June 2005

STATUS

A REPORT ON WOMEN IN ASTRONOMY

CONTENTS

A Publication of the American Astronomical Society Committee on the Status of Women in Astronomy

From the Editor

By Fran Bagenal

In the January issue of STATUS we commented on brewing issues of gender inequity at Harvard with "Watch this space for further developments on the gender gap at Harvard. But don't hold your breath." Well, we did not need to wait long. On January 14th Larry Summers made his infamous statements[1]

> "There are three broad hypotheses about the sources of the very substantial disparities that this conference's papers document and have been documented before with respect to the presence of women in high-end scientific professions. One is what I would call the high-powered job hypothesis. The second is what I would call different availability of aptitude at the high end, and the third is what I would call different socialization and patterns of discrimination in a search. And in my own view, their importance probably ranks in exactly the order that I just described."

…and then the whole subject of women in science erupted. The incident might not have been so noticeable had Nancy Hopkins (Professor of Biology and author of the 1996 study of women at MIT) not walked out of his talk and gone to the press. The hubbub stirred by his comments is not just confined to the halls of academia or "high-brow" papers, but also hit the front cover of TIME[2] (circulation 27 million) and articles appeared in mass circulation magazines such as Parade[3] (circulation ~36 million). If you Google "Summers women science" for the past six months you get back half a million references.

This "Summers explosion" propelled the issue of the under-representation of women in science into unprecedented limelight. But it has not been just sensationalism. I have seen three articles on the front page of the New York times in the past four months,

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Margaret Kivelson

Interview with Margaret Kivelson

At first glance Margaret Kivelson's career follows the mythical "perfect trajectory": AB, AM and PhD from Radcliffe (aka Harvard-for-women in the 50s), Professor and Department Chair at UCLA, Member of the National Academy of Sciences (2000), plus a host of awards (for example, in 2005 she received the Fleming Award of the American Geophysical Union and the Hannes Alfven Medal of the European Geophysical Union). However, when one looks closer at her CV (e.g., 18 years between PhD and a proper faculty position) and asks Margy about her career, one learns that the path was not so simple and that her successes were hard-earned. She has strived to help the women who follow and has sought ways to ensure institutional equity. The following is extracted from an interview with Fran Bagenal.

What do you regard as the most notable improvements in the climate for women that you have seen over your scientific career?

Changing expectations. When I started my studies to become a scientist, women worked if they had to. Few worked because they wanted to and were excited about what they were doing. When I first arrived at UCLA (1955, as a faculty wife), I was one of two Chemistry faculty wives (out of something like 30) who worked, and the only working mother. It was clear to me that many thought that being a working mom was seriously wrong and they worried about my children's well-being.

I started college in 1946 (Radcliffe, but that meant being at Harvard except for recreation and accommodations). Most of my family had joked that I was going to get an "MRS", a view that was widespread. Harvard had *no* women professors. In 1948 the first woman professor (the distinguished historian Helen Maud Cam) was appointed to a chair established for the purpose of appointing a female to

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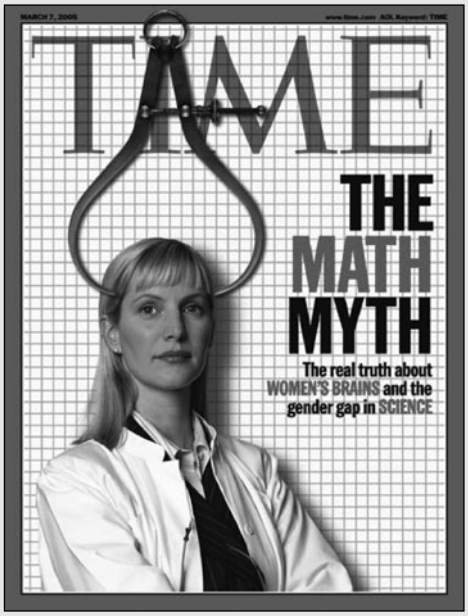
all well-researched and thoughtful. The three issues Summers mentioned in his talk are analyzed in depth. Three university presidents (of Stanford, MIT and Princeton) released a joint statement[4] emphasizing the importance of the issue of under-representation of women in science, quoting numbers that point to progress and urging attention to the future (rather than debates that "may rejuvenate old myths and reinforce negative stereotypes and biases"). I also recommend reading a speech made by Shirley Tilghman, President of Princeton, at the launch of the ADVANCE program at Columbia University[5].



The cover of the issue of TIME on March 7th that featured an article on gender-related brain studies "Who Says a Woman Can't be Einstein"? By Amanda Ripley and Coco Masters. Copyright © 2005 Time Inc. Reprinted with permission.

For those of us at the University of Colorado, the debate about Summers' speech was interesting to compare with the simultaneous debate about Ward Churchill (a professor of ethnic studies who called the 9/11 victims "little Eichmanns") that raged in our local newspapers. Both Summers and Churchill are faculty who are entitled to have opinions and should be free to express them, offensive though such opinions are to many people. The "crime" both these academics made was to be shoddy in their research and sloppy in articulating their thoughts, each very serious blunders in academia, for which each person is eventually likely to pay dearly.

It is inevitable that the "Summers explosion" dominate this issue of STATUS. We have collected some of the best articles that have appeared in the press. The first of Summers' hypotheses—that women do not want or cannot handle high-powered jobs—is not belabored in these articles, perhaps because the contrary is self-evident from exemplary performance of several high-powered women in academia (e.g. Susan Hockfield and Shirley Tilghman, both scientists and presidents of MIT and Princeton respectively). Addressing the second issue, of gender and "innate aptitude" we include Natalie Angier and Kenneth Chang's article on brain research from the New York Times. An excellent, longer article also appeared in TIME[2]. We include articles by Virginia Valian and Meg Urry that discuss Summers' third issue of socialization and discrimination. A related topic, people's unconscious biases is studied by Harvard psychology professor Mahzarin Banaji and had been causing a stir well before Summers' speech. I was sent Chris Berdik's Boston Globe article by Mary Rowe, the woman who has been successfully improving the climate for women students at MIT for the past 30 years. For a longer

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http://www.aas.org/~cswa/status

AAS members may receive hard copy by sending their postal address to Dennis Renner, **drenner@aas.org**

article on Banaji's work see Shankar Vedantam's Washington Post article[6]. More than all these carefully-researched and articulated articles, young scientist awardee Shannon McClintock says it best in "I'm Wired for Science".

The big question remains, however, whether the explosion has delivered sufficient momentum to change minds and institutions. ❖

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1 Transcript Remarks at NBER Conference on Diversifying the Science & Engineering Workforce. (2005, January 14). Lawrence H. Summers. Cambridge, MA, from **http://www.president.harvard.edu/speeches/2005/nber.html.**

2 Ripley A. and Masters C. (2005, March 7). See Who Says a Woman Can't be Einstein? *Time Magazine*.

3 McClintock S. (2005, March 27). I'm Wired for Science. *Parade Magazine*.

4 See page 21. Hennessey J., Hockfield S., and Tilghman S. *Women and Science: The Real Issue*. Retrieved February 12, 2005, from **http://www.princeton.edu/pr/news/05/q1/0211-womensci.htm**

5 Changing the Demographics: Recruiting, Retaining, and Advancing Women Scientists in Academia. Speech by Shirley Tilghman, President of Princeton University, at Columbia University, from **http://www.earthinstitute.columbia.edu/advance/events_past.html.**

6 Vedantam, S. (2005, January 23). See No Bias, *The Washington Post*.

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the faculty. Many think that Cecilia Payne-Gaposhkin was the first. But, despite the fact that she remained at Harvard after receiving her 1925 PhD, it was not until 1956 that Harvard University appointed her professor and chairman of its Department of Astronomy. So the only role models around conveyed the message that I didn't belong.

If I didn't belong at a major university, I also didn't belong anywhere else significant. Women were largely absent at high levels throughout society. Few had served as cabinet officers, as in congress, as heads of companies, as partners in law firms.

Today we look around and find that women can succeed in leadership positions. We complain about the low percentages of women on the science faculties of most major universities in this country, but they *are* represented on faculties and in administrative positions. Women are often encouraged to make the most of their talents. Faculty may not bend over backwards to recruit more women, but they are receptive to the idea of appointing women.

Other things have changed, such as salaries (closer to parity), but I think the most important change is in the expectations that women have for themselves and that others (parents, teachers, colleagues) have for them.

What do you think are the main causes of change?

Persistent effort to open opportunities for those excluded. I think that the women's movement really mattered and that it should be viewed in the context of the movement to open opportunities for minorities. The efforts in many ways were parallel even though there were different types of problems faced by the two groups. Women didn't have the vote until 1920. Blacks had the vote but, in many parts of the country, they were denied the opportunity to exercise that right. Women and minorities were paid less than white males, often for doing the same jobs. So the civil rights movement mattered greatly to both groups. Spokespeople emerged with new views of how our society functioned. I think of Betty Friedan's book *The Feminine Mystique* (1963) as opening my eyes to the underlying assumptions of the society in which I lived and making it OK for me to question those assumptions.

I personally attribute a great deal of the opening up of the society to Lyndon Johnson, during whose presidency we got Title IX of the civil rights act. Suddenly, institutions were under the gun to do something to increase opportunities for women. I saw many universities start trying to appoint women. The rate of appointment of both women and minorities to faculties was slow but non-zero and the derivative became systematically positive. Thoughtful people began to recognize that many young people were discouraged from moving into areas that required high levels of scholarly achievement.

