AWM in the 1990s: A Recent History of the Association for Women in Mathematics

Jean E. Taylor and Sylvia M. Wiegand

Ever since its founding in 1971, the Association for Women in Mathematics (AWM) has been a passionate organization with a mission: to encourage women to study and to have active careers in the mathematical sciences.[1] Largely through the devotion and energy of a few overcommitted but determined individuals, especially its past presidents and officers, AWM has flourished for almost three decades. The inexhaustible enthusiasm and inspiring example of the early AWM volunteers (e.g., first founding president Mary Gray) set the standard for extensive donations of time and energy by those who followed. As a result, the Association has become an effective voice and vehicle for the advancement of women in the mathematical sciences.

At the outset, the initials AWM stood for the "Association of Women in Mathematics", but soon "of" was changed to "for". Men have been instrumental in the growth and prestige of AWM; about seven percent of the approximately 4,500 members are male. Men give varied reasons for their membership, such as "to help me see what is available for women in mathematics and enable me to better mentor female students", or "to show support for women in mathematics". Many are motivated by a basic sense of justice and/or the belief that all of society stands to benefit from developing the mathematical talents of women. As one member explains, "If any group is subjected to willful or accidental discrimination, all of society is the victim [because society is deprived of the talents and potential accomplishments of that group]."

To commemorate the twentieth anniversary of AWM, Lenore Blum wrote an exuberant article for the *Notices* in which she described how AWM grew from a small, shaky beginning in 1971, when women were "invisible"—jobs were scarce for women, as were positions on the programs of meetings and conferences—to 1991, when, according to Carol Wood, women were "everywhere dense".[2] Blum's article recorded the dramatic improvements in the situation for women since 1971 and described the activities of AWM that contributed to these improvements. By 1991 the Association was a widely respected organization with a large influence internationally: AWM had a professional newsletter, an extensive program at the

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Photographs for this article are courtesy of AWM.

[1] *More generally, AWM promotes equal opportunity and equal treatment for women and other underrepresented groups in mathematics. In this article, "mathematical sciences" is often abbreviated as "mathematics".*

Editor's Note: Jean E. Taylor is president-elect of the AWM, and Sylvia M. Wiegand is president of the AWM. The authors are writing as individuals and not as representatives of the AWM.

[2] *September 1991, Volume 38, Number 7, pages 738–774; the article was also printed in the November–December 1991 and January–February 1992 issues of the AWM* Newsletter, *and it is accessible through the AWM Web site,* http://www.awm-math.org/.

January Joint Meetings, and various projects for encouraging younger women to study mathematics. As AWM nears the end of its third decade, it is an opportune time to update that article.

A major source of information for the present article is the last decade of newsletters of the Association (referenced in abbreviated fashion, for example, with "[JF93]" signifying the January–February 1993 issue). Former AWM presidents and other AWM friends contributed information and verification. AWM member Elizabeth Allman conducted and transcribed interviews with several younger mathematicians. The choice of what to include, however, was that of the authors, and the opinions expressed here are those of the authors and do not necessarily represent AWM.[3] The authors thank Elizabeth Allman, Lenore Blum, Anthony Knapp, Eric Macris, Judith Roitman, Roger Wiegand, and the reviewers for their help with this article.

Why AWM Is Still Needed

Since Blum's article, the participation of women in the mathematical community has in general increased. The percentage of women earning Ph.D.s in mathematics in the U.S. reached its highest level (25% overall, 29% of those granted to U.S. citizens) for the year of the latest published survey. Many more women hold entry-level positions now. Many more women speak at major meetings. In view of these improvements in the status of women in mathematics, is AWM still needed?

The answer is yes! Problems—sometimes more subtle than in the past—remain for women in mathematics at all levels. For example, the high point in the percentage of women receiving Ph.D.s in mathematics cited above masks the fact that the percentage varied considerably for the rest of the decade—about a mean several percentage points lower. Furthermore, the percentage of women entering graduate study has recently dropped at several institutions, as noted below. In spite of the description from Blum's article of women's participation in mathematics as "everywhere dense," sometimes it is "measure epsilon"; one young woman commented, "I was the most senior woman at the conference I just attended…and I was the only woman from the U.S. None of the twenty-plus speakers were women." As the data below indicate, the prediction at the end of Blum's article—that there would be significant numbers of tenured women in the U.S. top ten departments within five years—has not been realized. Although there is a welcome increase in numbers of new women mathematicians with academic positions, women are still scarce among tenured and full professors at most institutions, particularly those in the U.S. top ten. There remains evidence of discouragement, disparities, and lower expectations for women in mathematics at various levels, as the following snapshots reveal.

Social Unacceptability

Young women in high school and college still hear that "math isn't cool for women." Girls at a high school math camp for girls at Nebraska said they "could not" tell their peers that they were going to a math camp; it would be "socially unacceptable". Some high school guidance counselors still steer girls away from mathematics.

Teaching vs. Research

Many undergraduate women mathematics majors plan to become elementary and secondary teachers. Teaching is a rewarding and valuable occupation that both men and women should be encouraged to pursue. But sometimes even women who think their contribution would be greater or their life more rewarding with a research career are pressured to choose a career in teaching; this happens far more often for women than for men. Mathematically talented undergraduate women should be permitted to develop their talents and to pursue the career that suits them best.

