TIME FOR ADVANCEMENT

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Because pre-college attrition is so high, discussions of under-representation of women in science, mathematics or engineering often leave the impression that there is only a minor role for college faculty and research mathematicians. However, the number of women mathematicians has been substantial for many years. Not only have women received over 20% of the PhD's in mathematics earned by US citizens every year since 1982, but in recent years women have received nearly 50% of undergraduate and 25% of doctoral degrees in mathematics. Despite recent progress, there is evidence that women continue to advance more slowly than men, and are less likely to have their achievements recognized than men. During the last two years, as chair of the AMS-ASA-AWM-IMS-MAA-SIAM Joint Committee on Women in the Mathematical Sciences (JCW), I have reviewed a great deal of data. It has been a sobering experience to realize the extent of the disparity that remains.

I believe that mathematicians could do much more to advance the careers of junior women, and that this responsibility is shared by the entire mathematical community, men as well as women. Mentoring junior women should not be left to the increasing, but still overburdened, pool of senior women.

Are Women Getting All the Jobs?

The current job crisis in mathematics has been accompanied by claims that women are getting a disproportionate share of the positions. Before citing data to demolish this myth, I will try to provide additional insight with some personal reminiscences.

When I was a graduate student in the 60's, even the most insufferable male chauvinists never questioned my ability -- no matter how inappropriate and perverted they regarded my study of science, they conceded that a woman who could survive in graduate school at Wisconsin was capable. In 1972, near the previous nadir of the job market, I reluctantly took a postdoctoral research position for the fourth consecutive year, but decided to seek and accept nothing less than a regular faculty position for the following year. Moreover, in the fall of 1972, Elliott Lieb and I completed the proof of the strong subadditivity of quantum mechanical entropy, a problem which we had worked on during my 1971-72 postdoc at MIT. This result, which had been an open conjecture for 5 years, had gained enough notoriety in some circles that its solution would be expected to make one competitive in most markets.

A few months later a visitor was vociferously holding forth in the mathematics department lounge about the pressure to hire women. He alleged that his department had no women applicants and would gladly *create* a position if someone like me applied. So I

asked for the name of his university -- it turned out that I had just received a rejection letter from his chair in the mail I opened before lunch! In May, Rockefeller offered me a postdoc for which I had not even applied, but I still had no faculty offers. By June, I finally had a one-year position as Visiting Assistant Professor at the University of Oregon. Yet, when I reported the offer, one male mathematician said (to my face) "they must have been desperate to hire a woman". Nevertheless I enjoyed three years at Oregon, reaching the "tenure-track" level, before deciding to move on.

Reasonable people may disagree about the relative merits of individuals for certain appointments. However, honest disagreements should not be distorted into tales of outrageous favoritism, and those who hear such anecdotes third- and fourth-hand should regard them with considerable skepticism. Moreover, the existing data does not show any evidence for systematic preferential treatment.

I have culled and summarized some data from the annual AMS-IMS-MAA data surveys. Table I shows the percent and number of women among PhD's **from** different types of departments; while Table II shows corresponding data for those who received their first position at different types of institutions.[1] From 1988-92 the rate at which women were hired **BY** doctorate-granting mathematics departments increased steadily until in 1991 it finally reached that at which they received PhD's **FROM** group I departments alone![2] The group II (but not group III!) departments did sometimes hire at a higher rate, but **only** in years when the group I hiring rates were low. This suggests that the group II and III departments will hire women only if they can get group I women, but not if they have to settle for group II. Unpublished AMS data[3] giving further breakdowns confirms this -- women are rarely hired into group II and III departments from groups II and III, although substantial numbers of men are. In 1993, several things occurred simultaneously -- the per cent of women receiving PhD's from group I departments jumped from a previous high of 17% to 22%; the distribution of women receiving PhD's from groups I, II, and III was more uniform; groups II and III began to hire a few women from groups II and III as well as I, IV and V; women were hired by doctoral institutions at a rate slightly (very slightly) higher than that at which they received PhD's; and jobs were becoming increasingly scarce. The result was widespread claims that "women are getting all the jobs".[4] When, for perhaps the first time in history, women finally began to get **their fair share** (any excess being well within the limits of statistical

