

**The Association for Women in Mathematics:
How and Why It Was Founded, and Why It's Still Needed in the 21st Century
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It's 2011 and the Association for Women in Mathematics (AWM) is celebrating forty years of supporting and promoting female students, teachers and researchers. It's a joyous occasion filled with good food, warm conversation and great mathematics—four plenary lectures and eighteen special sessions. There's even a song for the conference, titled " $((3 + 1) \times 3 + 1) \times 3 + 1$ Anniversary of the AWM" and sung (robustly!) to the tune of "This Land is Your Land" [ICERM, 2011]. The spirit of community and the beautiful mathematics on display during "40 Years and Counting: AWM's Celebration of Women in Mathematics" are truly a triumph for the organization and for women in mathematics.



Participants from the Special Session in Number Theory at AWM's 40th Anniversary Celebration. Back row: Cristina Ballantine, Melanie Matchett Wood, Jackie Anderson, Alina Bucur, Ekin Ozman, Adriana Salerno, Laura Hall-Seelig, Li-Mei Lim, Michelle Manes, Kristin Lauter; Middle row: Brooke Feigon, Jessica Libertini-Mikhaylov, Jen Balakrishnan, Renate Scheidler; Front row: Lola Thompson, Hatice Sahinoglu, Bianca Viray, Alice Silverberg, Nadia Heninger. Photo Courtesy of Kiran Kedlaya.

[Song Sidebar (see below)]

Rewind forty years and the picture is very different. Take a few dedicated women and imagine the kinds of discussions they had at the 1971 Joint Mathematics Meetings in Atlantic City. Diane Laison, who attended that meeting, said, "This was during a period of much ferment; the position of women in mathematics was terrible and the assumption that girls and women could not understand/study/achieve in mathematics was very strong. Eventually something would have

happened. But that AWM was founded then and developed into such an important and strong organization is intimately tied to Mary Gray, her incredibly hard work, determination, organizational ability, connections, and smarts” [Laison, 2014]. With Mary Gray at the helm, AWM created a balance in which the organization was just separate enough from the existing structures to have freedom and flexibility, while maintaining an essential connectivity to the broader mathematical community to help achieve its goals.

Others have already written wonderful articles about AWM’s activities during its first several decades [Blum; Taylor & Wiegand]. In addition, all 43+ years of past and present issues of the *AWM Newsletter* are freely available online [AWM, 2014a] to both members and others, thanks to a generous donation by past AWM president Jean Taylor to digitize years 1971–2005. So we will focus on how and why AWM was formed and the active role it continues to play in the lives and work of girls and women. We’ll give some examples of how events and programs with their origins early in the history of AWM have led to new programs begun in the 2010s. To understand fully the emergence of AWM and its interconnections with the mathematical community and society, we’ll look back and reflect on how the advancement of the organization, and of women in mathematics in general, grew in tandem with changes in the overall status of women in the United States.

The First Wave

It all began in the mid-1800s with the formal organization of the women’s suffrage movement. In 1848, a small group of women in the village of Seneca Falls, New York, placed a notice in their local newspaper for “A Convention to discuss the social, civil, and religious condition and rights of Woman” [National Parks Service, 1994]. Among the leaders of this group were well-known abolitionists Elizabeth Cady Stanton and Lucretia Mott, who brought with them years of experience in advocating for social change. Eight years earlier, Mott and other women who had been sent as official representatives of the American Anti-Slavery Society to the World Anti-Slavery Convention in London had not been allowed to participate; this refusal planted the seeds for the later gathering. On the first day of the Seneca Falls Convention, organizers were surprised to find that their small notice had drawn a crowd of about three hundred people, forty of them men, including former slave and charismatic speaker Frederick Douglass. By the convention’s closing sessions, a hundred women and men had signed the Seneca Falls Declaration. Although the word “feminism” would not be widely used in the United States until about a hundred years later, most historians today believe that Seneca Falls began the first wave of feminism in the United States. Similar movements were taking place in Canada and Great Britain. Advocates of women’s suffrage saw the ability to vote as the first step in breaking down social and legal barriers faced by women at the time, preventing full expression of reproductive rights, equal access to education, and entry into professions that had traditionally been denied to them. Despite enormous backlash and opposition over the next seventy-two years, the hard work of the suffragists culminated in 1920 with the ratification of the 19th amendment to the Constitution, which granted women the right to vote. Sadly, only one signer of the original declaration lived long enough to enjoy the heady experience of voting for the first time.