Promotions and Rewards

Although entry-level job opportunities for men and women now seem equal,[4] women are neither promoted nor rewarded as often as men. Generally, women are more numerous at the lowest levels of mathematical activity. AWM past-president Chuu-Lian Terng reported that in 1995 women in the U.S. earned 45% of the undergraduate degrees in mathematics and 23% of the Ph.D.s, but constituted only 6% of all tenured faculty. That is, of the 4,500 tenured faculty in 170 Ph.D.-granting departments, only 274 were women, or 1.6 per department [JF96]. Currently, published data show that 63 out of 1,231, or 5%, of tenured doctoral full-time math faculty at Group I public institutions are female; for Group I private institutions the numbers are 22/506, or 4.3%; and for Groups I, II, and III combined, 305/4714, or 6.5%.[5] This represents a welcome increase of 31 tenured female faculty in the combined groups, but the ratio of the increase in tenured women to the total increase in tenured faculty is still only 31/214. By contrast, the numbers of part-time faculty for Groups I, II, and III combined are 347 female out of 941 total, or 37%.

An AWM panelist in January 1995 on the topic "AWM: Why Do We Need It Now?", Susan Landau located 65 of the 80 people awarded MIT Ph.D.s during 1980–84. Of these 65, 13 were women (plus

[3] *A longer version of this article is posted on the AWM Web site,* `http://www.awm-math.org/`*, with an opportunity for people to comment. Elizabeth Allman will moderate the discussion.*

[4] *Marie A. Vitulli and Mary E. Flahive,* Notices *44, No. 3, March 1997.*

[5] Notices*, October 1998, p. 1167.*

1 of the 15 she could not locate). She reported that 14 of the men were tenured at Group I institutions, but only 1 of the women; 25 of the men were tenured at Group I, II, or III institutions, but only 2 women; and overall 39 (out of 52) of the men had tenure, but only 7 (out of 13) of the women [MA95].

At the beginning of this decade there was roughly a 20% discrepancy between salaries for men and women in the mathematical sciences in the U.S. (see Table 1).[6]

	1990 Salaries for Ph.D.s	
	Men	Women
Science & Engineering	$54.5K	$44.4K
Mathematics	52.4K	43.8K
Statistics	51.7K	48.3K
Comp. Sci./Inf. Sci.	60.1K	50.0K

Table 1. Salary data from Science, "Women in math update", Vol. 257, July 1992, p. 323, as reported in [ND91].

Percentages at Elite Institutions

The percentages of women in mathematics departments at the elite institutions remain dismal, with a few bright spots. In 1991–92 there were five tenured women total in all of the top ten departments (National Academy of Sciences ranking) versus 288 tenured men, and a total of 27 untenured women versus 192 men [JF93]. There were no women at Caltech, and no tenured women at the University of Chicago, MIT, Princeton, Stanford, or Yale. (See Table 2.) Since then there have been notable changes at two institutions: Princeton University now has two tenured women, and the University of Michigan has four; MIT has an increased number of untenured women. Still, the total number of women is small. (See Table 3.)

Graduate School Attrition

Proportionately more women still drop out of graduate school than men. Furthermore, anecdotal evidence suggests that in some areas where the par-

Department	Tenured		Untenured		Tenure-Track[7]	
	Total	Female	Total	Female	Total	Female
UC-Berkeley	60	2 *	12	3	2	0
Caltech	13	0	6	0	1	0
Chicago	25	0	24	2	6	0
Columbia	14	1 **	12	0	0	0
Harvard	17	1	14	3	1	0
MIT	40	0	38	4	12	1
Michigan	49	1	38	6	3	1
Princeton	31	0	28	7	22	5
Stanford	23	0	9	1	2	0
Yale	16	0	11	1	3	0
Total	288	5	192	27	52	7

Table 2. Women in Mathematics, 1991–92.[8]

Department	Tenured		Untenured		Tenure-Track	
	Total	Female	Total	Female	Total	Female
UC-Berkeley	60	2	12	3	2	0
Caltech	12	0	3	0	3	0
Chicago	31	0	24	3	8	0
Columbia	17	1 **	13	2	0	0
Harvard	16	0	14	2	0	0
MIT	36	0	40	10	12	4
Michigan	58	4	44	9	1	0
Princeton	23	2	20	3	14	1
Stanford	22	0	9	1	2	1
Yale	15	0	8	0	1	0
Total	288	9	183	31	42	6

Table 3. Women in Mathematics, 1998–99.[9]

[6] *The authors have been unable to locate current data.*

[7] *Positions that could lead to tenure.*

[8] *In this table from [JF93], "*" denotes "joint appointment with UCLA", "**" denotes "tenured at Barnard", and "Untenured" includes all full-time members of a department who do not have tenure—both tenure-track and non-tenure-track positions. "Tenure-track", a subset of the untenured group, includes members of a department with appointments at the end of which the member must automatically be considered for tenure.*

[9] *This information was obtained from the departments by the authors. Again, "**" denotes "tenured at Barnard".*

AWM 20th anniversary celebration, January 17, 1991. Right, Jill Mesirov, 1989-91 AWM president (left in photo) recognizes Bettye Anne Case, AWM Meetings Coordinator, for "Outstanding Service to the Association". Below, Anne Leggett, AWM Newsletter Editor holds her "Outstanding Service" award.

ticipation of women once increased, it has lately decreased. Although the percentage of women entering graduate school in mathematics has increased to 50% in some schools, at others it has decreased; in particular, at the top ten institutions it decreased considerably in 1997–98, according to data compiled by Joan Birman [ND97]. Some universities, such as Northeastern and Rutgers, also have markedly fewer tenured women in mathematics now than twenty years ago.

