having held a postdoctoral appointment. They held one or two consecutive postdoctoral appointments spending between 6 months and 10 years in such positions. Some alumni left the academy after a postdoctoral

appointment to find more secure, better paying jobs, with some working outside their fields of training. Many alumni warned that graduate researchers should learn about their career prospects and consider whether it is important to them to raise families. While not suggesting that they would not have gotten their degrees, they did suggest that there are other job opportunities available without doctoral degrees.

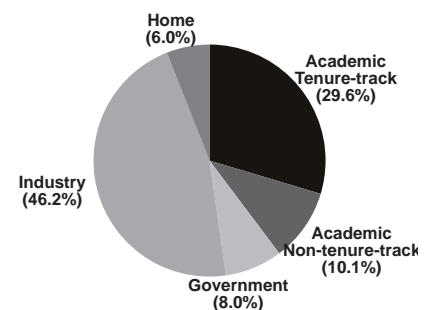
Well-funded university-based research is essential for the future of scientific inquiry, economic prosperity and advances in public health. Unfortunately, our data show that despite increases in funding to the life sciences, many scientists trained at Yale, do not remain in the academy because it is difficult to find secure, well-paying jobs. Even at Yale, President Levin's vision for the future of science relies more on the use of postdoctoral researchers than tenured and tenure-track faculty to perform research.

Since casualization of the sciences forces highly trained scientists out of academic careers, it is imperative that policies at Yale and at federal institutions, such as the NIH, create a real career path for scientists. Experienced scientists are needed to carry out basic research that contributes to the long term advances in technology and public health and that is performed in academic, rather than for-profit research settings. This means a more accessible system of advancement to tenure and more economically viable, secure positions prior to tenure.

Goals of Yale PhDs



Current Positions of Yale PhDs



**Alumni Survey Results:
Advice to prospective students**

“Go early, get done quickly and get out as soon as possible-- otherwise you'll be 40 and with no money.”

“If you're interested in having children, I'm not sure you can do this and remain competitive in your field.”

“The difference between a large pizza and a postdoc? A large pizza can feed a family of four.”

Solutions

National policy reforms are needed to ensure the United States continues to make enormous advances in science. Creating a career path for scientists includes significant policy changes on both the national level and institutional level. Young scientists need:

- Improved working conditions,
- Job security and a reduced length of postdoctoral “training,”
- Influence over the direction of science research, and
- A democratic voice in the laboratory and increased control over the results of research.

The remainder of this report will explain how the unionization of graduate researchers will help solve these problems on a national policy scale and at Yale in particular.

NATIONAL POLICY SOLUTIONS

Scientists across the country have started organizing to enact solutions through collective organizations, most frequently postdoctoral associations. Institutions with postdoc associations include:

- Johns Hopkins University
- Stanford University
- University of Pennsylvania
- Vanderbilt University
- University of Chicago
- University of Utah
- University of California, Berkeley
- University of California, San Francisco
- McGill University (Canada)
- University of Calgary (Canada)
- Fred Hutchinson Cancer Research Center and
- the National Institutes of Health

Postdoc associations have submitted policy recommendations to their host institutions for improved wages, benefits, professional development and representation in university decision making processes. Their efforts are amplified by a report from the recently formed National Postdoctoral Association, which makes national policy recommendations to the NIH.³⁸ Although many postdoc associations have proposed significant changes in policy, university administrations have thus far implemented few.

Some postdoctoral associations have won important benefits, including:

- mandated health care,³⁹
- child care,⁴⁰
- parental leave,⁴¹
- dental coverage,⁴²
- vacation,⁴³
- annual evaluations,⁴⁴
- postdoc policy committees,⁴⁵ and
- grievance procedures.⁴⁶

Significant changes will come about most effectively through unionization and collective bargaining agreements. Such agreements can allow scientists to engage democratically in decision-making, negotiate better conditions with university administrations and effectively lobby national policy and funding organizations to change their practices. Postdoctoral researchers at University of Alaska have a union contract. At the University of Connecticut, postdoctoral researchers recently voted to form a union.