While women had to wait more than seventy years from the time of the 1848 declaration for the right to vote, there were many successes for women before that critical victory, including some in mathematics. The first PhD received by a woman in the United States in any discipline was awarded in 1877, about two years after mathematician Sophie Kowalevski received one of the first doctorates earned by a woman in the modern era. Nine years later, Winifred Edgerton Merrill was the first woman to earn a PhD in mathematics in the U.S., from Columbia University. Between 1886 and 1900, just about a dozen math PhDs were awarded to U.S. women. Other women, including Christine Ladd-Franklin, made inroads and overcame barriers, even when they were not formally recognized until later. Ladd completed all of the requirements for a PhD in mathematics at Johns Hopkins University in 1882, about four years before Merrill's degree, but the university's overly conservative trustees were unwilling to set a precedent by granting a PhD to a woman [Jacob, p. 4]. Although Ladd-Franklin's thesis was published in 1883, she received her degree in 1926, 44 years late!

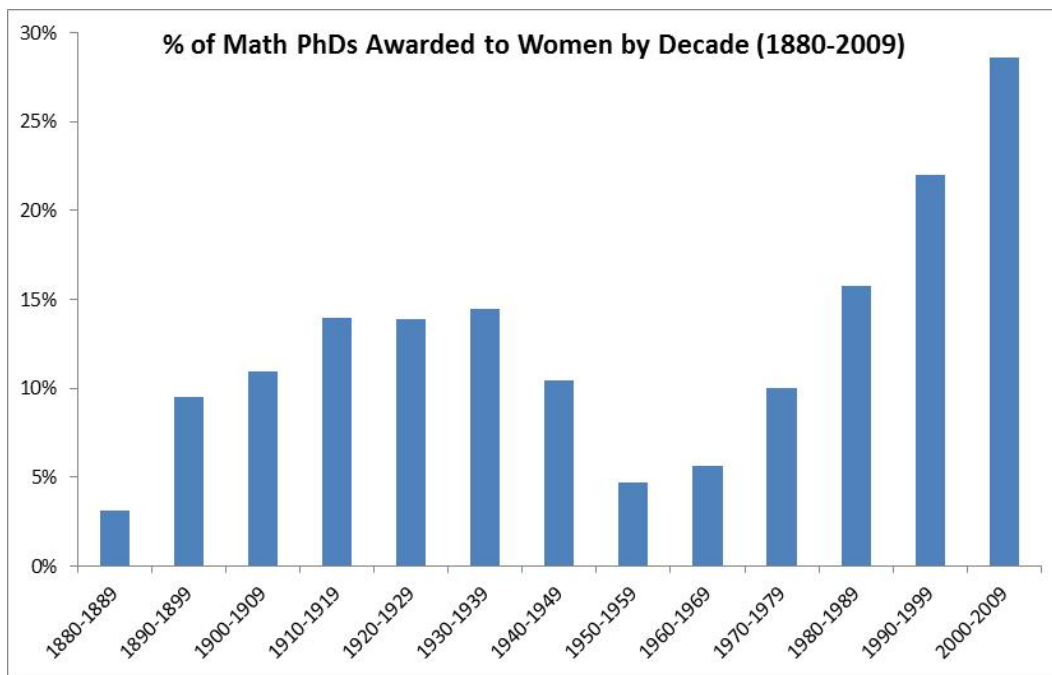
Women's colleges such as Wellesley and Vassar educated and employed women mathematicians, preparing new generations of women who would go on to work or earn advanced degrees in the next several decades. Women were also active in the professional sphere of mathematics. For example, the registration records of the 1893 International Mathematical Congress held in Chicago show that four of forty-five participants were women, namely Vassar professor Achsah Mely and three graduate students [Green & LaDuke, 1989, p. 382]. When the Mathematical Association of America was founded in 1915, 12% of its charter members were women [op.cit., p. 384]. The increase in educational opportunities for women and the greater participation of women in professional mathematics activities in the late 1800s and early 1900s are reflected in the growth of the number of U.S. women earning PhDs in mathematics through the 1930s [Murray, p. 5].

