

MIND THE GENDER GAP

Despite improvements, female scientists continue to face discrimination, unequal pay and funding disparities.

BY HELEN SHEN

As an aspiring engineer in the early 1970s, Lynne Kiorpes was easy to spot in her undergraduate classes. Among a sea of men, she and a handful of other women made easy targets for a particular professor at Northeastern University in Boston, Massachusetts. On the first day of class, “he looked around and said ‘I see women in the classroom. I don’t believe women have any business in engineering, and I’m going to personally see to it that you all fail.’”

He wasn’t bluffing. All but one of the women in the class ultimately left engineering; Kiorpes went on to major in psychology.

Such blatant sexism is almost unthinkable today, says Kiorpes, now a neuroscientist at New York University. But Kiorpes, who runs several mentoring programmes for female students and postdoctoral fellows, says that subtle bias persists at most universities. And it drives some women out of science careers.

By almost any metric, women have made great gains in closing the scientific gender gap, but female scientists around the world continue to face major challenges. According to the US National Science Foundation, women earn about half the doctorates in science and engineering in the United States but comprise only 21% of full science professors and 5% of full engineering professors. And on average, they earn just 82% of what male scientists make in the United States — even less in Europe.

Scientific leaders say that they continue to struggle with ways to level the playing field and entice more women to enter and stay in science. “We are not drawing from our entire intellectual capital,” says Hannah Valentine,

dean of leadership and diversity at the Stanford School of Medicine in California. “We’ve got to put on the accelerator to evoke social change.”

One of the most persistent problems is that a disproportionate fraction of qualified women drop out of science careers in the very early stages (see ‘Women in science’). A 2006 survey of chemistry doctoral students by the Royal Society of Chemistry in London, for example, found that more than 70% of first-year female students said that they planned a career in research; by their third year, only 37% had that goal, compared with 59% of males¹.

Many experts say that a big factor driving this trend is the lack of role models in the upper divisions of academia, which have been slow to change. The Royal Society of Chemistry has found, for instance, that female chemistry students are more likely than males to express low self-confidence and to report dissatisfaction with mentorship². Female students “conclude consciously and unconsciously that these careers are not for them because they don’t see people like them”, suggests Valentine. “That effect is very, very powerful — this sense of not belonging.”

The attrition continues at later stages. In biology, for example, women comprised 36% of assistant professors and only 27% of tenure candidates in a 2010 study by the US National Research Council³. “We’re not talking about a lack of talent here. Part of the story is that

women leave earlier. In a sense, they give up on an academic career,” says Curt Rice, vice-president of research and development at the University of Tromsø in Norway, who has studied gender equality in US and European universities.

FAMILY VALUES

Many of the UK chemistry students viewed research as an all-consuming endeavour that was incompatible with raising a family. Meeting the demanding schedule of academic research can seem daunting for both mothers and fathers. But family choices seem to weigh more heavily on the career goals of women.

Law professor Mary Ann Mason at the University of California, Berkeley, and her colleagues have found⁴ that male and female postdocs without children are equally likely to decide against research careers, each leaving at a rate of about 20%. But female postdocs who become parents or plan to have children abandon research careers up to twice as often as men in similar circumstances.

“The plan to have children in the future, or already having them, is responsible for an enormous drop-off in the women who apply for tenure-track jobs,” says Wendy Williams, a psychologist at Cornell University in Ithaca, New York. Furthermore, women who do become faculty members in astronomy, physics and biology tend to have fewer children than their male colleagues — 1.2 versus 1.5, on average — and also have fewer children than they desire⁵.

In response to these concerns, many universities have taken steps to establish family-friendly policies such as providing child-care assistance and extending tenure clocks for new

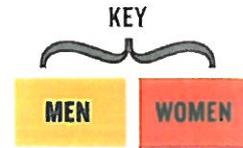


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WOMEN IN SCIENCE: MANY HURDLES AHEAD

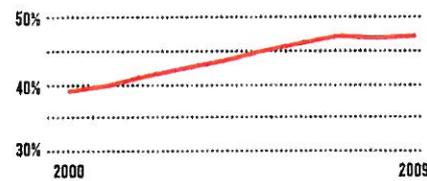
The number of women studying and practising science has risen sharply, but women are disproportionately driven away from scientific careers.