In your talks you have often mentioned that the progress is not always forwards—is it two steps forward, one step back?

I think there have been times when the opportunities for women began to close down rather than continue to open up. Probably the most dramatic example links to the time just after the Second World War. During the war, a large fraction of males were in uniform and the civil society hired women in large numbers to do the jobs that had previously been designated for men only (Rosie the

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Riveter, for example). Even leadership positions were filled with women when there were no men to fill them. I think this is the time of movies with Rosalind Russell and Katherine Hepburn in "boss lady" roles. Then the war ended; men returned in large numbers and needed jobs. Suddenly the picture changed. And my memory is that movies also changed. Women became the comforters and loyal helpmates. Dream families had five children, a ranch house and a stay-at-home mom. Many women who had started careers cut them off to fit into the mold.

I think there is good evidence that a more modest but significant change in the rate of progress for women started again in 1999 or 2000. I mention in my talks on women in science the decrease in the percentage of women among new hires at UCLA in the first few years of this century. We have also read of the decrease of women as a percentage of tenure offers at Harvard during the same years[1]. Something did change, and the change started at about the same time as the citizens of California passed Proposition 209 restricting the use of affirmative action in college admissions. Why did things change? I don't know. Backlash? A sense that we had gone far enough and no longer needed to make special efforts?

Do you think Title IX had any impact on women in science?

Title IX sure had impact on higher education institutions but I don't see any special impact on science. However, the way the requirements of Title IX were interpreted at most universities led to a set of actions including lots more money for women's athletics. But also, at least in principle, it led to requirements to include women on short lists when recruiting for appointments to faculty and administration, statements about non-discrimination in advertisements, etc. And some of these formal requirements did begin to pay off. Furthermore, the first appointments were critically important. It is much easier both for the institution and the appointee with the second female appointment. So the "kick-start" of Title IX was undoubtedly useful.

What effect did the MIT study have on academic institutions?

In the first place it certainly led to women saying, "Gee, if it can be a problem at MIT it's probably a problem in my own institution—we ought to get people to take a look at things." I know that certainly happened at UCLA. I am not sure how many other institutions reacted the same way but I know there was a spate of self-studies that followed the MIT study.

Moreover, most notable was the fact that the report was taken so seriously by the MIT administration and acted on. Earlier, there had been analogous reports of concerns in other institutions, but this was the first high-profile institution providing such a report and before the report was made public, the administration had responded to it by making costly changes (changing salaries, reallocating space). That was really a very strong endorsement of the findings. I can't think of any other time when such report came out that the administrators did other than nod and say "yes, yes". The MIT administrators said we're going to do something about this problem. And they did.

Which takes us to Nancy Hopkins and the "Summers explosion". What do you see to be the impact of this at Harvard? Nationally?

Did you notice that there was an article in today's New York Times[2]? This is at least the third time in three months that the topic of women in science has been on the front page. I think it shows you the impact of the "Summers explosion". However, the fact that there was such furor at Harvard had only a little to do with women faculty. I think that the faculty were already at boiling point and that this speech was just the trigger. But the impact on the community at large was enormous. When I was in Cambridge, about a month after his talk, every group of people I spent time with started talking about what was going on with regard to women in science. That's significant because I felt Summers' remarks revealed the level to which people remain skeptical about the ability of women to perform at high levels in science fields, despite a lot of evidence to the contrary and a lot of evidence that the numbers game is very a complicated one. So it was very useful that Summers' speech triggered discussions in so many venues.

Regarding the situation at Harvard, even before the explosion, there had been a report on the systematic decrease of the percentage of new tenure offers going to women year by year from the time Summers arrived at Harvard. So I think there was already some scrutiny being focused on what has happened to the hiring process.

I know in my own experience at UCLA that there was a period in the 80s and 90s when my department was under very severe administrative supervision to make sure that we were really looking at women candidates when we were making faculty offers. And then by the late 90s things started turning around and for the last few years I didn't have the feeling that search committees were being pressured to look for women and to make sure that we were interviewing women. At one point we had what we called institutional positions that could be called upon when there was an opportunity to hire a stellar minority or a stellar woman even if the department didn't have resources for hiring. That, of course, went away completely.

So, I think it may be broader than just Harvard. The context was a sense that we had done maybe enough for now. The Summers talk brought out some really critical views of what was perceived to be

preferential hiring of women, even though the reality is that the pressure to hire women had dropped a while back.

I think the effect of the Summers explosion is going to be that there will be pressure for Harvard to go back to effectively looking to hire more women, and presumably minorities as well. I think they have to do it. I think they're under the microscope. They've got to show that they're going to do something. The New York Times article points out that Chemistry has only one woman, but it doesn't mention that Physics at Harvard has done really quite well compared within other institutions. For many, many years there were no women at all on the Harvard Physics faculty. And I think the very, very serious efforts of Howard Georgi have paid off in really quite an extraordinary way. I think he set a policy of being welcoming to women. I don't how many women they have now. Last time I looked they had four, which is a small fraction of the total faculty, but nonetheless compared with other premier institutions is quite good. It shows that one person who is determined can make a difference.

I am hearing from young women increasing interest in finding ways to address issues of balancing career and family. You had children quite early in your scientific career. Your children have successful academic careers and families. What do we do to help women balance career and family?

The New York Times article says it's the child care system. Obviously, that's not the only thing, but to my mind, one of the great problems is how one assesses potential at the same time as recognizing that there will be a period of, let's say, a decade when preoccupations other than work will be so overwhelming that a person isn't going to be able to progress at the same rate that he or she would progress at if they didn't have children. But I know so many cases of families with children where as the children matured and the individuals had more time to devote to their scholarly efforts, there was a late blooming. The academic system doesn't really provide for that. In academia, you've got to sow your oats early and that means the demands of the two parts of life peak at the same time.

I think that young people will maybe have to recognize that they're going to have to do a lot of pruning of the things that distract them from the two primary issues of their lives for a decade or so—that's family and work. That's part of it. But what can the institutions do to make it easier? I think if we had better child care help on campus that it would be extremely valuable, but I also think emergency child care is important, something that no university that I know of has initiated. The idea is that if normal childcare arrangements break down for one reason or another there would be some place on campus where a child could be left and cared for. That might be helpful when there's either sickness or when the school for some reason declares a pupil-free day and all of the sudden the parents are left with children they thought would be in school from 9 to 2 and what are they going to do?

I had a child as a graduate student. But the age at which people have their first child has been increasing so it is becoming less common for women to have children as a graduate student.

Women of space physics in celebration of the election of Margaret Kivelson to the National Academy of Sciences, 1999.

Would you recommend it?

It is certainly not harder. In fact, it is better than afterwards. I did not have obligations that were tied to a calendar. I could do things later. But I was not working in a lab—I recommend being a theorist!

From my own experience, when the children were small every cent that I earned and then some went towards good child care. And I was lucky because I was able to work part-time. Nowadays, it bucks the trend to work part-time. There remains a notion that the university is a calling, not a job, and that a calling requires full-time work. You are more likely to be "forgiven" for working part-time as a graduate student.

The institutional rules have to be reconsidered in all aspects. Maybe, if we encourage women to have children during their PhD, some of them will run into some kinds of term-limits. There are a lot of rules the university has adopted without considering the issue of whether people need time off for family, whether it be students or faculty. I think that there is an opportunity to make more flexible rules that are devised in the context of trying to keep women in academic careers. That doesn't mean that you lower standards, but you need to be flexible about timing.

It's clear that the rules that are now in place to a large degree were adopted at a time when the population that was affected was very different. In fact, many of the rules probably have not changed since the days when monks wandered the halls of academia.

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What will get institutions to recognize the need to help people over what should be the relatively minor hurdle (in the long term) of the child-rearing years?

I was impressed to see in the New York Times article that Princeton was now going to automatically extend the time-to-tenure by a year for each child regardless of the gender of the faculty. Then, instead of having to ask for the extension, you could ask to be considered earlier, if you wish. I think there is a lot to be said for that. The article also said that more men were using such parental extensions than women. Women seem nervous that it would look bad. I think that there's an important lesson there. There are lots of things the university is prepared to do, but women are reluctant to ask. And so that's not new. It's not unique to Princeton. I've talked to quite a few women who have told me that yes they know there are maternity leave provisions, there is an extension provision, a stop-the-clock provision, but they say "I felt that if I used it, it would be held against me." It does not suffice to change the rules. You have to be sure that the new rules are being used in an effective manner by the people they were designed for. ❖

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1 Science September 17th 2004. See discussion in January 2005 issue of STATUS page 22.

2 For Women in the Sciences, the Pace of Progress at Top Universities Is Slow, Sara Rimer, New York Times, April 15th 2005.

The Poster Project: Using Visual Means To Challenge Stereotypes

Decorate your lab, library or office. Give an inspiring gift to a niece or protégé who might be struggling to combine art and science.

One of 36 posters that combine art, women and science. This poster features space physicist Margaret Kivelson, mother-in-law of poster artist P.D. Kivelson.

The primary goal of the Poster Project is to encourage scientific literacy, and to promote the public's awareness and appreciation of science and technology by humanizing the image of research science and scientists. Its other major goal is mentoring women and girls who choose to pursue careers related to the physical sciences and mathematics, and to retain, at the high school and university levels, women who have already chosen such careers. The project represents an intersection between science and art, gender socialization, and education. It visualizes women in science and the role of personal choice in a life in scientific research.