A Trough

World War II significantly changed the social and professional landscape within the United States, even before Pearl Harbor and the country's formal entry into the war. Many women entered the workforce for the first time. Others who were already working, including minority women in traditionally female service industries, had the opportunity to move into higher-paying jobs that had previously been held by men. This was also true in mathematics, where women, including some who had been barred from academic positions by anti-nepotism rules, were hired by mathematics departments to replace absent male faculty. Women continued to pursue graduate degrees in mathematics at this time, though in somewhat smaller numbers than in the 1930s. In 1943, Euphemia Lofton Haynes became the first minority woman known to have earned a PhD in mathematics in the U.S. For a few years after the war, the influx of former servicemen taking advantage of the GI Bill continued to provide faculty jobs for women in mathematics, even with the return of their male colleagues. Despite a robust post-war economy, a slowing or even reversal of many of the gains U.S. women had achieved was underway, against the backdrop of the emerging Cold War and the McCarthy-led zealous campaign against Communism. By the 1950s, the "American ideal" was increasingly a gender dichotomy in which men were the financial providers, while women stayed out of the paid workforce to care for homes and children. From the earliest levels of elementary school through the highest ranks of government and

industry, girls and women were routinely discouraged from pursuing either higher education or careers. The broad cultural permeation of these ideas was especially damaging. At the same time, the field of mathematics, which had played a significant role in the war effort, continued to grow in power and prestige [Murray, p. x]. Furthermore, teaching became a higher-status career than it had been in the past [Rury, p. 41], which attracted more men to its ranks. The percentage of all mathematics PhDs earned by women in the 1950s was about half of what it had been in the 1940s, and roughly a third of the share in the decades from 1910 through 1939 [Murray, p. 5] (see graph below).

As the 1960s began, the socially acceptable paths open to women reflected the narrowing of scope of the 1950s. For many, the expectation was that they would marry shortly after finishing high school, start families, and devote their lives to homemaking and other unpaid “feminine” pursuits. Even so, more than one-third of women over the age of sixteen were working or looking for paid work in 1960 [Mandelson, p. 4]. These women typically earned less than men and were often denied advancement. In December 1961, President John F. Kennedy established the President’s Commission on the Status of Women to examine workplace issues and legislation relating to women in the workforce. What is now commonly referred to as the Peterson Report, issued by the commission in 1963, gave recommendations on topics such as equal opportunity, affordable child care, and paid maternity leave. New legislation and rulings followed, including the Equal Pay Act of 1963 and the Equal Employment Opportunity Commission’s 1968 ruling that prohibited gender-segregated job advertisements. Other entities also established similar groups to address the needs of their constituents. Some of these issues remain (consider affordable child care and paid maternity leave), but many changes did occur—not quickly enough perhaps, but changes were made. Witness the upward trend from the 1950s in the graph that follows.



Data Source: National Science Foundation and Murray, pp. 4–5.

The Second Wave

During the late 1960s and the early 1970s, the second wave of feminism surged—with good reason. As with the first wave of feminism, its emergence was both in parallel to and in collaboration with other groups concerned with rights and social change, including the anti-war movement, the civil rights campaign, and the activist “New Left” political ideology, with whom it shared overlapping philosophies and goals. Notably, the Society of Women Engineers (SWE) had been formed in 1950, and the organization was growing in prominence in the 1960s, demonstrating the viability of women’s professional organizations. Similar forms of activism appeared within the mathematics community. An organization known initially as Black and Third World Mathematicians began meeting in January 1969; it was formally organized as the National Association of Mathematicians (NAM) in 1971 [Williams]. That same year, AMS created the Committee on Opportunities for Disadvantaged Groups to address civil and gender rights, though some became frustrated with its lack of progress [Pitcher, pp. 291–293]. In the late 1960s, groups of women mathematicians began meeting in the Boston area; many members of this “Boston mafia,” including especially Alice T. Schafer, were early members of AWM.

The Mathematics Action Group (MAG), which began meeting by the end of the 1960s, was especially important in the history of AWM’s founding. MAG was concerned about the militarization of mathematics and the lagging achievement of both civil and gender rights in our society. Numerous people involved with MAG would later become active in AWM: these included Joanne Darken, Chandler Davis, Mary Gray, Judy Green, Diane Laison, Lee Lorch, Harriet Lord, Gloria Olive, Francoise Schremmer, Annie Selden, and Ruth Silverman [Kenschaft, p. 131].