Graduate employee unions have won:

- Intellectual property rights similar to those of professors, including inventors' rights,⁴⁷
- ESL fellowships covering room and board,⁴⁸ and a day off to go to the nearest consulate to vote in home country elections⁴⁹ for international students,
- Free or subsidized, low-cost health and dental care for dependents including spouses, domestic partners and children,⁵⁰
- Covered eye examinations for people who use computer screens frequently,⁵¹
- Contributory retirement plan,⁵²
- Worker's Compensation for on the job injuries and⁵³
- Access to staff parking, bus passes,⁵⁴ parking discounts.⁵⁵

At Yale, GESO has been organizing graduate researchers in the sciences for over five years and recognizes the need for national policy changes to solve the problems of casualization. These solutions must provide incentives for highly trained scientists to choose careers in science, increase the accessibility of science careers to scientists from traditionally disadvantaged groups, maintain a balance of funding for all important fields of science, and allow scientists a democratic voice over the changes in their fields.

Federal funding agencies provide a significant amount of the resources that universities spend on research. They also determine the conditions for researchers. For example, many schools, including Yale, use the NIH payscale for postdoctoral researchers. Policy changes at the national level can alleviate many of the problems of casualization.

Working conditions

Federal funding agencies as a policy should provide universities the tools to adequately compensate graduate and postdoctoral researchers and allow them to advance. In particular, federal funding agencies should:

- Implement across-the-board wage increases and require universities to do the same.
- Guarantee full benefits, including pensions, comprehensive family health care, and parental leave to all graduate researchers, postdocs, and junior faculty.
- Promote policies that reward universities for successfully meeting the needs of women, U.S. minorities, and international researchers and diversifying all levels of research employment.

Job Security

Graduate and postdoctoral research appointments should be used primarily for training new researchers, rather than as a way to perform research inexpensively. Federal funding agencies and organizations of universities should:

- Fund graduate researchers directly and decrease the number of graduate students who rely on faculty research grants.
- Limit the length of postdoctoral appointments to the time necessary to develop particular professional skills.
- Provide avenues for permanent employment immediately after a postdoctoral appointment ends.
- Increase the availability of transition awards to facilitate postdocs becoming faculty members.

Direction of Science Research

Over the past quarter of a century American industry has benefited from discoveries based on federal funding of a diverse research base.⁵⁶ It is important to ensure that our most highly trained scientists who do research in areas that do not have obvious commercial potential continue to contribute to the scientific community. The Federal Government should:

- Increase funding for basic research.
- Renew its commitment to fund research in fields outside of the biomedical sciences.
- Ensure that university patenting policies make allowances for public health crises when

patenting medicines in developing countries

- Establish a means for the NIH and other agencies to collect feedback directly from graduate and postdoctoral researchers regarding the conditions of their research, education, and future career prospects.

Democratic voice in the laboratory

Federal funding agencies place many stipulations on universities in return for federal funding. In recognition of the rights of graduate and postdoctoral researchers, federal funding agencies should:

- Uphold the the rights of science researchers, especially graduate students and postdocs, to organize collectively.
- Issue statements encouraging universities to cooperate with graduate and postdoctoral researcher unions in their formation and in negotiating contracts.
- Prohibit the use of facilities and administrative costs (overhead) to be used for anti-union activities.

YALE-BASED SOLUTIONS

Graduate students do not have to wait for changes in national policy to begin to reform their own institutions. GESO recently surveyed over 200 graduate researchers at Yale and found that their key issues were health care access, career path and research. Many of these issues can be addressed through a union of graduate researchers.

Working Conditions

Graduate school and postdoctoral appointments can take well over a decade of a scientist's career. During these years, researchers make important contributions to their fields. Yale should compensate graduate researchers at a level commensurate with the academic and financial contribution that they make to the university.

Yale should:

- Increase compensation for physical scientists to the same level as their colleagues in the biological sciences, even if Yale has to augment the funding provided by the federal government to pay physical science researchers.
- Pay graduate teachers for every teaching assignment. All students who perform teaching and researching responsibilities simultaneously should be paid for both duties.
- Charge tuition only for the years in which graduate students take courses. Unlike some peer institutions, ⁵⁷ Yale currently charges four years of tuition for graduate research scientists, which often comes out of faculty grants.
- Provide full benefits to graduate researchers, including: child care, parental leave, dental care, prescription coverage, free family medical insurance, disability insurance, retirement benefits, subsidized housing, free facilities access year-round, paid vacation time and free parking.
- Increase compensation for all graduate researchers.