Disparaging Comments and Discrimination

It may seem that outstanding new women Ph.D.s who obtain jobs at top institutions no longer encounter any discrimination, but at least some of these women notice differences in their treatment from that of men. They report that male students and even colleagues accuse them of getting jobs, awards, and attention just because they are women. Some female students, perhaps expecting perfection when they finally see a role model, are also quite critical of women faculty. As for women who are not in top positions, they feel their faults are magnified and they are disparaged far more than comparable men.

As Melvin Rothenberg observed, "Thirty years ago discrimination against women was rampant and open. More than one distinguished colleague vowed never to accept a woman as a student. Now, discrimination is not open, if only out of fear of legal action. At the same time, I wonder how much better it is for women. The top five research departments have literally less than a handful of tenured women. … There is no doubt that there exists an environment and attitude at our leading mathematical institutions that many women find hostile and alienating. … This environment is deeply discouraging to women graduate students and is a significant factor in limiting their careers. … We can and should regard the absence of women in our ranks as a weakness and take appropriate action" [ND93].

For these and other reasons AWM is still needed. Rather than emphasize negatives, however, this article focuses on the accomplishments and the spirit of AWM. AWM programs have been enormously helpful to younger women in mathematics. As Cheryl Grood says, "AWM helped bring me into the mathematical community at each different stage and level in my mathematical career." Those interviewed for this article describe their experiences with AWM as "exciting and inspiring".

AWM's Activity List for the 1990s

During the 1990s, AWM has continued many of its earlier activities, described in Blum's article, and it has expanded into new areas. A great deal of the work of AWM on these activities has been done by unpaid volunteers, notably meetings coordinator Bettye Anne Case, *Newsletter* editor Anne Leggett, the AWM presidents and treasurers (who are involved in every AWM project), and members of the various committees. Case and Leggett—energetic, dedicated women who have served AWM in their posts for twenty-three and twenty-one years respectively—have made enormous contributions to the continuation, the memory, the shape, and the dream of AWM.

Newsletter

AWM publishes its bimonthly *Newsletter* under the direction of *Newsletter* editor Anne Leggett. This publication regularly features informative articles about women in science and mathematics; reports of AWM events and other mathematical events; listings of jobs, both academic and nonacademic; short blurbs about members, women in mathematics, news, and upcoming events; an informal "President's Report"; an "Education Column"; and book reviews. The *Newsletter*, widely read and enjoyed by the mathematics community, is praised for its interesting and valuable information and articles. Women members say each *Newsletter* "recharges" them and helps them fight feelings of isolation.

Web Site

In 1998 AWM established, through the efforts of volunteers Tamara Kolda and Barbara Ling, an award-winning Web site, `http://www.awm-math.org/`. It features announcements of up-

coming deadlines and events, articles (including an expanded version of this one), pictures from previous events, some of the AWM publications listed below, links to many resources on women in mathematics, information on applying for all programs AWM runs, information on ordering all of its publications, and other important information. AWM also sponsors AWM-Net, an electronic mail forum for AWM members that was started in 1994 by Dianne O'Leary. AWM-Net is used for discussing issues and publicizing events related to the AWM mission. Information on joining the AWM-Net is available at the AWM Web site.

Publications

AWM has produced these publications: *Profiles of Women in Mathematics: The Emmy Noether Lecturers*; a career booklet, *Careers That Count* (produced in 1991); an older *Careers for Women in Mathematics* booklet [ND86]; a *Directory of Women in the Mathematical Sciences*; membership directories; an AWM membership brochure; and an extensive report from the 1997 SIAM workshop.[10]

AWM Workshops

Begun in 1991 under the direction of AWM president Jill Mesirov, the AWM workshops highlight the achievements of outstanding new female mathematicians via talks by recent Ph.D.s and posters presented by graduate students. Currently funded by the National Science Foundation (NSF) and the Office of Naval Research (ONR), the workshops have continued each winter at the Joint Meetings and each summer at the SIAM meeting and are attended by both men and women. In the course of the workshops the new mathematicians are matched with mentors, established mathematicians who give career advice. Workshop organizers also arrange various sessions offering advice for new Ph.D.s on pressing issues. For example, the summer 1997 workshop featured a minisymposium on how to write mathematics and grant proposals [ND97]. At the January 1995 panel discussion "Launching a Career", Dusa McDuff discussed her career path briefly and emphasized making mathematical connections [MA95]. Catherine Roberts described the importance of finding mentors and listed nine practical suggestions for new faculty members [MA95]. Other workshop panel discussions have included: getting started doing research without an advisor, mathematicians in government, presentations by undergraduate students from Mills College on the Summer Program for Women, graduate education, career experiences, and balancing career and family.

New mathematicians find the workshops valuable "for networking with each other, for discussing career difficulties, and for being inspired seeing so many women doing such excellent mathematics." They appreciate the opportunity to meet successful senior women researchers, and they especially appreciate comments and suggestions from other mathematicians about their work. A workshop participant in 1995, Helen Moore, reported, "Every time I talked math with someone, I gained information or insight which advanced my work. … Every time I went to an AWM-sponsored event or talked with other women, I gained energy and made plans. … And aren't these two areas [our careers and our personal lives] the ones in which the AWM strives to make a difference for women?" [MA95].

At the AWM-ONR Workshop held in conjunction with the SIAM Annual Meeting, Stanford University, 1997. Row 4: Dianne O'Leary, Donna Calhoun, Pam Cook, Dawn Wheeler (AWM office), Joyce McLaughlin. Row 3: Jennifer Mueller, Elsa Newman. Row 2: Barbara Niethammer, Anna Georgieva, Suzanne Lenhart (workshop organizer), Sylvia Wiegand (1997-99 AWM president), Ruth Pfeiffer, Maeve McCarthy. Row 1: Ivonne Diaz-Rivera, Carolyn Hill Coleman.