Several of these early AWM members got their start in activism outside the mathematical community in the civil rights movement. In the 1940s and 1950s, Lee Lorch worked for housing rights in New York City and school desegregation in Little Rock, Arkansas, and he served as an official in a local Arkansas chapter of the National Association for the Advancement of Colored People (NAACP). As a result, he was subjected to retaliation that led to much personal sacrifice for him and his family. With no options left for jobs in the United States, Lorch moved to Canada, although he remained active in mathematical organizations that were U.S.-based, including AWM. Joanne Darken, who was instrumental in the founding of AWM, participated in a Congress for Racial Equality (CORE) project to register black voters in Louisiana during the summer of 1964. This was dangerous work that required both commitment and dedication—one night Darken’s car was even shot at while she was driving [Frystak, p. 188]. Darken noted: “It’s been said that the Civil Rights Movement served as an inspiration for the Women’s Liberation Movement, and being personally involved in the former likely heightened my consciousness re the latter” [Darken, 2014]. Diane Laison, another early AWM member, participated in the 1965 civil rights marches from Selma to Montgomery. The interconnections among different kinds of activism go both ways. For Mary Gray, who was involved in the civil rights and anti-war movements during the 1960s, work with MAG and then AWM led her to broader human rights advocacy in the years that followed.

A New Organization: AWM

At a 1971 meeting of MAG in Atlantic City, Joanne Darken stood up and suggested that those who were interested in women in mathematics stay and meet afterwards—and that’s how the organization began. Of course, it was not quite that easy. The people who stayed did so “against the advice of the male chair of the MAG meeting” [LaDuke et al., p. 11]. We don’t know why the chair objected. Maybe he thought a new organization with a feminist focus would weaken MAG. However, we think it’s more likely that no matter how activist MAG was and how open it was to women’s rights, in the early seventies it was simply still expected that leaders were male. As Mary Gray noted, “We all got tired of licking envelopes while men took leadership roles” [Gray, 1991, p. 7]. We asked Darken to comment on her motivation and initiative to rise up and organize what would become AWM, and she recalled:

The women’s movement was underway, and I’d had my share of the sort of experiences (in mathematics and out) that motivated the movement. I don’t believe I went to Atlantic City with the idea of proposing a caucus, and I don’t remember anything specific at the session to inspire it. But at that time comments and implications that would now be regarded as offensive were common so it’s very likely I heard something there that reminded me women were not held in high esteem in the mathematics community. Uniting for change was an idea whose time had come, or perhaps was a little overdue.
[Darken, 2014]

Darken’s call to action was a pivotal moment in AWM’s founding, but Mary Gray’s innumerable contributions powered the impetus. Many AWM members, including Lenore Blum, Joanne Darken, Judy Green, Diane Laison and Annie Selden, specifically attribute the founding and success of the early organization to Gray, the first president, who Blum calls “the mother of us all” [Blum, 1991].



Mary Gray, 1966. Paul R. Halmos Photograph Collection.

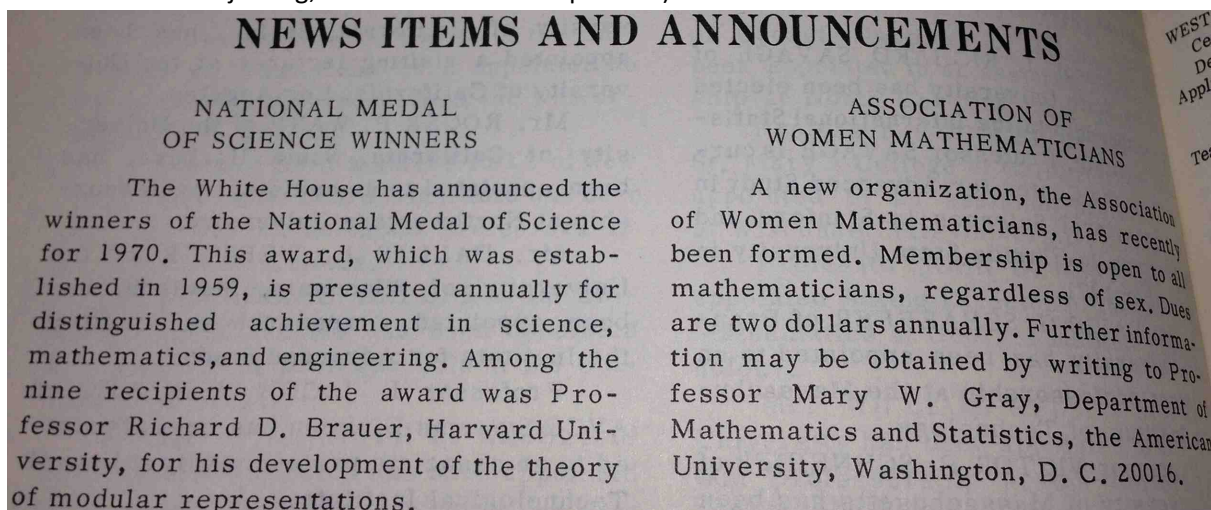
The pioneers of AWM made a conscious decision to create an independent organization outside of the governance structures of the larger established professional societies such as the American Mathematical Society (AMS) and the Mathematical Association of America (MAA). Just a couple of years before, in 1969, AMS members had rejected action on certain kinds of political and social issues and reaffirmed a focus on mathematics scholarship and research [Pitcher, pp. 300–303]. Also, at the time many people felt that the AMS was under the control of the white male establishment. Concurrently, advanced study and research were not major concerns of the MAA, which focused instead on the collegiate field [Jones, p. 10], so existing under the purview of the MAA would have allowed the powers-that-be in the AMS to suggest that AWM was “just those teachers.” Thus neither the AMS nor the MAA seemed like a proper home for AWM. The advantages of forming an independent association outweighed the challenges of doing so.