Job security

In order to provide a national model in reversing the trends of casualization, Yale should:

- Guarantee all graduate researchers full funding without regard to their faculty advisor's ability to get funding from granting agencies.
- Guarantee that graduate researchers whose faculty members leave the university have adequate resources to complete their degrees.
- Create and fund a career counseling center to help graduate researchers navigate the science job market.

Direction of Science Research

Historically Yale has made important contributions to all areas of scientific research. It currently is committed to furthering its presence as a center for scientific inquiry. Yale should:

- Fund important areas of research that are not a priority of federal funding agencies, including research into public health issues that will not lead to highly profitable drugs.
- Renew research programs in areas that do not have obvious commercial potential.
- Track the careers of graduates of Yale science programs and make the data publicly available.

Democratic voice in the laboratory

A key element to implementing the solutions in this report is to give graduate researchers a voice in the decision making processes of the university. The controversy over developing countries' access to the Yale-discovered AIDS drug, Zerit, revealed the need for university inventors to have greater control over the products of their work.⁵⁸

Yale should:

- Recognize the rights of its graduate researchers to organize and end its opposition to graduate student unionization.
- Negotiate a fair process, free from faculty intimidation or coercion, to determine support for a union and recognize the union if a majority of graduate students support it.
- Adopt GESO's "University Research Code of Ethical Conduct" with guiding principles to make medications developed at universities affordably available to those who need them.
- Reform the technology transfer process to give all researchers involved in a discovery, not only the principal investigator, control over the commercialization process and a share in the revenues from its discovery.

Conclusions

While the employment trends for scientists have been negatively affected by casualization, scientists who act collectively have begun to change these trends. Postdoctoral associations have won improvements in the working conditions of their members. Graduate employee unions have won intellectual property rights as well as other benefits for their members. At Yale, graduate researchers who are organizing may be able to win their own improvements through a union contract and turn Yale into a model of how to do scientific research without relying so heavily on casualized workers.