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1 In these AMS-MAA reports Group I consists of the top 39 PhD-granting math depts in the US, groups II the next 43, group III the remaining doctoral math departments, group IV consists of statistics departments, and group V of doctoral programs in applied math and/or operations research. M and B denote departments which grant Master's and Bachelor's in mathematics respectively. The symbol RI is used for research institute (e.g. IAS or MSRI) and D denotes the combined total of I-V + RI, i.e. new doctorates whose first position was in a non-industrial research environment.

2 Although excluding group II and III PhD's from the doctoral hiring pool may be justified, the actual hiring pool is somewhat higher than group I alone, since groups I and II do hire a significant number from group V and group III from group IV.

3 Don McClure, AMS-ASA-MAA data committee chair (1987-1993) sent the JCW a summary of this data.

4 A. Jackson, *AMS Notices* **40**, pp. 588-590 (Jul.-Aug., 1993); **41**, pp. 286-287 (April, 1994).

fluctuations), some men began to cry "foul".

The AMS also publishes data on new hires at all levels. That for 1991 supports the hypothesis that group II hires women only if it can attract the kind of top-notch women group I has finally begun to recruit. **True equality will be achieved** not when the top mathematics departments finally have a few more tenured women, but **when the group II departments stop recruiting group I caliber women and start hiring group II caliber women**!

However, Table III also contains some striking data about the number of recruited positions which were not filled. In 1990, 91 and 92, the number of "unfilled" positions reported by both group II and group III departments was always greater than the number of women actually hired! The nature of these unfilled positions is unclear -- they may have disappeared, or been filled late. In any case, factors other than competition from talented women are primarily responsible for whatever difficulties men currently encounter in finding jobs.[5]

Where are Women Getting Jobs?

Women are far more likely to have positions at institutions with high teaching loads than at research-oriented PhD institutions. While a great deal of attention has been focussed on the lack of tenured women at "top ten" departments, only a few of the less prestigious departments do much better. In fact, as shown in Table IV, the proportion of women among tenured faculty at groups I, II, and III was about 4%, 5%, 5.5% respectively in 1991 and 1992. However, it jumps to 11-12% at Master's and 15% at Bachelor's departments. This differential is *not* simply a historical artifact; women continue to be disproportionately hired by Bachelor's institutions. In 1992 about 46% of tenured women mathematicians were at 4-year colleges, as well as 46% of untenured women, i.e. both junior and senior women were equally likely to have positions at 4-year colleges. By contrast, only 28% of tenured and 33% of untenured men were at such departments. Similar patterns hold for 1991 and 1993.

Is this disparity a result of a greater appreciation of the rewards of teaching at 4-year colleges by women? This question cannot be answered until we are sure that every woman has the opportunity to pursue a mathematics career with the convex combination of teaching, research and administration that is best suited to her talents and interests.

But Are They Visible?

It is certainly heartening that many of the young women coming out of graduate

[5] The NSF data bureau recently reported substantial increases in the number of foreign scientists and engineers acquiring permanent residency in the U.S. in 1991 and 1992. Furthermore nearly half of the scientists were classified as mathematicians and computer scientists by the Immigration and Naturalization Service. By contrast, NRC data indicate that mathematicians and computer scientists constitute less than 10% of doctoral scientists (20% if one excludes social scientists). One needn't be xenophobic or unappreciative of the contributions of foreign immigrant mathematicians to be concerned about this imbalance. More, in view of anecdotal evidence that these immigrants were overwhelming male, it seems clear that the recent advances of junior women are an exceedingly minor factor in the current tight job market.

school are finally getting the opportunity to begin their careers in good research departments. However, most of these positions are not tenure-track.[6] The substantial number of women who received PhD's from 1975-88 is not reflected in the 5% of tenured women currently in doctoral departments. Will the women PhD's of the 90's fare better, or will attrition also pare their ranks? Rather than taking a "wait and see" attitude, the mathematics community should actively promote the advancement of junior women into the senior research ranks.