The posters were co-designed by Artists Pamela Davis Kivelson (Margaret Kivelson's daughter-in-law) and Inga Dorosz. There are 36 posters (24" x 36") in the collection and they can be purchase as a set ($500), in groups or individually ($35). Go to **http://www.pdksciart.com/** to see the collection and to order.

Recommended by Fran Bagenal (who persuaded 5 science departments to contribute to buy a complete set of posters which are now hanging on the walls around the University of Colorado). ❖

The June 2005 issue of STATUS contained an article (pages 7 and 8) from the NY Times. While AAS paid the copyright fee to reproduce the article in the printed version, the copyright fees for the web-based version were too high.

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Virgina Valian is a professor of psychology at Hunter College. She is author of "Why So Slow? The Advancement of Women" and is involved in several projects in gender equity. She is also researching two-year-olds' knowledge and use of language, the role of input in syntax acquisition, gender differences in mathematics problem-solving, theoretical models of language development, and the relation between competence and performance in language. This article was published in the Washington Post, January 30, 2005. Reprinted with permission.

Raise Your Hand If You're a Woman in Science...

By Virginia Valian

For the past two weeks, my e-mail in-box has overflowed with messages from women—and some men—about the hypotheses recently offered by Harvard President Lawrence H. Summers to explain the dearth of women in the academic sciences. One woman wrote, "It is not surprising that people are angry when they see such full-blown contemptuous arrogance." Others were shocked at his apparent insensitivity: Had he no concern for the female students and faculty in math and science at Harvard or other academic institutions?

That's an important question. Although we can't do anything about Summers's method of calling for more research into whether women and men have innate differences when it comes to mathematics and science (he told an economics conference on Jan. 14 that he was trying to be provocative), we can address the resulting controversy. There is a wealth of data about men and women in science, about cognitive sex differences, about the effects of expectations on people's behavior, and about unintended misjudgments of women and men.

Summers is not alone in his lack of awareness of the compelling evidence of the power of small differences in how we treat boys and girls, men and women. Yet those differences, I would argue, provide a better hypothesis than innate sex differences to explain the gap between the numbers of men and women in academic jobs in the sciences. Nor is Summers alone in being unaware of the large set of experiments showing that well-intentioned people, intelligent people, people who believe in a meritocracy—people, in short, just like many successful college presidents—consistently underrate women's abilities and overrate men's.

The finding that emerges from the research, in experiment after experiment, is that bias is a problem not because it is deliberate, but because it is the outcome of assumptions of which we are not consciously aware. Take, for example, a study published last year by New York University professor Madeline Heilman and her colleagues. The researchers asked people to rate individual men and women who were described as holding the position of assistant vice president in an aircraft company.

The evaluators' job was to rate how competent and likable the employees were. They were given background information about the person, the job and the company. In half the cases, the employee was described as about to have a performance review (his or her competence was thus unknown); in the other half, the person was described as having been a stellar performer.

When the evaluators had received no information about how well the assistant VP was doing in the job, they rated the man as more competent than the woman, and rated them as equally likable. When the background information made clear that the person was extremely competent, evaluators rated the man and woman as equally competent. But both men and women rated the highly competent woman as much less likable than her male counterpart, and considerably more hostile.

Thus, in evaluating a woman in a male-dominated field, both male and female observers see her as less competent than a similarly described man unless there is clear information that she is a top performer. And in that case, they see her as less likable than a comparable man.

The result of the experiment by Heilman and colleagues is typical of other research: Both men and

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women give men the benefit of the competence doubt. Why do we do this? Because we're like Summers: We have conceptions—what psychologists call "gender schemas"—of what it means to be male or female. We tend to see males as capable of independent action, as doing things for a reason and as getting down to the business at hand. We tend to see females as nurturing, communal and expressive. So which person, man or woman, seems a better fit for the job of assistant VP in an aircraft company? One guess. You can expect similar results in other male-dominated fields—such as the sciences.

Although an abundance of research of this sort exists, it has not become part of our common understanding and thus has not yet redressed the imbalances between men and women in professional life. With that in mind, it's useful to look at the three challenges that Summers presented in his speech to men and women who think elite institutions need to move faster to increase the number of women on their faculties. His comments, as reported by those who heard them, highlight some of the most common and enduring misconceptions.

Summers claimed, echoing the neoclassical economics view, that discrimination is too costly to institutions to last. Over the long haul—perhaps a very long haul—discrimination will wither away, this line of thinking goes. Here's the rub: Harvard has a $20 billion endowment. Thus Harvard—and other rich schools—can afford to neglect a lot of female and minority talent and have shown a willingness to do so. The problems women experience in getting promotion and tenure are exacerbated at high-prestige institutions, as is shown by "From Scarcity to Visibility," a book that examines gender differences in the sciences. The deep pockets of elite schools allow them to buy the services of a lot of very talented white men. They may be paying too much for those men, but they can afford it.

Meanwhile, people at institutions with heavy teaching responsibilities, few resources and insufficient staff have neither the time nor the money to perform the scholarly research they were trained for and that might win them jobs at more prestigious institutions. Women are overrepresented at such underfunded institutions, where they cannot reach their full potential. So when Summers looks around, he will mistakenly think that he isn't missing anything: Where, he will say, are all those super-productive women that I'm supposedly not hiring? And he's right, in a way. Those potential stars are performing beneath their abilities—just like their white male counterparts who aren't at elite schools. What society is losing out on isn't immediately apparent.

Another point often raised is that women don't put in the hours, and Summers followed that line, too, when he suggested that women don't want to work 80-hour weeks. The implication was that women wouldn't wind up at, or stay at, a place like Harvard. The first assumption is that 80-hour workweeks are a necessary condition for intellectual creativity and excellence, for either men or women. That assumption has very little data going for it. The second assumption is that women who do put in 80-hour weeks receive the same rewards as men. That assumption has a lot of data going against it, as we have seen.

By far the most provocative discussion inspired by Summers's comments is whether women may be innately inferior to men in math. Women do score lower, on average, than men on the standardized math tests that are part of the SAT and GRE (Graduate Record Examination). We already know, from research by sociologists Yu Xie of the University of Michigan and Kimberlee Shauman of the University of California (who were examining the reasons that women do—and don't—leave science), that the differences on math tests do not account for the gender gap in who chooses to major in science. The gender gap persists even when you take test scores into account. So in a sense the question is moot.

We also know that the differences within each sex are far larger than the average difference between the sexes. And we know that sex differences in math are smaller than cross-national differences. One study, comparing the United States, Taiwan and Japan, found that Japanese girls in grammar school scored almost twice as high on certain tests as American boys and almost always scored distinctly higher.

Maybe Asians are innately better at math. If so, following Summers's reasoning, Harvard should be preferentially hiring Asian women over American men. (We don't know what's behind the large cross-national differences—although education is key—and, as Americans, we're a little reluctant to think we're inferior.)

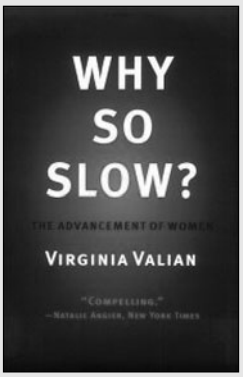
In the meantime, we don't cultivate women who are strong in math. A study of seventh and eighth-graders in the top 1 percent of math performers shows that the girls do not improve their scores over a four-year period to the same extent that boys do; nor do girls in that top pool continue in math and science at the same rate as boys. We cultivate and nurture mathematically inclined boys. And children—like adults—have a tendency to fulfill expectations. We expect boys to excel at math and treat them accordingly. Shouldn't we do the same for girls?

There is one cognitive ability that appears to be linked to sex differences in hormones. It's called mental rotation: the ability to look at a picture of a three-dimensional block figure and imagine it rotated in space. Males are much better than females at this task (although, with practice, someone of either sex can improve), and that result appears to be related to testosterone level. Girls who have experienced excess androgen in utero show higher mental rotation scores than normal girls. That's the kind of evidence we need to demonstrate a hormonal connection. We

don't have that evidence for math or other cognitive differences. Does mental rotation ability matter? Maybe for a couple of scientific fields, but on balance, differences in math abilities seem better accounted for by differences in what we expect of women and how we treat them.

The National Science Foundation has recognized that the nation loses out if colleges and universities squander the talents of women faculty members. And if women are going to thrive in math and science, academia has to change. To speed that change, the NSF has awarded ADVANCE Institutional Transformation Awards to 19 schools, of which Hunter College, where I teach, is one. And there are already results from this ambitious new program: These schools are hiring more women, improving their promotion and tenure policies, and doing more to ensure that women have the resources to do their best work.

Summers now says he was wrong to have spoken in a way that has sent an unintended signal of discouragement to talented women. He also has pledged $25 million to promote the hiring of women and minorities at Harvard. That message would have been a welcome addition to his comments at the Jan. 14 conference. The most important message, though, is that if we raise expectations of women in science—and give them the resources they need—they will make it to the top. ❖



Cover of Valian's book "*Why So Slow? The Advancement of Women*" which summarizes a variety of psychology research on human behaviors that have hindered women's advancement. Published by The MIT Press (mitpress.mit.edu).

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I'm Wired for Science

By Shannon McClintock

Lawrence H. Summers, the president of Harvard University, recently sparked controversy when he suggested that women lack the ability to excel at math and science. Shannon McClintock, 15, of San Diego—the 2004 grand prize winner in the sixth annual Discovery Channel Young Scientist Challenge—responds:

So some bigwig from Harvard tells the world that girls just aren't wired to be scientists. Well, the boys better watch out, because there's a new generation of girls ahead—ready to take comments like these as challenges and to show what girl power really can do. I am one of them.