Notes

- 1 Richard C. Levin, "The Global University," Yale Club of Korea, Seoul, May 15, 2003.
- 2 *Chemical and Engineering News*, "Academic R&D Spending Trends" (Vol. 81, No. 29, July 21, 2003) p.25
- 3 Eugene Russo, "Victims of Success," *Nature*, Vol. 422, March 20, 2003, p354
- 4 Teresa Riordan, "Patents; Keeping Track of Federally Aided Technology Is the Subject of a Congressional Hearing Today," *New York Times*, July 11, 1994, at D2.
- 5 Teresa Riordan, "Patents; Developing Easier and More Efficient Ways to Deliver a Drug that Enhances Oxygen Capacity," *New York Times*, March 2, 1998, at D2.
- 6 *Chemical and Engineering News*, "Academic R&D Spending Trends" (Vol. 81, No. 29, July 21, 2003) p.25
- 7 Richard C. Levin, "Preparing for Yale's Fourth Century," *Yale Bulletin & Calendar*, Nov. 4-11, 1996.
- 8 NSF WebCASPAR Database System. Inflation calculation based on Consumer Price Index for Urban Areas
<http://www.newsengin.com/neFreeTools.nsf/CPIcalc?OpenView&Start=2&Count=30&Expand=2#2>
- 9 Yale Book of Numbers 1975 to 2000. Biological Sciences and Paid School of Medicine Faculty all categories: in 1983, 948, in 2000, 1342.
- 10 Funding to the physical sciences increased from 1980 to 1986, flattened then began to drop in 1988. NSF WebCASPAR Database System. Inflation calculation based on Consumer Price Index for Urban Areas
<http://www.newsengin.com/neFreeTools.nsf/CPIcalc?OpenView&Start=2&Count=30&Expand=2#2>
- 11 Yale President Richard C. Levin, "Preparing for Yale's Fourth Century" *Yale Bulletin & Calendar*, November 4, 1996
- 12 Office Of Cooperative Research, Yale University, *From Bench To Bedside* (1998).
- 13 Office Of Cooperative Research, Yale University, *From Bench To Bedside* (1998).
- 14 Yale Office of Cooperative Research "1982-2002 Yale OCR Annual Report: Bringing Life to Ideas" <http://www.yale.edu/ocr/images/2002.ocr.annual.report.pdf>
- 15 Yale Office of Cooperative Research "1999-2000 Annual Report: Adding Value to Ideas" http://www.yale.edu/ocr/images/docs/ocr_report_99-00.pdf
- 16 Yale Office of Cooperative Research "1982-2002 Yale OCR Annual Report: Bringing Life to Ideas" <http://www.yale.edu/ocr/images/2002.ocr.annual.report.pdf>
- 17 NSF WebCASPAR Database System.
- 18 <http://www.yale.edu/opa/newsr/00-02-24-01.all.html> and <http://www.yale.edu/opa/newsr/00-01-19-01.all.html>
- 19 The Class of 1954 Environmental Science Center, which is associated with the School of Forestry and Environmental Science, is the other building. A new Chemistry building is in progress as the time of printing.
- 20 *Yale Alumni Magazine*, March 2003
- 21 Yale Book of Numbers 1976-2000. Table G-4 This number does not include postdoctoral fellows who are paid directly through external entities for their work on Yale research.
- 22 Yale Book of Number 1976-2000. Table I-1. Tenure and term faculty from the Faculty of Arts and Sciences in the Biological and Physical Sciences plus paid tenured and term faculty from the School of Medicine. If the School of Medicine is not included, the number of tenured and term faculty decreased by 6%.
- 23 The total numbers of postdoctoral researchers at Yale is not a public figure, therefore we were able to collect this data only in departments where all personell are listed on rosters, the internet, or where individual lab members provided this data. Departments included and data source are as follows: neurobiology (roster), MCDB (roster), EEB (internet), MBB (roster), Immunobiology (roster), microbial pathogenesis (personal communication), and chemistry (roster). We believe that this sample is representative of the employment ratios by job classification in all biology departments.

24 Affidavits for the National Labor Relations Board.

25 Biological & Biomedical Sciences get \$24,000 for 2003-2004. <http://info.med.yale.edu/bbs/introBBS.html> choose the Financial Support Link; those who bring in outside fellowships get \$28,000. Engineering and Applied Science gets \$22,500 for 2003-2004, http://www.eng.yale.edu/graduate/doctoral_program.html

26 Letter to Yale Faculty from John Alvaro, Director, Yale School of Medicine Postdoctoral Affairs, Dated My 30, 2003. The minimum required salary for postdocs is \$34,200 for the 2003-2004 academic year, unless a lower salary is approved. New grants should follow the current NIH postdoctoral salary guidelines.

27 Graduate researchers are enrolled in the Yale Health Plan which requires them to purchase prescription coverage separately. <http://www.yale.edu/uhs/menu.html> Postdoctoral associates have similar benefits to faculty members, but the cost to the employee is a much higher percent of their salaries than the percent that faculty pay. Postdoctoral fellows have even lower health care benefits. <http://www.yale.edu/hronline/benefits/indexpd.html>

28 Postdoctoral associates have to be reappointed each year. Although there is a “Complaint Procedure” for individuals who feel that they were treated inconsistently with Yale’s policies in the Handbook for Postdoctoral Associates and Fellows, there is no binding grievance procedure for cases in which a postdoctoral appointee is terminated. Graduate researchers similarly have no formal, binding procedure for reversing a situation in which they are terminated from the laboratory in which they work. In both cases, final decisions are left up to an appointee of the Yale Administration (either the Provost or the Dean of the Faculty of Arts and Sciences).

29 The total numbers of postdoctoral researchers at Yale is not a public figure, therefore we were able to collect this data only in departments where all personnel are listed on rosters, the internet, or where individual lab members provided this data. Departments included and data source are as follows: neurobiology (roster), MCDB (roster), EEB (internet), MBB (roster), Immunobiology (roster), microbial pathogenesis (personal communication), and chemistry (roster). We believe that this sample is representative of the employment ratios by job classification in all biology departments.