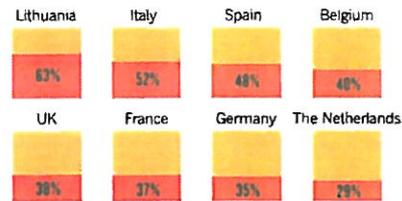
GRADUATE SCHOOL

The fraction of women gaining doctorates in science has more than doubled in the United States since 1980 and is now nearing equity. In some European countries, women outnumber men in science degrees but there is significant variation between nations and fields.

US FEMALE DOCTORAL RECIPIENTS IN SCIENCE AND ENGINEERING



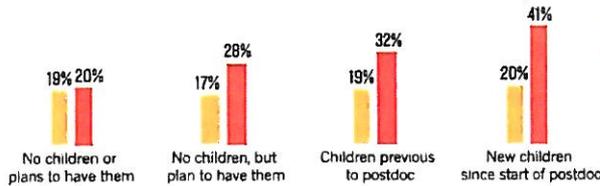
FEMALE DOCTORAL RECIPIENTS IN SCIENCE IN EUROPE (2006)



POSTGRADUATE POSITIONS

A 2009 survey of postdoctoral fellows at the University of California showed that women who had children or planned to have them were more likely to consider leaving research.

POSTDOCS WHO DECIDED AGAINST CAREERS AS RESEARCH FACULTY MEMBERS (2009)



"The plan to have children in the future, or already having them, is responsible for an enormous drop-off in the women who apply for tenure-track jobs."

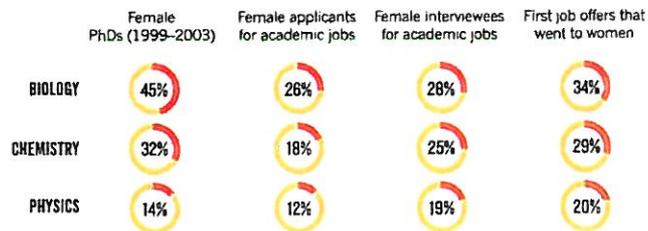
Wendy Williams, Cornell University

EARLY CAREER

Female representation among science and engineering faculty members in the United States has lagged behind gains in graduate education, in part because many women do not apply for tenure-track jobs. But women who do apply are more likely than men to receive interviews and offers.

"At least part of the lack of applications is due to the fact that women look at these careers and don't see people like themselves."

Hannah Valentine, Stanford University

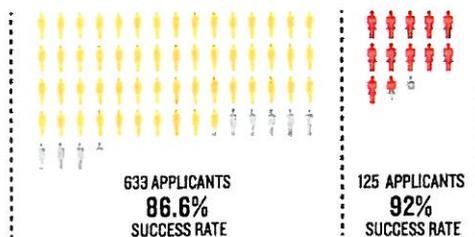


RISING IN THE RANKS

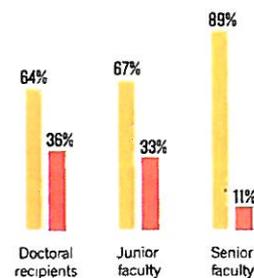
A study of US science departments showed that women were more successful than men in gaining tenure between 2002 and 2004. In Europe as in the United States, the gender gap is greater among senior than among junior faculty members.

US TENURE DECISIONS 2002-04

♂ / ♀ = 10 PEOPLE

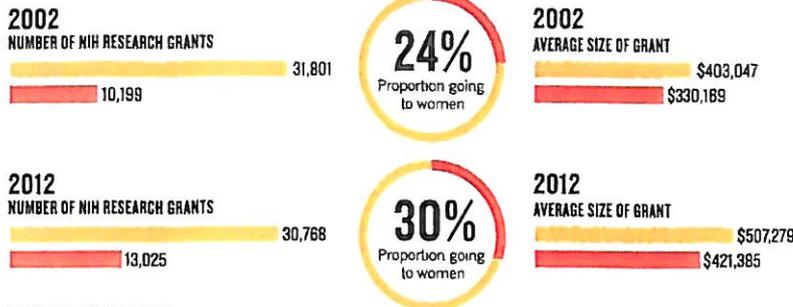


GENDER GAP AMONG SCIENTISTS IN EUROPEAN UNIVERSITIES (2006)