SK Days

AWM coordinates the Sonya Kovalevsky High School Days, programs held in various parts of the U.S. for high school girls and their teachers. The participants meet with college mathematics educators and women in industry for a day of interesting mathematical activities, and they learn about careers in mathematics and the importance of mathematics for many other careers. The Sonya Kovalevsky Days programs were started in 1985 by Pamela Coxon; recent funding from the National Security Agency has supported about fifteen of the programs per year. High school women have remarked that the programs have changed their lives and have opened up a world of career possibilities and interests. Educational institutions find the programs benefit their recruitment efforts, and some institutions even offer their own self-sufficient programs. At present, funding for the whole

[10] *This report, which was the center twelve pages of [ND97], is also available separately.*

AWM Emmy Noether Lecturers during the 1990s
Bhama Srinivasan (1990, University of Illinois at Chicago)
Alexandra Bellow (1991, Northwestern University)
Nancy Kopell (1992, Boston College)
Linda Keen (1993, CUNY)
Lesley Sibner (1994, Brooklyn Polytechnic University)
Judith Sally (1995, Northwestern University)
Olga Oleinik (1996, Moscow State University)
Linda Preiss Rothschild (1997, University of California, San Diego)
Dusa McDuff (1998, SUNY at Stony Brook)
Krystyna Kuperberg (1999, Auburn University)

International Congress Emmy Noether Special Lecturers
Olga Ladyzhenskaya (1994, St. Petersburg Steklov Institute)
Cathleen Morawetz (1998, Courant Institute, NYU)

Top photo: Chuu-Lian Terng (AWM president 1995-97) on left and Linda P. Rothschild (1997 Emmy Noether Lecturer and AWM president 1983-85) at the Noether Lecture, San Diego, January 1997. Center: San Francisco, January 1995. Teresa Edwards (left) and Sylvia Bozeman (right) accept the AWM Louise Hay Award on behalf of Etta Falconer. Cora Sadosky (AWM president 1993-95) presents the award. Bottom: 1991 Schafer Prize honorees, including prizewinner Jeanne Nielsen Clelland (third from right), with 1973-75 AWM president Alice T. Schafer (fourth from left) and 1991-93 AWM president Carol Wood (fourth from right).

project is renewed year by year; long-term support or self-sufficiency would be desirable.

Travel Grants
Through a grant from the NSF, AWM administers a grant program to fund travel by women mathematicians to research conferences.[11] This program, which was started in the mid-1980s by then-president Rhonda Hughes, has funded hundreds of travel proposals and provides a valuable opportunity to advance research activities and visibility of women in the research community.

Special Conferences
The tradition of holding special conferences in honor of famous women in mathematics, such as Sonya Kovalevsky and Emmy Noether, began in the early days of AWM. In 1996 AWM held another special conference, in honor of Julia Robinson, and the Association is currently organizing an Olga Taussky-Todd conference to be held July 16–18, 1999, at the Mathematical Sciences Research Institute (MSRI). Described by participants as wonderful, energizing, and empowering, the Julia Robinson conference featured talks on her life and work; other mathematical talks; poster presentations, and panel discussions on job hunting, building a career, and applying for grants.[12] Sharon Frechette summarized her experience at the conference, "A panel discussion with women from different kinds of educational institutions, NSA, and industry was informative and interesting. … A session on how to conduct a job search with a great mock interview with Q&A afterwards [was] incredibly helpful. … Overall, I was impressed with the message AWM seemed to be sending to young women mathematicians: 'Things might have been difficult for many of us as we were starting out, but it needn't be that way, and we're working to ensure that things continue to improve for women making a career in this field.'" Another young woman said the conference had a large impact on her cohort, "both in the number of beginning mathematicians who participated and the connections formed by each of them."

Lectures
AWM sponsors and cosponsors lectures at the January Joint Meetings and the summer Mathfests, including sponsoring the prestigious Emmy Noether lectures given in January. The Noether Lecturers have been women research mathematicians who have made fundamental and sustained contributions to the mathematical sciences. AWM, through its 1993-95 president Cora Sadosky, was instrumental in setting up similar lectures at the International Congress of Mathematicians.

[11] *The guidelines for awards are the same as those for other NSF research awards.*

[12] *This conference was supported by NSA, NSF, MSRI, and the Rosenbaum Foundation.*

AWM Awards
Each year at the January Joint Meetings prize session, AWM presents two awards. The Alice Schafer Undergraduate Prize for Outstanding Undergraduate Work by a Female Student, first awarded in August 1990, now includes established mathematicians among past recipients. The Louise Hay Award for Excellence in Mathematics Education was first given in 1991.

Panel Discussions
AWM holds panel discussions at the January Joint Meetings and at the SIAM Annual Meetings. As is evident from two of the topics, "Affirmative Action" and "How to Be a Successful Woman Mathematician", these discussions concern issues of current interest in the profession as well as advice for young people. Sometimes controversial, always popular, they are among the most well-attended events at most meetings.