Growing up, maybe I wasn't like every other girl. I had Barbies, but I also had Lincoln Logs and Legos. When I was 4 years old, I built arches and ramps with square blocks.

My parents and some excellent teachers were my best mentors. They taught me to question why things are as they are. But, like most of the girls in my classes, I started to lose interest in science by middle school. Then I got into my science fair project, "The Little Engine That Could, which dealt with giving train tracks extra traction. I started winning competitions, and this little engine didn't stop after that first hill. I went as far as the Discovery Channel Young Scientist Challenge! I—along with 21 other females—was one of the top 40 middle-school scientists in the nation.

We tested Einstein's theories using a skateboard ramp and lasers, and I learned that science is more than guys in white coats locked in a lab. I love science and engineering. And I'll do much more than one little science fair project—maybe even discover the cure to Alzheimer's or design a space rover! I'm a girl, and that's just how I'm wired. ❖

U.S. Olympic gold medallist Michael Phelps congratulates Shannon McClintock, 14, of San Diego, CA, who was named America's Top Young Scientist of the Year by the Discovery Channel.

Meg Urry is a professor of physics and the director of the Yale Center for Astronomy and Astrophysics. She organized the first Women In Astronomy conference in Baltimore (1992) and instigated the Women in Astronomy II: Ten Years After conference (2003).

This article by STATUS editor Meg Urry was solicited by the Washington Post in which a similar version appeared on February 6, 2005.

Diminished By Discrimination We Scarcely See

By Meg Urry

I came of age when discrimination was a thing of the past, or so I thought. True, there were not many women in my college physics classes, but I figured that was just a matter of time. And although we had all heard horror stories about women being excluded because they were women, those predated the feminist movement of the '60s and the anti-discrimination legislation of the '70s. None of my peers or professors in the early '80s would ever have said out loud, "Women can't do physics as well as men" even though some think it and Harvard University President Larry Summers suggested as much last January.

Still, I can remember a few uncomfortable moments. As a physics grad student 25 years ago, I once found pictures of naked men on my desk. As one of the few women at professional meetings when I was a grad student, and then a postdoc, the attention I got from male colleagues wasn't always about science. One professor used to address the graduate quantum mechanics class as "gentlemen and Meg." So I knew that my gender identified me. I just didn't think the distinction amounted to discrimination. It wasn't until a few years ago, after I became a tenured professor at one of the world's top universities, that I finally realized it was discrimination all along.

That's the thing: Discrimination isn't a thunderbolt, it isn't an abrupt slap in the face. It's the slow drumbeat of being underappreciated, feeling uncomfortable and encountering roadblocks along the path to success. These subtle distinctions help make women feel out of place.

And some are not so subtle! When I was a young astrophysics postdoc at MIT (and the only female postdoc), one weekly colloquium speaker began his talk about the importance of high resolution in optical imaging with a badly out-of-focus slide. As he sharpened the focus to make his point, a topless woman in a grass skirt on a Hawaiian beach gradually appeared. The male students laughed, while the one other woman in the room shared an appalled look with me before standing up and walking out.

No one ever told this speaker that his choice of slide was inappropriate. I intended to talk to him afterward but left the talk after about 20 minutes, having realized I hadn't heard a word he'd said. Ironically, a few years later the speaker won the Tinsley prize from the American Astronomical Society, named in honor of a brilliant late-20th-century woman astronomer at Yale University.

I loved MIT, but it could be a harsh environment for women 20 years ago. (It's changed a lot!) I remember two professors having a dinner conversation in my presence about the inferiority of women scientists who had been hired because of affirmative action. (When I mentioned this to the man who'd hired me, he hastened to assure me that it didn't apply to me.) My ambition to be an academic was sometimes met with encouragement, but one male professor told me, "Oh, we would never hire you." And discouragement always makes a bigger impression than encouragement.

During my postdoc career, I started wondering why women weren't getting hired into faculty positions. I'd been told, from graduate school on, that I'd have no trouble getting ahead: I was a woman, people would come after me. When they didn't, I subliminally absorbed the idea that I wasn't good enough. But was it possible that all the women getting physics and astronomy degrees from top institutions weren't good enough? I saw precious few being hired into faculty jobs.

For some reason, I hung in there. Maybe it was the strong support from my parents and from the fellow physicist I married, who took on half (and sometimes more than half) the responsibilities of child rearing. He doesn't "help"—we share. Our two daughters, Amelia (nearly 14) and Sophia (11) carry both our last names, as their middle and last names, but in alternate order. We made it equal, start to finish.

But work was never equal. When I told my thesis adviser I was pregnant, he said, "So, you want to have it all!" I smiled and nodded but later thought, Wait a minute, isn't that what all you guys have? Why is it "all" for me and "normal" for you?

Over the years, I saw women in the scientific world treated badly, being marginalized, mistreated, harassed. One woman manager I know was second-guessed, unlike any of the male managers, and when she pointed this out, was told she was depressed and should get professional help. Another told me it had become routine for her to cry while driving home from work. Every woman I know has had her suggestions ignored in a mainly male meeting, only to hear the same idea praised when later raised by a man.

Hey, bad things happen. But feeling out of place over and over again eventually soaks in; it did for me. About a decade ago, frustrated and alienated, I approached the director of my institution to ask about special management training for women:

Maybe there were tips that would help me navigate the foreign waters in which I found myself. He didn't seem to understand. I said, "You know, it's like being the red fish in the sea of blue fish—I want to understand the blue-fish rules." "Oh," he answered. "Maybe it's not your lack of training, Meg, maybe it's just your difficult personality."

After enough of this kind of thing, women feel beaten down and underappreciated, or worse, they feel incapable. That's the most insidious thing. After years of being passed over, ignored, and insulted, we start wondering what we are doing wrong. Maybe if I had made the suggestion differently, it would have been heard. Maybe if I lowered my voice and spoke more slowly, I would get more respect. Maybe—even though I published many papers, did seminal work in more than one field, brought in big grants, had successful students and postdocs—maybe I wasn't a good enough scientist.

It was easier to see what was happening to other women than to me. My good friend Anne Kinney (now "Director of the Universe" at NASA—how's that for a title?) said in an after-dinner speech to a conference on women in astronomy that she'd never had a five-year plan because there were no women five years ahead of her. Her speech was very funny and I laughed a lot, but I didn't think it applied to me, exactly. Weeks later, it dawned on me that I'd never had a five-year plan either—and for much the same reason.

I watched women around me, especially young women, who were smart and keen to work hard, but who, after a few years in grad school or after a discouraging spell as a postdoc, decided maybe they weren't cut out for science, or maybe they would find a non-academic job, or maybe they'd get married and have a family rather than a research career.

I have no problem with any of these choices. What troubles me, though, is that I rarely saw men making them, especially the choice to stay home with kids. I think some women use "family" as an excuse to leave science when science actually drives them away.

This is a huge loss for our country—these women PhDs are some of the best scientists we train. We need their talent.

In my field, physics and astronomy, women still make up a small percentage of active scientists—about 10 percent of physics faculty are female and about 14 percent of astronomers. Those percentages are increasing, but slowly. So I grew up with almost no women professors. When I first heard of Beatrice Tinsley—who came to the United States in 1964 from New Zealand with a master's in physics, created an entire sub-field of astronomy, finished her thesis under adverse circumstances and by all accounts was an incredible person—I felt the kind of relief that a child raised by wolves must feel when she first sees a human being.

Physics has fewer women than other scientific disciplines. I think it may be because physics is more hierarchical, more aggressive than other areas. ("Combat physics," a friend of mine calls it.) Physicists act as if they are better and smarter than everyone else. The standard for excellence is to be the best in the world—and that seems pretty boastful to polite girls raised not to brag.

When I expressed ambition, though, I sometimes got put back down. I suggested I was ready to be tenured—"Be patient, Meg, it's too early for you." I mentioned I was interested in a high-level national committee—"Isn't that a bit ambitious, Meg?" I expressed interest in a promotion: "You're not a leader, no one would follow you."

Social scientists like Virginia Valian of Hunter College have developed a lot of evidence showing that women and men are treated and evaluated differently. Yet physicists reject the possibility that scientists are not objective. I learned about the lack of objectivity the hard way—through experience.

On hiring committees or tenure and promotion committees I served on, we'd evaluate men and women, and somehow the women seldom came out on top. They were "good," even "very good" but the men were always better. Some of this was caused by letters of recommendation. Every woman was always compared to other women, as if every woman scientist is female first and a scientist second. Also, women's letters were somehow more pedestrian—the candidate "works hard" and she "has a nice personality," "gets along well with others." Once you see the patterns, you realize that these evaluations reflect people's expectations more than reality.

As I got more educated about the abundant social science research, I got more frustrated: The answers were there, if only physicists and astronomers would read the literature. So I made it easier. I organized conferences to talk about these issues. We held that first conference on Women in Astronomy in 1992 and wrote the Baltimore Charter, a kind of manifesto for change (**www.stsci.edu/stsci/meetings/WiA/BaltoCharter.html**). In 2003 we organized a second meeting, from which the Pasadena Recommendations have just been produced (**www.aas.org/~cswa**).

It's been slow, but we've made progress, and we're making a difference. More young women are flocking to science every year. It's a great life, after all, doing something you love, having control of your time, being paid pretty well.