The difficulties that women in mathematics had faced over the years provided ample motivation for AWM to succeed in meeting those challenges. Mary Gray said of this choice, “I realized that AWM as a separate entity would have a struggle to be taken seriously, but I figured we would just keep pushing.... It prompts me to say that Lee [Lorch] certainly was an encouraging force in the early days of AWM. I am sure his decades of experience with AMS lack of action on minority issues was helpful to me in seeing why we had to do it on our own” [Gray, 2014]. Despite both legal and social advances in the 1960s, many barriers to women’s advancement in mathematics still existed, including nepotism rules and exclusionary or patronizing attitudes expressed by male colleagues. It was rare to find a woman acting in a significant leadership role in the AMS at that time, or receiving major recognition for her mathematical accomplishments [Green & LaDuke, 1989, p. 393]. As a self-governing group, AWM gave women in mathematics new opportunities to serve in professional roles of responsibility and authority within the community, along with a chance to have a voice in the direction and activities of the organization. The *AWM Newsletter* provided an independent forum for disseminating ideas which might not otherwise have appeared in print. Mary Gray edited the newsletter for the first few years, starting with the inaugural issue in May 1971, when the organization was just a few months old. Panels at meetings, whether local, regional or national, were another outlet for the discussion of important issues. And the eldest of we three writers recalls the simple pleasure felt by women mathematicians, who were often isolated in their departments, in spending time with other women at mathematical meetings.

Separate but Connected

However, in no way did AWM try to distance itself from the other professional societies—quite the opposite. While AWM wanted to maintain its autonomy, it also desired to be accepted in the broader mathematical community as a professional society, not just as a mathematical “consciousness raising” group. Thus AWM built on previous ties of its leaders and membership and developed new relationships within that larger community, in part to help build its professional reputation. For example, just a month after its inception, in February of 1971 the new organization was included in the “News Items and Announcements” section of the *Notices of the AMS* [p. 334] as the Association of

Women Mathematicians. (It was Lee Lorch who suggested that the name be changed to the Association for Women in Mathematics, to be more inclusive to a broader audience, in particular to make it easier for men to consider joining; this was soon accomplished.)



Notices of the AMS, February 1971, p. 334

Whether or not its goals were accepted in full (and often they were not!), AWM was quickly recognized and supported by the community in important ways. Mary Gray acknowledged the assistance of AMS staff members, especially Hope Daly, during the early years of the organization. (In fact, Daly remained a valiant supporter of AWM until her retirement, and the Meetings Department of AMS has continued that support through the present day.) Beginning in August 1972, AWM's business meetings and panel discussions were regularly listed in the meetings program in the *Notices of the AMS* [p. 222]. An AWM panel on part-time positions held at that year's summer meeting wasn't specifically mentioned in the *Notices*, but in November 1972 [p. 344], the AWM events at the January 1973 conference, its business meeting and a panel on employment and affirmative action, were listed. The first mention of AWM in the *MAA Monthly* appeared within a report on an August 1971 MAA panel on women in mathematics [November 1971, p. 1049]. The Philadelphia Chapter of AWM authored an article in the October 1973 issue [pp. 903–904]. Announcements of upcoming AWM meetings began in the October 1974 issue [p. 944]. In 1974, AWM sponsored two panels at the Vancouver meeting of the International Congress of Mathematicians (ICM), one on the status of woman mathematicians around the world and the other on women mathematicians and employment in North America [*AWM Newsletter*, September 1974, p. 1].