Other Societies, Public Relations, and Education Activities
The Association regularly participates in activities of other major organizations of the international mathematical and scientific community. AWM is a member of the Conference Board of Mathematical Sciences, a consultant and presenter for the Board of Mathematical Sciences, and an affiliate of the American Association for the Advancement of Science (AAAS). AWM has been a participant in all International Congresses of Mathematicians (ICMs) from 1974 onward, more recently helping to organize panel discussions among women of different countries and special Emmy Noether Lectures. It has participated in and organized symposia at the International Congress for Industrial and Applied Mathematics (ICIAM) since 1995. AWM has formed an Affiliated Research Group to assist with the national effort, led by the National Council of Teachers of Mathematics, to delineate standards for K–12 education in the U.S. At the 1998 Joint Meetings in Baltimore, AWM cosponsored with the Mathematicians for Education Reform network (MER) a special session on evaluating faculty; another session is planned for 1999. The AWM president joins with officers of the other major mathematics, science, and engineering societies in activities to improve the public perception of mathematics and science and to increase federal (U.S.) support for research. In particular, AWM encourages members to speak with legislators about the importance of encouraging young women in science.

AWM Office
The AWM office has been at the University of Maryland since 1993. Judy Green, AWM treasurer from 1992 to 1996, helped set up the present office and its operations; meetings, membership, and marketing director Dawn Wheeler joined the staff at that time and conducted a major membership drive. After having a succession of various individuals and titles for the second full-time staff person, AWM recently hired a finances and grants administrator, Doug Farquhar, to work with the AWM treasurer, currently Amy Cohen. Some of the office expenses to support publications and programs are partially funded by unrestricted grants from the Exxon Education Foundation. Historical material about AWM continues to be kept at the Wellesley College Library under the supervision of AWM archivists Alice Schafer and Bettye Anne Case.

AWM Panel "What it takes to have a successful career in the mathematical sciences", San Diego 1997. Left to right: Mary Gray (AWM president 1971-73), Audrey Terras, Lesley Sibner, Nancy Kopell, and Lynne Butler.

Speakers Bureau
AWM maintains a Speakers Bureau, a list of women in mathematics who are available to give talks to groups.

Networking Parties
Finally, AWM holds parties at meetings; these are large, joyful occasions with many opportunities for informal networking.

As former president Chuu-Lian Terng said, "The list of AWM activities is impressive, but many people probably do not realize that to continue having these programs requires enormous effort by the small AWM staff and by many women mathematicians writing proposals for funding, running the programs, and serving on various committees. During my term, I seemed to be constantly asking people to help AWM, and one of the most rewarding things about my job was that people would say yes and even seem honored to be asked. This says a lot about how our organization is perceived by the mathematical community."

Issues of the 1990s

As we begin this section, it is important to note that some issues of AWM's first twenty years seem to have almost disappeared in the 1990s. For example, in 1971 there were no invited addresses by women at the January Joint Meetings [ND91, p.12];

AWM Presidents of the 1990s and Their Initiatives

AWM presidents spend much of their terms (including when they are president-elect and past-president) applying for grants, consolidating the initiatives of previous presidents, and responding to various crises. Nevertheless, each has managed to put her own distinctive stamp on the organization. Here are the AWM presidents of the 1990s, their terms as president, and a few of the initiatives from their terms.

JILL MESIROV, 1989–91, began the ongoing AWM presence at SIAM Annual Meetings. She initiated AWM workshops, the Twentieth Anniversary Celebration, and revision of the AWM Resource Center at Wellesley College; and began the Schafer Prize and Hay Award.

CAROL WOOD, 1991–93, stabilized the organization through crises due to the growth in its activities, increased the influence of AWM in national policy, and led the Executive Committee in formulating its policy statement on conflict resolution. The booklet *Careers That Count* was produced and distributed to schools. At the end of Wood's term, AWM had about 2,000 members.

CORA SADOSKY, 1993–95, organized the move of AWM headquarters to the University of Maryland and the concurrent staff changes. She increased AWM's international connections and involvement in science policy, in particular initiating (in coordination with other organizations) the first Emmy Noether Lecture at an ICM in 1994 and representing AWM at the International Congress of Mathematics Education in 1993.

CHUU-LIAN TERNG, 1995–97, initiated a fund-raising drive (coordinated by Sylvia Wiegand), emphasized mentoring activities (including starting, with Karen Uhlenbeck and with liaisons to AWM, the Institute for Advanced Study/Park City mentoring program for women), and promoted discussion and writing about affirmative action. The Julia Robinson conference was held during this term.

SYLVIA WIEGAND, 1997–99, joined with officers of the AMS and other scientific societies to promote government funding for science and mathematics. One of the few presidents from the "heartland" of the U.S., she traveled and spoke on behalf of the AWM throughout the U.S., at the ICM, and elsewhere.

JEAN E. TAYLOR, 1999–2001, while president-elect, was a midwife to the creation of the AWM Web site, worked with others to strengthen the infrastructure of AWM, and is initiating a Corporate Task Force.

this was typical of the times, not an aberration. The "Milestones" section of this article demonstrates how different the 1990s have been in this regard. But some issues remain and others have surfaced.

Affirmative Action

In 1992, with a bad job market, some universities were rumored to be trying to make up for past inequities by offering no position unless a qualified woman could be hired; AWM president Carol Wood found this awkward for AWM and asked AWM members for advice on what stand to take [JF92]. Then, in January 1994, AWM president Cora Sadosky arranged an AWM panel on "Are Women Getting All the Jobs?", which addressed the fear head-on that the job crisis, in Sadosky's words, "would be much better if it were not for all those women and minorities or all those foreigners who are taking all the jobs" [MA94]. She added, "We strongly believe that this is false and dangerous, that pitting one group of under/unemployed mathematicians against another is just the old tactic of dividing people with similar interests in order to exploit them all." Women were apparently not receiving preferential treatment: 18% of Ph.D.s from Group I mathematics departments went to women, but only 14% of those getting positions at Group I were women. Overall, 22% of all mathematics Ph.D.s were earned by women, and 21% of all entry-level positions at Ph.D.-granting institutions went to women [JF95]. Marie A. Vitulli and Mary E. Flahive's article in the *Notices* (Vol. 44, March 1997) corroborates that women were not getting a higher percentage of entry jobs than men.