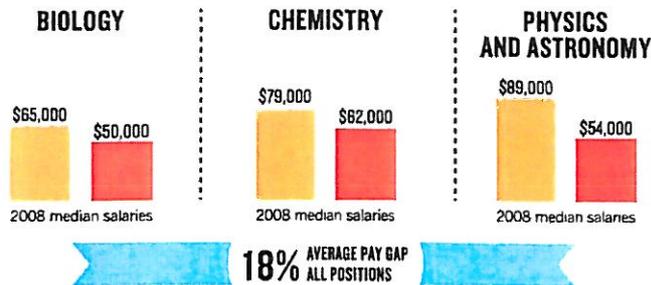
THE FUNDING GAP

Women are earning an increasing share of research grants from the US National Institutes of Health (NIH) but the average size of their awards has consistently lagged behind what men receive.



THE SALARY GAP

Female scientists in the United States earn much less than men, on average, with the difference varying strongly by field.



parents. Shirley Tilghman, president of Princeton University in New Jersey, believes that such initiatives provide crucial support for women, but that other solutions are still needed. "I don't think there's a single obstacle," she says. "I think there's a whole series of phenomena that add up."

LIVE ISSUE

At Yale University in New Haven, Connecticut, microbiologist Jo Handelsman is one of many researchers who think that gender discrimination continues to be a significant part of the problem. In a much-talked-about experiment last year⁶, her team showed that science faculty members of both sexes exhibit unconscious biases against women. Handelsman's group asked 127 professors of biology, chemistry and physics at 6 US universities to evaluate the CVs of two fictitious college students for a job as a laboratory manager. The professors said they would offer the student named Jennifer US\$3,730 less per year than the one named John, even though the CVs were identical. The scientists also reported a greater willingness to mentor John than Jennifer. "If you extrapolate that to all the interactions that faculty have with students, it becomes very frightening," says Handelsman.

Her findings match well with the results of a survey⁷ done in 2010 by the American Association for the Advancement of Science. Of the 1,300 or so people who responded, 52% of women said that they had encountered gender

bias during their careers, compared with just 2% of men.

Still, other concrete evidence of bias is hard to find. Some measures show female scientists outperforming male rivals in landing interviews and job offers early in their careers. The National Research Council study³ showed that women accounted for 19% of the interview pool and received 32% of job offers for tenure-track electrical-engineering positions. Women fared just as well as men in tenure evaluations, but female assistant professors in many disciplines seemed less likely to reach tenure consideration compared with men.

Women face even more daunting odds in Spain. Men are 2.5 times more likely to rise to the rank of full professor than female colleagues with comparable age, experience and publication records⁸.

Disparities can also be found in grant funding in some countries. In one frequently cited study⁹, Christine Wennerås and Agnes Wold at the University of Gothenburg in Sweden found in 1997 that female applicants for postdoctoral fellowships had to score 2.5 times higher on an index of publication impact to be judged the same as men.

Several groups, such as the UK Medical Research Council and biomedical research charity the Wellcome Trust, have since investigated their grant programmes and found negligible or very subtle effects of gender¹⁰. The Canadian Medical Research Council found no differences in success rate in most of its research

grant programmes, but reported lower success rates for women in some training grants¹¹. In the United States, women are slightly more successful than men in obtaining grants from the National Science Foundation, but the trend is reversed for the National Institutes of Health (NIH). The NIH also gives women smaller awards on average (see 'The funding gap').

Information provided to *Nature* by the NIH through a Freedom of Information Act request indicates that the percentage of women on review panels has improved marginally over the past decade, from 25% in 2003 to 30% in 2012. Those figures roughly parallel the percentage of women applying for and receiving grants in that time.

PAY PROBLEMS

The inequalities also extend to salaries. In the European Union, female scientists earned on average between 25% and 40% less than male scientists in the public sector in 2006 (ref. 12). Although the average pay gap is smaller in the United States, the disparity is particularly large in physics and astronomy, where women earn 40% less than men.