And, however slowly, the barriers women face are being abraded. The American Astronomical Society and American Physical Society, my professional organizations, have been immensely forward thinking. As for me, Yale hired me with tenure four years ago and treats me wonderfully. My science has never been better. I bet some people say I got this job because I'm female. But now that I've been around awhile, I'm finally able to say, confidently, that I'm really great at this job. I'm lucky to be here at Yale, yes, but even more, they are really lucky to have me. The doubt is finally going away. ❖

Anne Kinney, Director, Universe Division, Science Mission Directorate, NASA.

Invisible bias

By Chris Berdik

A group of psychologists claim a test can measure prejudices we harbor without even knowing it. Their critics say they are politicizing psychology.

Inside the wood-paneled confines of the Harvard Club, about 200 Bostonians gathered recently to tap into their subconscious. Literally. Audience members were told to move as quickly as possible through a series of faces and words projected on a screen, tapping their left knees for a young face or a "good" word (joy, sunshine, love), and their right knees for an old face or a "bad" word (bomb, agony, vomit). It took about 15 seconds for most to finish. But when asked to switch, to pair young faces with "bad" words and old faces with "good" words, the rhythm faltered and the tapping slowed. Audience members shook their heads and giggled. Some threw up their hands.

Photo of Mahzarin Banaji at Harvard.

To the Harvard psychologist Mahzarin Banaji, who presided over the event, the demonstration showed that most of the audience—like most of the people who have been subjects in this type of experiment—have a harder time associating old people (or nonwhite people, or homosexuals) with "good" when given no time to think. These are all examples of what Banaji calls implicit prejudice, and their importance extends way beyond an intellectual parlor game. Implicit prejudice, she argues, can affect our decisions and behaviors without our even knowing it, undermining our conscious ideas and best intentions about equality and justice.

Such implicit prejudices are "ordinary," says Banaji. "Ordinary people show them. They stem from ordinary cognitive processes."

About a decade ago, Banaji and Anthony Greenwald, a psychologist at the University of Washington, developed a test for uncovering these subconscious preferences—the Implicit Association Test (IAT). Normally, instead of tapping knees, an IAT subject uses a computer keyboard to group "good" and "bad" words with images as split-second differences in response times are measured and tabulated.

Today, some 8,000 people a week take an IAT on the website of Project Implicit (**https://implicit.harvard.edu/implicit**/), founded in 1998 by Banaji, Greenwald, and Brian Nosek, a University of Virginia psychologist. The site has dozens of tests measuring implicit biases on everything from politics to race to gender roles. Some results so far: 75 percent of white respondents implicitly favor white over black, more than 70 percent of all respondents favor straight people over gay people, and about 80 percent favor young over old.

To Banaji and a growing number of researchers, the IAT has potential uses far beyond the lab. This year, Banaji is heading a group of psychologists and legal scholars at the Radcliffe Institute to develop new approaches to anti-discrimination law based on the idea of implicit prejudice. The IAT has been proposed for use in corporate ethics classes, police and other professional training, and in consumer research.

But not everybody trusts the IAT. Social psychologists are divided on just what the IAT measures, arguing that different response times may just reflect an awareness of cultural stereotypes and social inequality. In February, the journal Psychological Inquiry will devote an entire issue to the debate surrounding the test. And beyond the technicalities, a bigger question looms: If prejudice really is rooted deeply in our subconscious minds, how can we get rid of it?

The foundation for a social scientific study of prejudice was laid 50 years ago by a Harvard psychologist named Gordon W. Allport in "The Nature of Prejudice." Prejudice, Allport wrote, grew from the instinctive way people simplify their world by categorizing everything—including other people.

According to Allport, we have various automatic expectations based on probabilities. We assume, for instance, that a man in a three-piece suit has money and employment or that the person sitting beside us in church shares our basic beliefs. Allport noted that while such expectations aren't always correct, they're useful and generally harmless. For Allport, prejudice—the dangerous phenomenon that could lead to everything from racial slurs to lynchings—began when those expectations were accompanied by conscious antipathy toward a particular group and were inflexible in the face of contradictory evidence.

Allport's treatise remained a foundation for psychological research into prejudice for decades. Indeed, Banaji and her colleagues begin with the premise that prejudice has its roots in the normal human tendency to categorize. But they veer sharply from a fundamental tenet of Allport's theory. In their view, you don't need to have antipathy toward any particular group to harbor implicit prejudices that could lead to discriminatory behavior. Instead, according to IAT researchers, implicit prejudices build over time as stereotyped images seep into our brain—news images of the African-American suspect or the Arab terrorist, commercials where wives clean the house, the not-so-bright sitcom character with a Southern drawl.

Says Banaji, "Seeing is believing, at least at some level."

A big reason for the persistence of these prejudices, she emphasizes, is denial. People with strong egalitarian values know there are prejudiced people out there who act in prejudiced ways, but they don't allow that they might be one of them. Banaji argues that this denial is rooted in the desire to believe that our judgments and actions are all within our conscious control.

IAT co-creator Greenwald agrees: "There are many, many well-meaning people who attend diversity trainings and say, 'I'm happy to go along with this, but it's not my problem.' But with the IAT, people discover, 'Well, there's something going on in my head, too."

That's why Banaji and her colleagues at the Radcliffe Institute think it's problematic that much anti-discrimination law requires plaintiffs to prove an employer or other individual *intended* to discriminate. They hope to spread the idea of implicit, unintentional prejudice throughout the criminal justice system. And they hope to develop legal arguments, bolstered by theories of implicit prejudice, that could prove in court that an employer's hiring and promotion policies discriminate against women or minorities, for example, even without any conscious intent.

While Banaji says many subjects react negatively to being told they exhibit implicit prejudices, those at the Harvard Club who cared to comment after the presentation seemed convinced. "I think everybody has biases. It's part of being human," said va Das, 62, a civil rights lawyer. "I think the only real question is what to do about them." Bob Frankel, a 59-year-old research engineer at MIT added, "I think one of the values of people taking tests like [the IAT] is so they realize, 'OK, maybe I'm not quite who I thought I was." But not everyone thinks Banaji and her colleagues have necessarily discovered a hidden reservoir of prejudice. The dissenters, a number of whom have articles in the upcoming issue of Psychological Inquiry, argue that a speedier association of white with good and black with bad may simply reflect a subject's awareness of societal inequalities, such as the disproportionate number of blacks in prison, rather than a subconscious bias.

The principal critique of the implicit prejudice theory, written by Hal Arkes of Ohio State and Philip Tetlock of Berkeley, carries the subtitle "Would Jesse Jackson 'Fail' the Implicit Association Test?" In one section, they speculate whether Jesse Jackson and Jesse Helms would score similarly on the IAT.

"Although the two figures disagree profoundly on certain political issues," the authors note. "They agree that the 'African-American family' is in trouble, that African-American crime rates are far too high, and that African-American test scores are too low. Should we theoretically expect indices of 'negative affectivity' [such as the IAT] to differentiate people who share a considerable knowledge base *but* who differ only in their causal attributions *for* between-group inequality?"

Instead, Arkes and Tetlock argue that to conclude a person is prejudiced, one should stick with the Allport standard, which says that prejudice requires some level of hostility toward a particular group. What's more, they say, Banaji and other IAT promoters are "politicizing" psychology. "We suspect that, when the history of social psychology is written at the end of the 21st century," they write, "implicit prejudice research will be a prime exhibit of how society became so obsessed with avoiding stereotypes that it skewered citizens as racists for displaying even trace awareness of politically painful realities."

But Banaji dismisses the argument that the test simply reflects "awareness" of stereotypes and inequalities. She brings up a recent "meta-analysis" of more than 60 studies that show the IAT to be a better predictor of behavior than explicit measures of attitude in sensitive areas such as racial interaction. Among white subjects, for example, a strong subconscious bias for whites over blacks among white subjects was correlated with behaviors such as lack of eye contact with a black test administrator. Other IAT lab experiments found implicit prejudices correlated to more negative ratings of a black author's essay and a greater willingness to make hypothetical cuts in the budgets of minority student groups.

"If it's just an activation in my head, if it's not my attitude, then it shouldn't affect my behavior," says Banaji. "We would all agree that this is something that comes from the culture. But I would say it becomes us."

Banaji recently bought some postcards featuring prominent people of color: Jackie Robinson, Zora Neale Hurston, Ghandi. She scanned them into her office computer, and they now cycle through as screen savers. It's part of the ongoing effort of this Indian-born psychologist to rid herself of her own pro-white IAT bias. "[My race bias] troubles me perhaps more than any other one," she told the audience at the Harvard Club. "I try to beat that test all the time." Banaji also admits to other implicit biases, such as associating men more strongly with careers and women with the home.

Indeed, Banaji and fellow IAT researchers are investigating ways of mitigating the biases their tests uncover. Some methods are more passive, such as altering the environment where we live and work to increase exposure to images and situations that contradict prevalent stereotypes. Experiments reveal, for instance, that having an African-American administer the test to subjects lessened their pro-white bias, as did having a subject view images of admired African Americans just before taking the test. (In fact, black IAT subjects are split almost evenly between favoring black and favoring white.)

But the researchers believe the remedy can't just be passive. "Just as we need to do work with the

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Chris Berdik is a freelance journalist in Boston. This article appeared in the Boston Globe on December 19, 2004. Reprinted with permission.

Invisible bias *continued from page 13*

physical body, I think mental muscles need the same kind of treatment," says Banaji.