Affirmative action came under attack around the country in 1995. In response, the AWM published a series of articles in the *Newsletter*, the AWM Executive Committee passed an official AWM statement in support of affirmative action [JF96], and affirmative action was the topic of the 1997 January Joint Meetings panel discussion. A sampling of the opinions expressed follows: Mary Gray described how a program at American University had benefited many women and minority students; she asserted that such programs are necessary to combat years of discouragement [JA95]. Ronald Douglas observed that choices in hiring often are made to include less-represented disciplines and that when choosing speakers for conferences, a conscientious effort is made to achieve balance in fields and geography; these same arguments apply to achieving gender and ethnic balance [ND95]. Robion Kirby gave his view that "there is no significant discrimination on the basis of sex in mathematics" and thus that "affirmative action programs for women are unnecessary" [ND95]. Hugo Rossi discussed the dilemma of an imaginary mathematics department that is concerned about maintaining "standards" and finds that this strict adherence to standards and consequent critical look at candidates results in the rejection of females and minorities, because it is assumed they are considered solely for diversification reasons [JA96]. In response to Rossi, Karen Tonso wrote that rigid adherence to fixed standards has historically kept the status quo for departments; it is necessary to analyze the contributions of diverse people in a new way [SO96]. Beth Ruskai described the success of certain policies for women and then answered Kirby with some statistics: for example, "Women who received Ph.D.s [in] 1994 or 1995 were almost twice as likely as men to obtain their first position in a department [that offered only a bachelor's degree]" [MA96].[13]

[13] *This article is posted at the AWM Web site.*

Two-Body Problem

The two-body problem of professional couples seeking jobs together is of particular concern for women mathematicians, who are frequently paired with men mathematicians. Enlarged and rephrased as "Is Geography Destiny?", this topic was discussed by a panel at the San Antonio meeting in January 1993 [MJ93]. Susan Landau praised departments with programs to assist spouses in finding positions, but concluded: "With rare exceptions, the problem of the two-career academic couple has been viewed as the problem of the individuals involved. That is a narrow view, as this complication affects a majority of women scientists" [MA94]. Beth Ruskai responded that single women also have difficulties and included some surprising data about their relative advancement, and James Humphreys pointed out the even greater difficulties faced by gay partners [MJ94].

Children

A central issue for nearly all professional couples, the child-care-maternity-leave policy issue has occasionally been addressed by AWM. In the beginning, when AWM was striving to be taken "seriously", there were doubts about whether this was a relevant subject for AWM. Now that women are more numerous in mathematics study and at entry levels of careers, this problem has become identified as an impediment to their advancement. The prime childbearing years often coincide with the years in which a female mathematician is establishing her career and working toward tenure. There is no consensus on an appropriate resolution to this conflict. Some women decide not to have children; others choose to give family concerns priority while hoping their careers will survive. Some couples postpone having children until after a tenure decision is made. Others manage reasonably successfully to combine two careers, marriage, and children. To young female professionals, this decision about childbearing may be serious and all-consuming. Some found the discussion between men and women mathematician parents of different ages in the January 1998 AWM panel on "Mathematicians and Families" to be particularly helpful [MA98].

From time to time, queries have come to AWM regarding child care at meetings, but the meetings staff at AMS say the need for liability insurance has made the cost prohibitive. Moreover, attempts by AWM to arrange cooperative child care have not received much business from parents. As for maternity leave, policies at most institutions have been nonexistent or haphazard; in 1991 a sample maternity leave policy to show employers was drafted by AWM [MJ91].

Nature vs. Nurture

AWM members and supporters have continually been obliged to expose pseudoscientific arguments that women have inherent mathematical deficiencies. There was a flurry of eloquent letters about this in the early 1990s, to the effect that cultural factors were sufficient to overwhelm any possible inborn component for differences in measured mathematical abilities between males and females [SO90, ND90, MA91, MJ91, JA91, JA92, MJ93, JA93].

AWM members, having fought to encourage young women in mathematics, were outraged when Mattel created a Barbie doll who said, "Math is tough"; the doll was eventually recalled (which probably made her especially valuable for collectors) [ND92, JF93].

Sexual Harassment

An AWM statement on sexual harassment was published in the *Newsletter* [ND93] and again in [MJ97]. The prominent case of Anita Hill, a female law professor at Oklahoma who testified at the confirmation of Supreme Court Justice Clarence Thomas that he had once sexually harassed her, was discussed in some *Newsletter*s. In [JF92] a letter from Marjorie Senechal and Jean Taylor asserts: "Why did women mathematicians wait all these years to say anything about this issue, even to one another? Because, until Anita Hill's testimony, sexual harassment has been a private embarrassment."