30 National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, 1993 and 1999, Table 3-12.

31 National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, 1993 and 1999, Table 3-12.

32 *Yale Alumni Magazine*, March 2003

33 The Anlyan Center opened in March 2003.

34 In addition to the use of casual researchers in the Anlyan Center, all of the custodial services in the building have been subcontracted to a non-union company. These workers receive lower wages and fewer benefits than members of Local 35

35 “Trends in the Early Careers of Life Scientists”, National Research Council, Committee on Dimensions, Causes and Implications of Recent Trends in the Careers of Life Scientists 1998. <http://www.nap.edu/readingroom/books/trends/>. “Addressing the Nation’s Changing Needs for Biomedical and Behavioral Scientists”, National Academy of Sciences, Committee on National Needs for Biomedical and Behavioral Scientists, 2000 http://grants1.nih.gov/training/nas_report/index.htm. Freeman, R. et al, “Careers and Rewards in Bio Sciences: the disconnect between scientific progress and career progression”, American Society for Cell Biology, 2001. <http://www.ascb.org/publications/competition.html>. “Policy Recommendations to the National Institutes of Health”, National Postdoctoral Association, 2003. http://www.nationalpostdoc.org/white_paper

36 A majority of those surveyed graduated before 1993.

37 Surveys on file at the office of the Federation of Hospital and University Employees

38 “Policy Recommendations to the National Institutes of Health”, National Postdoctoral Association, 2003. http://www.nationalpostdoc.org/white_paper

39 Fred Hutchinson Cancer Research Center, Student/Postdoc Advisory Committee www.fhcrc.org/education/spac/

40 Fred Hutchinson Cancer Research Center, Student/Postdoc Advisory Committee www.fhcrc.org/education/spac/

41 The Johns Hopkins School of Medicine Postdoctoral Association

www.hopkinsmedicine.org/jhpda

42 Fred Hutchinson Cancer Research Center, Student/Postdoc Advisory Committee
www.fhcr.org/education/spac/

43 Fred Hutchinson Cancer Research Center, Student/Postdoc Advisory Committee
www.fhcr.org/education/spac/

44 The Johns Hopkins School of Medicine Postdoctoral Association
www.hopkinsmedicine.org/jhpda

45 McGill University, Post-Graduate Students' Society www.pgss.mcgill.ca/IS/postdoc.html

46 Stanford University Postdoc Association www.stanford.edu/group/supd/

47 University of Massachusetts, Amherst, Graduate Employee Organization / UAW Local 2322,
<http://www-unix.oit.umass.edu/~geo/contract.htm>

48 University of Michigan, Graduate Employees Organization / AFT Local 3550,
<http://www.umgeo.org/modules.php?op=modload&name=UpDownload&file=index&req=getit&lid=17>

49 Oregon State University, Coalition of Graduate Employees / AFT Local 6069,
<http://www.peak.org/~cge/docs/cgecontract1.pdf>

50 Michigan/GEO and University of Iowa, UE Local 896/COGS, <http://www.cogs.org/contractsettlement.htm>

51 University of Wisconsin, Teaching Assistants' Association / AFT Local 3220 <http://www.taa-madison.org/contract99-01.html>, "Frequently" is defined in the contract.

52 University of California, UAW Local 2865, <http://www.uaw2865.org/contracts.html>

53 Oregon State/CGE

54 UC system/ UAW Local 2865

55 UMass/GEO

56 Richard C. Levin, speech, "The University as an Engine of Economic Growth"
http://www.yale.edu/opa/president/univ_economic_growth.html

57 MIT pays for 65% of tuition for research assistants and full summer tuition for graduate students doing research, rather than charging full tuition to faculty members' research grants. http://web.mit.edu/osp/www/grad_student_tuition.doc At Harvard, "[t]uition and fees drop from \$26,400 in the first two years, to \$8,174 in the third and fourth years, and \$3,400 in the fifth year and beyond (2002-2003 rates)." <http://www.gsas.harvard.edu/financial/index.html>

58 *The Guardian UK*, "Campus Revolt Challenges Yale over \$40m Aids Drug," Julian Borger and Sarah Boseley, March 13, 2001.