Career advancement does not consist entirely in getting job opportunities at good research institutions, or even in publishing in top notch journals. Recognition and contacts also play an important role. Therefore, women mathematicians have long been concerned about the paucity of women speakers at mathematics research conferences. Although the situation is improving, there are still far too many conferences with no or few woman speakers. The data summarized in Table V for AMS special sessions of invited 20-minute talks illustrates one aspect of the problem. In sessions with only men organizers, 7-8% of speakers were female; in those with at least one woman co-organizer, 15-16% of speakers were female. Careful examination of meeting programs and discussions with colleagues have convinced me that this pattern is typical of many other meetings, and is the result of the following phenomenon. **Men tend to invite primarily well-established women who could also be hour speakers, while women organizers include more promising junior women and lesser luminaries.** When junior women are overlooked, they may miss the exposure and contacts that are essential to professional growth and career advancement. However, it is not unusual for organizers to include junior (male) colleagues. In addition to including more senior women among the major speakers, organizers should seek out junior women who are beginning to contribute to an area, particularly if the meeting includes shorter talks.

But conferences are only one aspect of a larger problem. The research community should take a more active role in advancing the careers of promising junior women by suggesting them as speakers; inviting them to workshops at the various mathematics institutes; encouraging them to apply for grants and fellowships; giving savvy advice on grant proposals; nominating them for awards; etc. etc. In other words, doing all the things that some advisors have always done for their best male students.[7] Because cultural factors inhibit many women from applying for awards or

inviting themselves, it is particularly important that senior researchers nominate and encourage them.

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6 The non-tenure-track positions range from prestigious research instructorships at top institutions to exploitive one and two-year temporary positions. The large number of women in non-tenure-track positions is partly a consequence of their finally getting a higher share of the research instructorships. However, it is worth noting that in 1993 women held only 6% (10 of the 156) tenure-track positions at group I departments vs. 19% (68 of 360) of the non-tenure-track positions.

7 For those who want more detailed suggestions, see M.A. Olmstead, "Mentoring New Faculty: Advice to Department Chairs" *CSWP Gazette* **13**, pp, 1, 8-11 (August, 1993).

Let me emphasize that I am **not** advocating differential standards, but an expansion of the existing network process to insure the inclusion of women. It is not at all unusual to find that including more women actually raised standards. The essence of my recommendation is simply to make a small, but concerted, effort to insure that promising women are not lost or overlooked. The current pool of mathematically talented young women is a vital resource which the mathematical community ought to do everything possible to develop. The existence of other pools of mathematical talent should not tempt us to squander this unprecedented opportunity, but challenge us to find ways of utilizing all the wealth.

Conclusion

Past experience has shown that the most modest effort inevitably produces some backlash[3]. Despite the negative anecdote I recounted at the start, I have also had many positive experiences and very supportive male colleagues. However, although I am convinced that the number of truly malicious and bigoted people is very small, I am also increasingly convinced that the number willing to confront and fight them is comparably small. As a result, a small number of "bad guys" can have a disproportionately large effect. I doubt that affirmative action results directly in hiring more women; it's utility is primarily as a tool for diminishing the effect of the malicious minority.

Only a few cases of hiring, promotion, speaker selection, etc. are really clear cut. We do not live in an ideal world where every decision can be based upon pure merit. Because most people have both good and bad points, detractors can always find something if they look. The difficulty is to distinguish between a bona fide criticism and an excuse to hide bigotry and double standards. Even when the "good guys" win, the process of airing and defeating irrelevant complaints can have a detrimental effect on a junior faculty member's career. I have seen too many young women falter either because no one bothered to provide a necessary "push" at critical times, or because detractors managed to prevail.

Some people will point out that similar things can happen to young men also, and there are certainly cases in which men, as well as women, have been unfairly treated. What I find unfortunate is that, instead of being a stimulus toward fairness, this observation often becomes an excuse to tolerate discrimination or double standards. Senior faculty not only have a responsibility to be honest themselves, but to fight for their junior colleagues when necessary.