Teaching Evaluations

In an article "Are student ratings unfair to women?" [SO90], Neil Koblitz analyzed data on student ratings of instructors by gender and concluded that students often rate the same performance differently for women and men. Women will be rated highly "only if they are especially accessible to the students and spend a lot of time with them, while men can receive equally high ratings while remaining more aloof." Also, "if an instructor feels compelled to put students under pressure [assigning a lot of homework, giving challenging exams], then…most students are inclined to 'punish' the instructor [by giving low ratings]. There is considerable evidence that the 'punishment' is more severe if the instructor is female." A psychologist agreed, "Female professors…appear to be evaluated according to a heavier set of expectations than are male professors, and these expectations affect student ratings. … Those of us who evaluate female faculty must be alert to the various and subtle ways in which gender bias can affect perceptions and evaluations" [SO94]. Koblitz's article has been widely circulated by women mathematicians, who have found it useful in conversations with chairs, deans, and other administrators, not to mention graduate students and their fellow mathematicians.

Policy Matters vs. Individual Cases

The case of Jenny Harrison, a University of California at Berkeley mathematics department faculty member who was denied tenure and fought the decision, shook up the academic community and

AWM business meeting, San Diego, January 1997. Left to right: Rebecca Struik, Chandler Davis, Lee Lorch (with microphone), Helen Moore, M. Beth Ruskai, Jean Taylor (AWM president 1999-2001).

commanded media attention. AWM members were divided about the case but were united in the opinion that AWM takes positions on policy matters, not individual cases [ND92, SO93, ND93].

Lobbying

The 1990s have been marked by increasing activism within AWM to encourage adequate funding for mathematics by the U.S. government. In 1997 AWM officials joined with officials of the AMS, SIAM, MAA, and a hundred other scientific societies in a concerted effort to lobby the U.S. government in support of science (including mathematics) and education. AWM representatives participated in a press conference; spoke to congressional representatives, senators, and aides; and encouraged AWM members to help with this effort. Before this lobbying effort, funding in stable dollars had been decreasing for science and technology. Some legislators adopted science as something positive to promote, something that inspires general approval by the public, and as a result the NSF fared better than expected with a 4.7% increase (in real dollars) for 1998 over 1997. (For research the increase was 5% [MA97].)

International Issues

AWM's membership is international, and many of the issues it addresses are of concern outside of America. European women were inspired by AWM activities at the ICM in Berkeley in 1986 to found a sister organization, the European Women in Mathematics (EWM). At many ICMs, AWM has discussed problems encountered by women with other groups of women in mathematics. As a result of one of these discussions, EWM compiled a list of the percentages of women mathematicians as of 1994 in each of the various European countries [ND94]. The highest percentages of women in mathematics were in Portugal (40%–50%), Georgia (40%), Italy (35%), Poland (30%), and Bulgaria (30%). The lowest were in Iceland (0%), Finland (2%), Switzerland (2%), The Netherlands (4%), Ireland (5%), and Sweden (5%).[14] In the Italian education system, typically a mathematics student begins advanced, specialized work at an earlier age; this makes it easier for women to combine a career in mathematics with having children.[15] Terng described her impressions of the situation for women mathematicians in China, where changing education and other policies seem to have caused the percentage of women in mathematics to decline [JA95]. There are few women in mathematics in South Africa [SO97] and Morocco [JF98].

Milestones of the 1990s

The following milestones show that the climate and the opportunities for women in mathematics in the 1990s are much brighter than in the past. Credit for the many wonderful accomplishments being made by individual women mathematicians goes to these individuals, although AWM can certainly claim credit for bringing to public awareness the previous lack of women.

Speakers at ICMs

Before the 1990s, Emmy Noether (in 1932) had been the only female Plenary Lecturer at an International Congress of Mathematicians (ICM). Then in 1990 (Kyoto) Karen Uhlenbeck was a Plenary Lecturer, in 1994 (Zurich) Ingrid Daubechies and Marina Ratner both were, and in 1998 (Berlin) Dusa McDuff was one of 21 Plenary Lecturers that year. In 1994, 8 other women delivered Invited Addresses at the ICM (out of a total of 152); in 1998, 11 did (out of a total of 165). Furthermore, in both 1994 and 1998 AWM and EWM jointly sponsored an Emmy Noether Special Lecture at the ICM, which was given by Olga Ladyzhenskaya in 1994 and Cathleen Morawetz in 1998. In the U.S. each January Joint Meeting from 1993 to 1998 has featured at least four invited hour addresses by women (including the AWM Noether Lecture as one of these); the specific numbers are five, four, eight, four, five, five. At the summer Mathfests in the 1990s, the Hedrick Lectures have twice been given by women. In fact, the major mathematics organizations have established guidelines that encourage organizers to include women; women often have leadership positions in these organizations or serve on program committees for meetings.

[14] *The only data found for West Germany were from 1987, when the percentage was 3%.*

[15] *Some Italian women have added that mathematics in Italy has less prestige than in other countries and that mathematicians' salaries are low, and these could be results of or reasons for more women.*

Governance by Women in Mathematical Organizations

In 1996 Cathleen Morawetz and Margaret Wright, presidents of AMS and the SIAM respectively, were part of an even more remarkable phenomenon: during that year women presided over eleven major organizations for mathematical scientists and educators in North America plus the umbrella scientific society, the American Association for the Advancement of Science.[16] A number of these women were not the first female presidents of their organizations (for example, Julia Robinson was the first female AMS president, and mathematician Mina Rees the first female AAAS president), but it was extraordinary that so many women were presidents simultaneously. Many women mathematicians are active in all these organizations, as well as in the MAA (which had three female presidents in previous years), both in governance positions and as organizers and speakers at meetings.

Mathematics Competitions

For the first time in the twenty-four years of U.S. participation in the Olympiad, the 1998 U.S. team included a young woman, Melanie Wood, a silver medalist from Indiana. For the first time, the Canadian team included two young women: Mihaela Enachescu of Westmount, Quebec, and Yin (Jessie) Lei of Windsor, Ontario. Among the top twenty countries there were thirty-eight women.