At least one member of the Harvard Club audience seems to have taken this advice to heart. After Banaji's lecture Sarah Smith considered "the necessity of meditating on people who are not like me…to stretch my sense of who I'm in the same human boat with, as it were." As an example, the 56-year-old writer from Brookline quipped, "I now try thinking kind thoughts about Republicans on a regular basis."

Writing on the cusp of the civil rights movement, Allport noted, "It required years of labor and billions of dollars to gain the secret of the atom. It will take a still greater investment to gain the secrets of man's irrational nature. It is easier, someone has said, to smash an atom than a prejudice."

In the decades since, much overt or sanctioned discrimination has been eliminated from American society. Congress passed the Civil Rights Act of 1964, the Voting Rights Act of 1965, and the Americans with Disabilities Act of 1990. But the scholars who debate the IAT give this progress different spins. In Psychological Inquiry, Arkes and Tetlock write that it's disconcerting that "cognitive research programs now attempt to gauge prejudice not by what people do, or by what people say, but rather by milliseconds of response facilitation or inhibition in implicit-association paradigms." In another paper they ask, "How far down the continuum should we venture in pursuit of ever-sneakier forms of racism?"

On the other side, IAT researchers point to the concern many feel about the persistence of social inequalities. Minority populations continue to have higher rates of poverty and unemployment than do white populations. A racial "achievement gap" persists in education. Women still earn only about 80 cents for every dollar earned by men.

"It's difficult to be optimistic given that all that well-meaning activity of the second half of the 20th century hasn't been able to rid us of these disparities," says Greenwald. He adds, "I think if we can use the IAT to spur a new look at human attitudes and stereotypes, then we can begin to develop a new model of the person and educate people about it. And I think this is the basis of some optimism."

Banaji insists that these efforts should be more about awareness than about guilt. "My job is not to construct ethical theories or define the ultimate good," she says. "We're interested in revealing to people that their own moral and ethical standards are being compromised by the stuff in their heads." ❖

The Paper Version Of the Implicit Association Test

This test was designed by University of Washington psychologist Anthony Greenwald. It is intended to measure how easily people associate home- and career-related words with either men or women. If you can, time yourself as you do Part 1 and compare the result with how long it takes to do Part 2. Many people find grouping men with home words takes longer than grouping women with home words -- evidence of a possible gender bias. Do you think your results occurred because you took the tests in a particular order? You can repeat the tests again, this time pairing men with career words in Part 1 and women with career words in Part 2. Whichever part took longer the first time should be shorter this time, and vice versa. Results from the Web version (**https://implicit.harvard.edu**) are considered more reliable than those from the paper version.

Part 1

The words in this first list are in four categories. MALE NAMES and FEMALE NAMES are in CAPITAL letters. Home-related and career-related words are in lowercase. Go through the list from left to right, line by line, putting a line through only each MALE NAME and each home-related word. Do this as fast as you can.

executive LISA housework SARAH entrepreneur DEREK silverware MATT cleaning TAMMY career BILL corporation VICKY office STEVE administrator PAUL home AMY employment PEGGY dishwasher MARK babies BOB marriage MIKE professional MARY merchant JEFF garden KEVIN family HOLLY salary SCOTT shopping DIANA business DONNA manager EMILY laundry JOHN promotion KATE commerce JILL kitchen GREG children JASON briefcase JOAN living room ANN house ADAM.

Part 2

The following list is the same as the one above. This time, go through the list putting a line through only each FEMALE NAME and each home-related word. Again do this as fast as you can.

executive LISA housework SARAH entrepreneur DEREK silverware MATT cleaning TAMMY career BILL corporation VICKY office STEVE administrator PAUL home AMY employment PEGGY dishwasher MARK babies BOB marriage MIKE professional MARY merchant JEFF garden KEVIN family HOLLY salary SCOTT shopping DIANA business DONNA manager EMILY laundry JOHN promotion KATE commerce JILL kitchen GREG children JASON briefcase JOAN living room ANN house ADAM.

Applying to Graduate School II

By Fran Bagenal

In the last issue of STATUS I presented a list of advice from the community (solicited via the AASWOMEN e-newsletter) for students applying to graduate school in astrophysics. One issue that was not addressed in the previous article is advice on writing the personal statement or essay in the graduate application. I have been asking around and while there is a range in opinions about the importance of the personal statement, there was more or less consensus on what the application readers are looking for. Another perennial thorny issue is the value of the physics GRE exam as a predictor of success in grad school. At the Women In Astronomy II conference (June 2003) I presented a poster showing the statistics from that year's applicant pool to the University of Colorado. I have now added statistics for the 2004 and 2005 application pools and present the results.

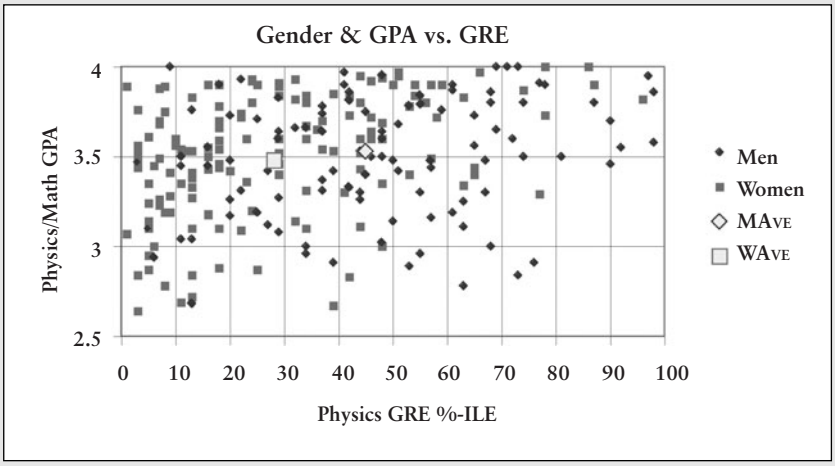

Figure 1: Grades of 316 domestic applicants to the PhD program in Astrophysical and Planetary Sciences at the University of Colorado, spring 2003, 2004 and 2005.

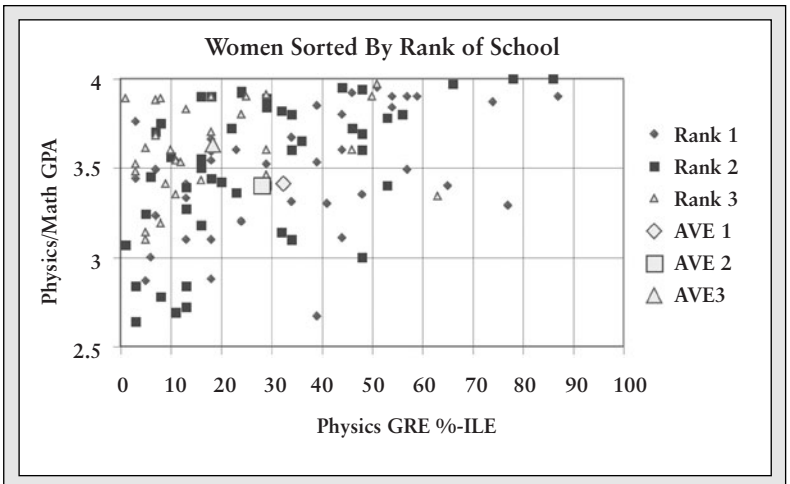

Figure 2: Physics scores of women applicants sorted by perceived rank of undergraduate physics program.

Personal Essay

Most graduate applications ask the applicant to write a statement of their objectives in going to grad school or an essay about themselves. There are books and websites that provide suggestions on how to write such essays. I asked various colleagues who had just finished reading hundreds of applications what were the important criteria for judging a student statement. Here are a list of their comments:

- By far most important objective of the essay is to show that the student can write coherent intelligent sentences that communicate relevant thoughts.
- Show genuine motivation and enthusiasm (for grad school and for astronomy).
- Readers are looking for expression of a past that reflects motivation and enthusiasm, i.e. a path that has not been blindly meandering.
- The essay should show some general idea of where the student wants to go in the future (in research topic, career, etc.) It is understood that on entering grad school students often have varied interests and their ambitions can change during grad school. But the application should indicate some thought on the issue.
- Have your advisor proofread the statement. As most faculty have served on an admissions committee, they will offer critical and helpful advice.
- Be concise. Admissions committees have to read hundreds of applications, and ignore most fluff anyhow. One to two pages are ideal.
- Discuss a topic of research you have done in some depth. Showing that you understand the research, from motivation to results, implies a great potential for future research abilities.
- Spell check, and grammar check. It sounds silly, but in the modern age of technology the misuse of homophones goes widely unnoticed.
- Avoid clichés such as: I have always wanted to be an astronomer, I have been fascinated by the stars since my father/aunt/neighbor gave me a telescope, I grew up in wonder of the Universe, etc.
- Don't litter your essay with exclamations!!

Physics GRE Scores

I turn now to the issue of the physics GRE exam. Serving on the graduate admissions committee for the Department of Astrophysical and Planetary

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Fran Bagenal is Professor of Astrophysical and Planetary Sciences at the University of Colorado, Boulder.

Applying to Grad School *continued from page 15*

Sciences at the University of Colorado I have read many, many applications and wondered whether some gender tendencies were real, figments of my imagination or urban myths. Specifically, I had an impression that women tend to have lower scores in the physics GRE, even when they have good course grades. So, I took the applicant pools for springs of 2003, 2004 and 2005 (approximately 100–150 students per year) and plotted their grade point average in all physics and math course (Physics/Math GPA) against the percentile ranking in the physics GRE (Figure 1).