For young academic scientists, however, those differences may be fading. The National Research Council found an 8% pay gap at the level of full science and engineering professors but no significant differences among junior faculty members³. Some experts argue, however, that the salary gap may reflect other continued trends, such as the fact that a disproportionate share of women move into non-tenure positions or faculty jobs at lower-status universities.

Tilghman says that Princeton and many other universities have grown increasingly conscious of the need to track and rectify gender gaps in salary and other institutional support. "Absolutely, it needs eternal vigilance," she says. "But we're in a much better place." ■

Helen Shen is an intern with Nature in Washington DC.

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BARRED FROM THE BOARDROOM



BY ALISON MCCOOK

Nancy Hopkins started Googling her colleagues in spring 2012. She mentally scanned the hallways of her institution at the Massachusetts Institute of Technology (MIT) in Cambridge — along with the campuses of other elite institutions — for the offices of men she knew who had founded companies. Then she clicked on the websites of their firms, and counted the number of men

and women serving on their scientific advisory boards (SABs), a prestigious position for researchers who steer the company's scientific direction.

It was an informal exercise, rather than a systematic survey. But Hopkins, a molecular biologist at MIT and a long-time campaigner for women in science, found the results shocking. A sample of 12 of the companies she examined had a

VIKTOR KOEN



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total of 129 SAB members; only 6 were women. "I was completely stunned," says Hopkins. "And it made me sad. I thought, 'gee, why don't these men want to work with [MIT] women?' We have such incredible women faculty."

The proportion of women in industrial and academic science has shot up over the past 20 years. According to the US National Science Foundation, women make up 25% of tenured academics in science and engineering and more than 25% of industry scientists in research and development. But when it comes to academics engaging in commercial work — patenting their discoveries, starting biotech companies or serving on SABs — the picture is less progressive. Studies have confirmed Hopkins' impression that even leading female scientists are often absent from these roles. "The secret club [of men] used to be going to the lab and conferences," says Fiona Murray, who studies life-sciences entrepreneurship at MIT. "That world has changed a lot, but we have a new venue where it is still difficult for women to play a similar role."

Experts in industry and academia speculate that the disparity could reflect the small numbers of women in certain specialized fields; the demands of family life; or a residual male clubbiness. Whatever the reasons, this stubborn gender gap hurts everyone, says Bonnie Bassler, a molecular biologist at Princeton University in New Jersey. "I think the companies would do better science by having the best people on their board. And I think these women, who are great scientists, would do better science in their labs by having access to these ideas."

"Everybody's losing," says Bassler.

HIDDEN PROBLEM

For much of the 1980s and 1990s, there were more than 11 men for every one woman in the science faculty at MIT. Things started to change 20 years ago, when Hopkins, as the first chair of MIT's Committee on Women Faculty in the School of Science, and her team drove through major increases in the hiring of women. By 2006, one out of every five biology faculty members on the MIT campus was a woman.

At a dinner last April to honour these achievements and mark her retirement from the lab, Hopkins spoke about the work still to be done. She talked about a list she had been given by a graduate of Harvard Business School in Boston, Massachusetts, showing the names of scientists in the area who had received funding from a local venture-capitalist firm. Among 100 names, only one was a woman. The list would not have surprised Hopkins more than 30 years ago, when she had been told by a colleague that "women aren't allowed" to found biotech companies. But to see such a dearth of academic women in modern biotechnology was upsetting.

Around that time, Hopkins embarked on her Google search. She was particularly interested in SABs because they consist mainly of working scientists who are often invited by the company's academic founders — a social process that could reveal conscious or unconscious biases against female academics. And membership in advisory boards comes with advantages: it can tip members off to promising tools and areas of research, and lead to other lucrative prospects, such as consulting. Plus, for a few meetings per year, board members are paid a sometimes-substantial fee, given stock options, or both.

The first name Hopkins looked up was Eric Lander, founding director of the Broad Institute of MIT and Harvard. She typed "Eric Lander companies" into the search engine. Scrolling through the results, she came upon Verastem, a cancer stem-cell company founded in 2010 by Lander and others, including Robert Weinberg, a cancer researcher at the Whitehead Institute in Cambridge. She counted 14 people on Verastem's SAB; all were men.