Summing Up: The Effect and the Future of AWM

In its twenty-seven years of existence, AWM has helped, encouraged, and inspired many female mathematicians in the early years of their careers. AWM has poured an enormous amount of energy and resources into programs improving the representation and climate for women in mathematics. As past-president Terng said recently, "[As a result of AWM] about half of the undergraduate degrees in math are now women, and there are many more strong young women researchers. Many departments are more conscious about the need for putting more effort into nurturing their women students." The AWM Sonya Kovalevsky Days, the publications, and all the efforts by AWM to make women more visible in mathematics have been effective.

Men Special to AWM

Many men have participated in AWM panels, contributed articles to the AWM *Newsletter*, and nominated women for AWM prizes (particularly the Schafer Prize). Many male officers and employees of mathematical societies and government agencies have been extremely supportive of AWM activities. But four men have been especially praised in the *Newsletter* during the 1990s for their contributions to AWM and the advancement of women in mathematics. The first two are Lee Lorch and Chandler Davis for their support, advice, and assistance to AWM. "While our founding mothers were creating AWM, twenty-one years ago, Chandler was at their side," said the AWM message honoring Davis at his retirement party [ND92], and he quietly continues his assistance to this day. AWM honored Lee Lorch with a citation in January 1992: "To Lee Lorch, a founding member of AWM. … Lee has often been a thorn in the side of the mathematical establishment. But then, to its credit, so has AWM. … That mathematics has become more receptive to women and minorities owes much to Lee" [MA92].

The late Lipman Bers and Wilhelm Magnus were both eulogized in *Newsletter*'s of the 1990s for their remarkable mentoring and success with women graduate students. Of Bers's 48 Ph.D. students, 16 were women [MJ94]; Magnus had 14 women Ph.D. students among his total of 62 [JA91].*

**The AWM* Newsletter *is interested in publishing accounts of other particularly successful mentors for women in mathematics.*

There are still many ways that the situation for women in mathematics could be improved through further efforts by AWM. The current and future plans for AWM are in three areas: (i) infrastructure and funding, (ii) outreach projects, and (iii) networking.

In order to achieve results for women in mathematics and even to continue past successes, the infrastructure of AWM must be maintained and improved. AWM must have a well-functioning office, with its finances in good order, and operate with a good governance structure. AWM must also continue to pursue funding for its current high-quality programs.

In the area of outreach, AWM hopes to expand its high school programs, such as the Sonya Kovalevsky Days and the *Careers That Count* booklet, and to extend its efforts to the elementary grades. AWM hopes to cooperate more with other organizations to increase the participation of women in mathematics and science. At the undergraduate level, AWM hopes to help persuade more women undergraduates to study mathematics, to expose them to more women in mathematics, and to aid them in the process of learning mathematics so that they can succeed at a wide variety of graduate programs. At the graduate level, AWM will continue to encourage and assist with the formation of Noetherian Ring chapters (support groups for graduate students). AWM hopes to offer better mentoring of more recent

[16] *American Mathematical Association for Two-Year Colleges: Wanda Garner; AMS: Cathleen Morawetz; Association of State Supervisors of Mathematics: Mari Muri; American Statistical Association: Lynne Billard; AWM: Chuu-Lian Terng; Canadian Mathematical Society: Katherine Heinrich; Institute of Mathematical Statistics: Nancy Reid; National Council of Teachers of Mathematics: Gail Burrill; National Council of Supervisors of Mathematics: Bonnie Walker; SIAM: Margaret Wright; Sociedad Matemática Mexicana: Patricia Saavedra; AAAS: Rita Colwell.*

Ph.D.s and advanced graduate students, and, in particular, to set up more mentoring pairs at the annual meetings. Such a mentoring program might also involve midcareer women.

As for networking, AWM intends to expand its efforts to connect women in mathematics at all stages, from K–12 students on up. It hopes to strengthen communication between AWM and the mathematical community, between women in industry and labs and women in academia, and between AWM volunteers and people from around the world. Furthermore, AWM intends to continue to enlist the aid of other organizations to monitor and speak out about inequities for women and underrepresented minorities and to work to reduce them.

Finally, here are some ways that people can assist AWM and the status of women in mathematics:

- Support and mentor women—junior faculty, undergraduates, and graduate students.
- Offer rigorous undergraduate programs and encourage women to take them.
- Encourage undergraduate women to apply for Research Experience for Undergraduates programs.
- Form support groups for women graduate students (e.g., a "Noetherian Ring").
- Join and help AWM, contribute articles to the *Newsletter*, and encourage others, especially young women, to join AWM.

Senior mathematicians may not realize the marvelous effect an encouraging comment can have on the ego of a young woman (or man) versus the negative effect of a tepid or disparaging comment. Our whole profession benefits from helping beginning and midcareer mathematicians attain their potential. AWM, or any organization that assists in developing future mathematical talent using the experience and expertise of established mathematicians, makes an outstanding contribution to our profession.

As Cora Sadosky observed, "Our Association really makes an impact on the situation of women in mathematics. And it is a great privilege to work for something that matters. … Many gains have been made in the twenty-two years of existence of AWM. Still, women continue to face formidable problems in their development as mathematicians—from elementary school to graduate school to the National Academy and beyond. To successfully confront these problems, we need the ideas and the work, the enthusiasm and the commitment of all—students and teachers and researchers and industrial mathematicians—of every woman and every man who stands for *women's right to mathematics*" [MA93].