The first thing that struck me when I looked at the plot was the lack of correlation. Why are some people with excellent physics GPAs ranked so low in the physics GRE? When separated by gender, the average GPA scores are similar for men (3.53 ± 0.34) and women (3.48 ± 0.40) but the women have a lower average GRE position (28 ± 21%) compared to the men (45 ± 23%). But look at the huge scatter.

Most puzzling are the cluster of women towards the top left and the cluster of men towards the bottom right. Some women with really good physics/math GPAs are performing poorly on the physics GRE. At the same time, there is a cluster of men who have mediocre GPAs but get strong GRE scores. Are the men better at taking this type of exam with time pressure? Are women doing well in the physics courses that they take but are perhaps not taking the courses that prepare them for the GRE? Or is the gender difference related to who is applying to grad school? One could imagine different pressures from peers, teachers, advisers, parents that might be factors.

One hypothesis might be that the GRE is doing its job of distinguishing the rigor of physics programs. The better physics programs should produce higher GRE scores. I asked the chair of the admissions committee for 2005 to sort the applicant pool (excluding non-US applicants) by ranking of the school. This was entirely subjective—but this is exactly what admissions committees are doing when looking at applications. The top-ranked schools included both public and private schools.

Figure 2 shows that there is little difference in performance between applicants from the top- and middle-ranked schools but the 3rd-ranked physics programs are not preparing students as well for the physics GRE. My advice to students wanting to go to graduate school in the physical sciences is to recognize that your undergraduate training does matter— not all physics programs are equal. This does not mean that only people from ivy league schools get to grad school. Far from it (some of those "top left" applicants are from the "big name" schools). But if you are acing all the physics courses in your local state college, then perhaps you need to consider transferring to a research university—most states have at least one good physics program at a public university.

Wondering why some women from good schools and with good GPAs are bombing the GRE, I developed another hypothesis. I wondered if women undergraduates are spending time on research projects rather than studying for GREs. To test this idea I took the top 25-GPA-scorers (for 2003 only) and sorted them by the number of REUs (Research Experience for Undergraduates) mentioned in their application. I found no correlation—so much for that theory.

What can we conclude about the value of the physics GRE in applying to grad school? I am afraid to say the answer is "Not very much." It is actually very hard to get faculty to talk honestly about their own admissions process and even less about their graduation rate. It seems that each department thinks it has a secret recipe. There are rumors (reaching almost mythic proportions) that the high-GRE-scorers do indeed tend to do well in grad school, the very-low-GRE-scorers tend not to survive, and the ones in the middle are unpredictable. Some faculty have a "magic minimum" GRE score. Others prefer to look at verbal GRE scores.

All very surprising, eh? And not very helpful, I am afraid to say. The most important thing remains, of course, to be accepted by the program of your choice. All I can say to applicants is:

- The physics GRE continues to be an important factor in graduate admissions to most astronomy PhD programs.
- Are you taking the physics courses that prepare you for the physics GRE? Upper division physics courses[1] may not seem necessarily for the topic of your intended research but they usually build on (hence provide further experience in) basic material and expose you to more concepts that will be tested in the GRE.
- You *can* do well in the physics GRE—it is an exam in which it really pays to learn the test-taking strategies from those who have done well before you (preferably just a few years before). You may be philosophically opposed to such exams but consider it a necessary hurdle, swallow the pill and log the study hours.
- You might consider taking the GRE a year early—for practice.

At the University of Colorado we have started a short preparation course for the physics GRE taught mostly by graduate students, who have recent experience of taking the exam. But such courses do not help the applicants from schools without a graduate program.

Of course, what we really need to know is how well does the physics GRE actually predict *success*. What is the correlation of GRE with PhD graduation? With career "success"? Has anyone researched this issue? If you have some statistics send them my way, please. ❖

[1] Upper division physics courses recommended that provide a strong basis for the physics GRE include classical/analytical mechanics, electricity and magnetism (I and II), quantum mechanics (I and II), thermal/statistical physics, and a modern physics course that includes atomic, nuclear, particle, or solid state physics.

NOTICES
A SECTION OF STATUS

Review of "Women in Physics and Astronomy, 2005" by Rachel Ivie and Kim Nies Ray

(American Institute of Physics)

Review by Fran Bagenal

The dozen or so statisticians at the AIP support our professional organizations (including AAS) by providing a detailed analysis of demographics in the physical sciences. The latest study is a careful evaluation of the current trends for women in physics and astronomy. The overall national statistics are encouraging with increasing fractions of women at all academic levels. While there remains a disproportional leak of women at college level, the national statistics show the percentages of women at faculty levels are consistent with the academic pipeline.

These national statistics are encouraging. And astronomy fairs better than physics overall. But before we become complacent it should be noted that there are huge variations between institutions.

Figure 1: Physics departments that awarded more than 25% of PhD degrees to women, 1999-2003.

Alaska, University of
Cincinnati, University of
Dartmouth College
Georgia, University of
Hampton University
Kent State
Missouri, University of, at Columbia
Notre Dame, University of
Tulane University
Washington University

Note: To be included on this list, departments had to have at least 5 women graduates during 1999–2000, and had to consistently respond to our annual surveys.

AIP Statistical Research Center, Enrollments and Degrees Survey.

For example, Figure 1 lists the physics departments that awarded over 25% of bachelor degrees to women and Figure 2 shows lists departments where there are four or more women on the faculty. These lists show a wide range of institutions, including some of the best schools in the country. Yet there remain many institutions which lag far behind the national average. For statistics of astronomy see the 2003 CSWA survey including statistics of departments and a discussion in the June 2004 STATUS by Meg Urry and Jennifer Hoffman. Departments must

Figure 2: PhD-granting physics departments with four or more women in professional ranks, 2002.

Boston University
California Institute of Technology
California, University of (Los Angeles)
California, University of (San Diego)
California, University of (Santa Barbara)
Harvard University
Illinois, University of (Urbana-Champaign)
Kansas, University of
Maryland, University of (College Park)
Massachusetts Institute of Technology
Michigan, University of (Ann Arbor)
New Hampshire, University of
North Carolina State University
Northwestern University
Notre Dame, University of
North Carolina A & T
Oklahoma, University of
Pittsburgh, University of
Rutgers University (New Brunswick)
Washington, University of
Wisconsin, University of (Madison)

Note: To be included on this list, departments had to have responded to our 2002 Academic Workforce Survey.

AIP Statistical Research Center, 2002 Academic Workforce Survey.

realize that students applying to graduate school are very web-savvy and are aware of these statistics.

There also remains the very worrying issue of why a disproportionate number of women do not continue studying the physical sciences in college. A useful study for CSWA to pursue would be to find out why the membership of the AAS drops from a whopping 60% women at aged 18 to ~30% of astronomers in their mid-30s.

Finally, the report also includes statistics on women in physics internationally. The international league table is not as one might initially expect. Would you have predicted Turkey to have the highest percentage of physics PhDs going to women? ❖

Links

AIP report on Women in Physics and Astronomy, 2005
http://www.aip.org/statistics/trends/gendertrends.html
CSWA 2003 survey summary
http://www.grammai.org/astrowomen/stats/
CSWA 2003 survey data of 36 departments/institutions
http://www.grammai.org/astrowomen/stats/2003data.htm

A Teacher's Efforts to Create Gender Parity in Class

Recommended by Doug Duncan, Astrophysical and Planetary Sciences, University of Colorado

February 14, on the NPR program All Things Considered, a Chicago teacher Daniel Ferri gave a commentary, *A Teacher's Efforts to Create Gender Parity in Class*. Commentator and middle school teacher Daniel Ferri is trying to make sure the girls in his eighth-grade science class get as many chances to participate as the boys. Sometimes, his efforts backfire. It was a fascinating story about what happened when a newspaper came to interview, "two boys and two girls about science". The issues he talks about in his 8th grade class certainly show up among college students, and especially if you teach, I recommend you listen to his experience. Even if you do not teach, it is a remarkable piece of journalism—a short, vivid description of a social situation with a thought provoking dénouement. ❖

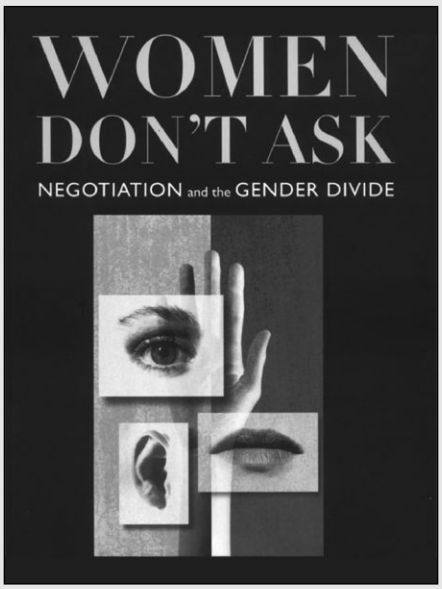
This commentary, along with a number of others dealing with the same topic, can be found by searching on the name "Daniel Ferri" on the NPR website, **www.npr.org** or by going directly to **http://www.npr.org/templates/story/story.php?storyId=4498787**

Review of "Women Don't Ask"

(Linda Babcock and Sara Laschever, Princeton University Press)

By Fran Bagenal

Full of examples from both academia and business, this modest book not only points out how women tend to be socialized to believe "nice girls don't ask" in both social or professional circles but also shows that by asking simple, straightforward questions life can often be made easier and better. And it's not just about asking for a pay raise. The books shows how a situation can be turned from a contest to cooperation by going through a series of steps from asking diagnostic questions, sharing information about your position, separating key from side issues and brainstorming about possible solutions. ❖



Cover illustration of *Women Don't Ask* by Linda Babcock and Sara Laschever. Published by Princeton University Press.