Entering "Phil Sharp companies" brought up Alnylam Pharmaceuticals, a Cambridge-based firm co-founded by the Nobel prize-winning molecular biologist at MIT in 2002. The company, which is developing therapies based on RNA interference, had one woman on its 11-person SAB. "Bob Langer companies" yielded a handful of the 20-plus firms that the MIT bioengineer has helped to launch, including Taris Biomedical in Lexington, Massachusetts, which focuses on genitourinary conditions, and the biopharmaceutical company Blend Therapeutics in Watertown, Massachusetts. Neither SAB included any women. (Weinberg and Lander say that they were not involved in selecting the SABs at Verastem, and Langer that he was not involved with the process at Blend or Taris. Sharp says that at Alnylam, choosing the SAB required "agreement between" the founders, chief executive, venture capitalists and other people already brought into the company.)

Hopkins included in her search a few scientists from other institutions, such as Harvard University in Cambridge and Memorial Sloan-Kettering Cancer Center in New York. Overall, among the full-time professors affiliated with a sample of 14 companies she reviewed, only 5% of founders or SAB members were women. Although boards change over time, that fraction was much the same as of last month.

Last July, Hopkins began circulating her results to a handful of faculty members at MIT and to scientists further afield. Vicki Sato, a professor of biology and management at Harvard with a long career in the biotechnology industry, says she could not believe what she was seeing. "I was stunned by the sampling she had done, and told her she had to be wrong," says Sato. "But I knew deep down she was right."

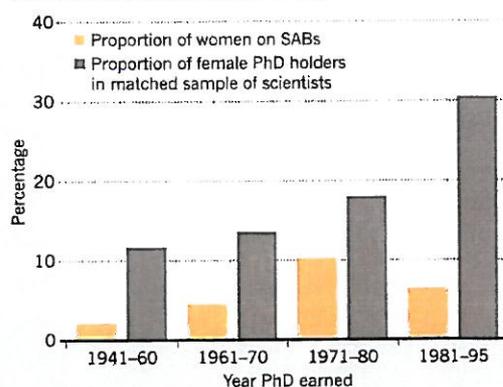
GLOBAL CONCERN

More rigorous studies have reached similar conclusions. In a paper published last October¹, Murray, Toby Stuart at the University of California, Berkeley, and Waverly Ding at the University of Maryland in College Park reviewed all publicly available lists of US biotech SABs, starting in the 1970s and including about 500 companies. Although women represented between 12% and 30% of academically active PhD holders over that time period, the percentage of women on SABs never exceeded 10.2% (see 'Inequality on board'). Even when the researchers compared male and female faculty members with similar levels of achievement, measured by factors such as publication and citation counts, male scientists were roughly twice as likely to join SABs as female ones.

SABs are not the only commercial forum in which academic women seem to be disadvantaged. US women also receive patents about 40% as often as men², start businesses half as often¹ and receive significantly less funding for the start-ups that they do launch³. This is not just a US problem: a study released in April 2012 by the Royal Society of Edinburgh found that women

INEQUALITY ON BOARD

The proportion of women on biotech scientific advisory boards (SABs) lags behind the proportion of eligible female candidates.



SOURCE: REF. 1

are underrepresented on the boards of UK science, technology, engineering and mathematics companies⁴. That is despite the fact that including women seems to be beneficial: a 2012 report from Credit Suisse in Zurich, Switzerland, found that worldwide, companies with women on the board have higher share prices than those with all-male boards⁵.

INVITATION ONLY

So what is going on? For SABs, Hopkins thinks that the answer is simple: women are not asked. When she noticed the stark patterns in board memberships, Hopkins asked some of her female colleagues — including one she believed was an “absolute star” — if they had ever been invited to serve on boards. All of them said no. “In the end, these stories are very sad,” says Hopkins. “People know they’re excluded, and it’s costly professionally. They’re embarrassed to talk about it. It’s like not being asked to dance.”

But the picture is not so simple, says Paul Schimmel, a former colleague of Hopkins who is now based at the Scripps Research Institute in La Jolla, California, and is a co-founder of Alnylam. He says that he has tried to ensure equal gender participation in his lab and his companies for the past 20 years. “There’s no lack of effort, I tell you,” says Schimmel. But serving on a board “can be a lot of work” — conference calls, e-mails, travel several times a year and thick documents to review — and women often bear the majority of domestic work and child care. At least one woman has turned down Schimmel’s invitation to serve on an SAB because of family responsibilities, he says. Indeed, research has shown that female academics with children are less likely than those without to patent their discoveries⁶.

Some prominent female scientists disagree. Carolyn Bertozzi, a chemical biologist at the University of California, Berkeley, who has two young children and one on the way, says that she is always willing to make time to serve on the research advisory board at GlaxoSmithKline, which entails attending two-day meetings twice a year for “generous” compensation. The meetings teach her about what it takes to make a drug, including medicinal chemistry, regulatory issues and intellectual property; that helps with her start-up, Redwood Bioscience in Emeryville, California, which has two female SAB members out of four. Bertozzi acknowledges that her situation is unusual: her female partner is a stay-at-home mother. But Bassler, too, says that the work involved in SABs is worth the sacrifices. “If I were asked to serve on a board, I wouldn’t do something else,” she says. Bassler has been invited to serve on two SABs in her career, but “of course” would accept another invitation if it arose.

Research seems to support the idea that it is a lack of invitations — not a lack of time — that reduces female membership in biotech SABs. Murray, Stuart and Ding found that both men and women tend to join SABs on average around the 20th year after completing their PhDs¹ — often a time when the major strain of child rearing is over. This suggests that family obligations are not holding back women more than men. And in interviews at a leading institution that Murray declined to name, women consistently reported they had rarely been invited to serve on their colleagues’ SABs — which was not the case in a matched sample of men⁷.

Stuart says that the disparity is most likely to be a result of social connections and unconscious bias among men. “If you’re male, you’re slightly more comfortable shooting the shit with your male colleagues, and they’re who come first to mind when you’re putting these boards together. You may assume — ‘oh, she’s got two kids, she’s not going to be interested’ — and then not invite her.”

But companies say that they can have difficulty finding women with the right experience, because there are fewer women than men in academia overall. At Alnylam, says Schimmel, the type of science and the diseases it hopes to treat “considerably narrow the size of the pool of highly qualified senior investigators, regardless of gender”. (A statement from the company notes that women represent “nearly 30%” of Alnylam’s management team.) At Taris, says Langer, the SAB had to include mostly clinical experts in urology, who are generally men. And Verastem found that there were few prominent female biologists who focus on cancer stem cells, says chief medical officer Joanna Horobin. At least one woman declined the offer to join the SAB, Horobin says, because she was already working with a competing company.

The academics and biotech companies interviewed for this story say that they hope the situation will change. At Alnylam, people have “discussed openly the issue of gender and the SAB”, says Schimmel. “All of us support strongly the idea of addressing the ‘gender problem’ in a thoughtful way and are actively working on it.” In Lander’s opinion, more important than the make-up of the SAB is the selection of the company’s board of directors — who “control the entire company”. Two out of seven directors at Verastem are women.

Women can also make the first move, says Helen Blau, a stem-cell biologist at Stanford University in California, who has served on the advisory boards for several start-ups. She broke into commercialization by patenting discoveries and talking to companies at conferences about her work. The effort paid off: companies

have licensed at least a dozen of her patents, which helped Blau to get consulting jobs, board invitations and now her own start-up, Didimi in Berkeley, California.

Hopkins, meanwhile, has not let the issue lie. After she discussed her data with MIT colleagues, the group decided to forward the findings to the university’s provost, Chris Kaiser. It turned out that Lydia Snover, director of institutional research at MIT, had already started mining faculty CVs across the entire institution for information about activities such as patenting, technology licensing and participation in SABs. If MIT finds gender differences and can help to do something about them, it will, says Snover. “We want all [faculty members] to be involved in the same way.”

Hopkins wants to see all institutions follow MIT’s example. In academia, people used to believe that “time would fix things naturally”, and that women would eventually move up the ranks, she says — and this attitude may still exist when it comes to academics moving into industry. “I think [the gender disparity in SABs] is what universities would look like if we hadn’t stopped, analysed what was going on, and changed it. If you don’t put attention to it, it doesn’t happen.” ■

Alison McCook is a freelance writer and editor in Philadelphia, Pennsylvania.

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