❊

John Hennessey is a computer scientist and president of Stanford University. Susan Hockfield is a neuroscientist and president of the Massachusetts Institute of Technology. Shirley Tilghman is a molecular geneticist and president of Princeton University.

Women and Science: The Real Issue

By John Hennessey, Susan Hockfield and Shirley Tilghman

Harvard President Lawrence Summers' recent comments about possible causes of the under-representation of women in science and engineering have generated extensive debate and discussion—much of which has had the untoward effect of shifting the focus of the debate to history rather than to the future.

The question we must ask as a society is not "can women excel in math, science, and engineering?"—Marie Curie exploded that myth a century ago—but "how can we encourage more women with exceptional abilities to pursue careers in these fields?" Extensive research on the abilities and representation of males and females in science and mathematics has identified the need to address important cultural and societal factors. Speculation that "innate differences" may be a significant cause for the under-representation of women in science and engineering may rejuvenate old myths and reinforce negative stereotypes and biases.

Why is this so important? Our nation faces increasing competition from abroad in technological innovation, the most powerful driver of our economy, while the academic performance of our school-age students in math and science lags behind many countries. Against this backdrop, it is imperative that we tap the talent and perspectives of both males and females. Until women can feel as much at home in math, science, and engineering as men, our nation will be considerably less than the sum of its parts. If we do not draw on the entire talent pool that is capable of making a contribution to science, the enterprise will inevitably be underperforming its potential.

As the representation of women increases in every other profession in this country, if their representation in science and engineering does not change, these fields will look increasingly anachronistic, less attractive, and will be less strong. The nation cannot afford to lose ground in these areas, which not only fuel the economy, but also play a key role in solving critical societal problems in human health and the environment.

Much has already been learned from research in the classroom and from recent experience on our campuses about how we can encourage top performance from our students. For example, recent research shows that different teaching methods can lead to comparable performance for males and females in high school mathematics. One of the most important and effective actions we can take is to ensure that women have teachers who believe in them and strong, positive mentors, male and female, at every stage of their educational journey—both to affirm and to develop their talents. Low expectations of women can be as destructive as overt discrimination and may help to explain the disproportionate rate of attrition that occurs among females as they proceed through the academic pipeline.

Colleges and universities must develop a culture, as well as specific policies, that enables women with children to strike a sustainable balance between workplace and home. Of course, achieving such a balance is a challenge in many highly demanding careers. As a society we must develop methods for assessing present and future productivity that take into account the long-term potential of an individual and encourage greater harmony between the cycles of work and life—so that both women and men may better excel in the careers of their choice.

Although we have a long way to travel in terms of recruiting, retaining, and promoting women faculty in scientific and engineering fields, we can also point to significant progress. According to the National Science Foundation, almost no doctoral degrees in engineering were awarded to women in 1966 (0.3 percent), in contrast to 16.9 percent in 2001. And in the biological and agricultural sciences, the number of doctorates earned by women rose from 12 percent to 43.5 percent between 1966 and 2001.

Our three campuses, and many others, are home to growing numbers of women who have demonstrated not only extraordinary innate ability, but the kinds of creativity, determination, perceptiveness, and hard work that are prerequisites for success in science and engineering.

These figures demonstrate the expanding presence of women in disciplines that have not, historically, been friendly to them. It is a matter of vital concern that the future holds even greater opportunities. ❖

Three (Other) Presidents Speak-following Harvard President Summers' comments become public, the presidents of Stanford, MIT and Princeton issued this joint press release.

❊

Steve Mojzsis is a professor of astrobiology in the Department of Geological Sciences at the University of Colorado. His research involves searching remote rocky outcrops around Greenland for evidence of the earliest forms of life.

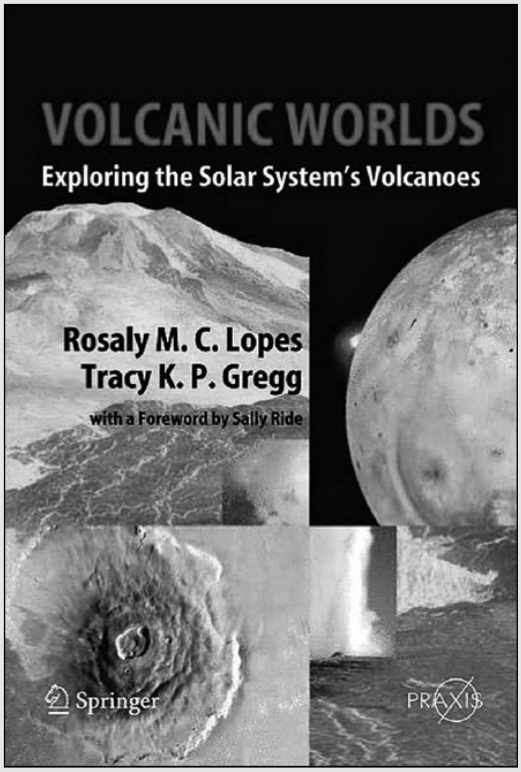
"When we were asked by Praxis-Springer to edit a book reviewing the current state of knowledge in planetary volcanology, we started it the usual way: deciding on the types of chapters we needed, and then putting down at least 3 names for potential authors. The authors needed to be: first, leading experts in the field; and second, people who we felt would deliver chapters in a timely manner. While reviewing our list, we were very surprised—perhaps even astonished—to see how many female names there were. Indeed, for every chapter, at least one woman's name was listed, in some cases two or even three out of the top three names were female. We realized that, perhaps for the first time in astronomy, a book could be written exclusively by female experts." Rosaly Lopes, JPL/Caltech.

Review of Volcanic Worlds– *Exploring the Solar System's Volcanoes*

(R.M.C. Lopes and T.K.P. Gregg, Editors, Springer)

By Stephen.J. Mojzsis

Planetary bodies with significant mass must lose heat in one or a combination of several ways: Convection of a mantle, conduction through the crust, plume activity or through the process of ridge spreading and plate subduction. Of these, the principal operator on Earth is heat loss at the ~60,000 km-long ridge circuit interspersed with the semi-frequent hotspot. Earth is a volcanic world cloaked in a veneer of the (relatively) tranquil ocean, with the scars of past catastrophes smoothed out by the mellowing agent of weathering, denudation, erosion and deposition of sediments. On other worlds in the solar system, the multiplicity of heat loss mechanisms is laid bare so that, ironically, missions to Venus and Mars tell us much about past volcanic activity on the Earth. What is volcanically possible have astounded observers over the past two decades; within some satellites, heat generation is not governed by the steady decay of radionuclides (mainly U, Th and K), but by tidal interactions between the satellites and the host planet. The spectrum of temperatures tapped by volcanic activity in the solar system is likewise surprising. Adding to the list of our terrestrial-type eruptions of high-temperature silicate melts seems hum-drum compared to ice volcanoes of Triton or the violent resurfacing of Io.



Cover illustration of *Volcanic Worlds* edited by R.M.C. Lopes and T.K.P. Gregg.

Volcanologist Kathy Cashman next to molten lava on the Kilauea volcano.

Now the time may have come to take a look back and take a deep breath, as *Volcanic Worlds* does, and digest what we have learned of the solar system's volcanoes. This book is a collection of chapters that

provides an overview of the nature of volcanism in the inner solar system (Earth, Moon, Venus, Mars) that sets the stage for exploration of what is beyond the snow line. Treating in separate chapters Io and the other Galilean satellites (Ganymede, Europa and Callisto) as separate members of the same satellite system makes sense; they share the same mechanism of heat generation (for most assuredly they are now bereft of significant radionuclides) but not the same manifestation of heat loss. Indeed, a whole or several texts could be devoted to icy volcanics in the outer solar system alone. The purpose of this well-organized book, however, is to tie it all together and it does an admirable and accessible job of doing so. It is not suitable for use as a textbook, but is contains up-to-date interpretations and references that make it appropriate for an upper-division undergraduate seminar in planetary surfaces. ❖

I have yet to hear a man ask for advice
on how to combine marriage and a career.
- Gloria Steinam

Illustation by: Ann Didyk

Send your "Notes" to ***bagenal@colorado.edu***

"Notes from a Life," first printed in the June 1999 issue of STATUS, are anonymous vignettes describing quotidian life of a woman in science.

Notes From A Life

An Anonymous Contribution from one of Our Readers

♀ I am about to give a public talk. I love doing this—it's most often very gratifying. I'm young, and a woman, so when giving a talk, any talk, I "dress like I know what I'm talking about." So, I'm wearing a black suit. I'm in the first row, waiting for the meeting to start so that they can get their administrative business out of the way and then I can start my talk. A man in the front row initiates conversation with me. In hindsight, perhaps the fact that he wanted to talk about faked moon landings should have been a tipoff. But after some polite conversation (in which I assured him that the moon landings were real), he said with some astonishment, "Are you our speaker?!?" I said that yes, I was. He said, "You look like you should be working in a kitchen!" Remember, I'm in a suit. I was stunned into silence, finding no way to figure out what he could have possibly been thinking in any polite fashion. ❖

Honoré Daumier (1808-79). French caricaturist, painter, sculptor—political and social satirist.

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