As AWM grew, imagine the letters between Mary Gray and Alice Schafer, exchanging hopes and ideas. In a December 28, 1973 letter [Wellesley College archives], Mary Gray acknowledged the importance and challenges of obtaining and staffing a well-placed independent informational table at conferences. She also explained that AWM had shared tables with MAG at earlier meetings. According to the January 1974 *AWM Newsletter*, the organization had its own table at the January Joint Mathematics Meetings, thanks to the work of Eleanor Palais. AWM's newsletter became increasingly important for keeping the organization's members both informed and connected [Greenwald, 2012]. In the words of past president Lenore Blum, "The *Newsletter* has since become the very embodiment of the AWM. From the

start, it was our forum for discussing the role of women in mathematics, for exposing discrimination, for exchanging strategies, encouraging political action and, affirmative action, for informing, supporting, honoring, and of course, for job listings (which first appeared in the February 1972 issue). It has been our key linkage with each other..." [Blum, 1991].

AWM Comes Into Its Own

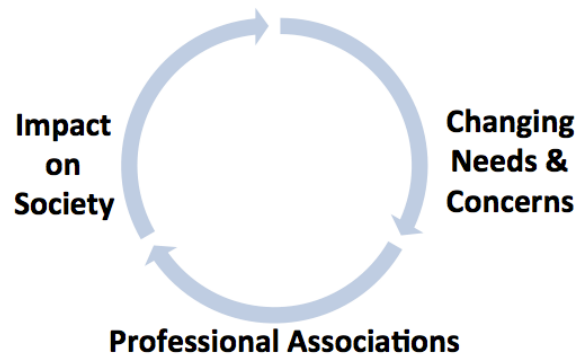
AWM grew rapidly. Under the leadership of second president Alice T. Schafer, it was legally incorporated in 1973 and received tax-exempt status in 1974. Concurrently, the efforts of AWM and MAG members resulted in important changes in AMS legislation and attitudes about discriminatory practices. For example, in 1973 the AMS Council endorsed a resolution about equal opportunities for women [Pitcher and Bateman, 1973, pp. 660–661]. Diane Laison introduced several resolutions at the 1973 Business Meeting for discussion in 1974: "After a year of debate and a spirited floor fight, there was a substantial victory for AWM (as well as a victory for MAG, which helped birth AWM), contributing significantly to the pressure for change in the AMS" [Laison, 2014]. Members at the 1974 Business Meeting strengthened a resolution on discrimination and thus endorsed "its categorical opposition to discrimination against mathematicians in matters of hiring, promotion, termination, tenure, and salary on the basis of race, sex, politics, religion, ethnic origin, age, or other non-professional characteristics" [Pitcher and Ross, 1974, p. 656]. While this statement may be quite commonplace today, at the time it was groundbreaking. The AMS members at the business meeting also put their money where their mouths were by approving the suggestion that the society provide loans to people who needed financial support to pursue discrimination lawsuits.

In 1976 AWM's legitimacy was further recognized when it became an affiliate member of the Conference Board of Mathematical Sciences (CBMS), after a process that was more extended than anticipated. What was the holdup? Although AWM had originally applied for CBMS membership in 1974 and had been accepted by the AMS and most of the other CBMS member societies, the MAA became concerned when the Midwest Category Seminar applied for affiliate membership in January 1975 and was also accepted by the AMS. Not until criteria for admission of affiliate members were created did the MAA vote to accept AWM; MCS did not meet the criteria. We are inclined to believe that MCS's application to CBMS was made to cause difficulties for AWM, because in spirit (as expressed later in the criteria), CBMS was never intended for organizations with regional missions. AWM members also achieved recognition in peer organizations. For example, Mary Gray became the second female vice president of the AMS in 1976; the first had been Charlotte Angus Scott in 1906—a gap of exactly 70 years.

Success Engenders Success

How do organizations enact change? With widespread recognition of AWM, advocacy became easier and more effective. AWM members envisioned a better future, and its grassroots efforts and action programs were designed to increase the participation of girls and women in mathematics, as well as to achieve greater recognition for the significant work done by women in mathematics. The organization

was able to celebrate and raise awareness of women’s accomplishments in many ways that were readily recognized within the mathematical community. At the same time, it responded to the new and changing needs of girls and women within the professional community and beyond.



How much of the victories for women in mathematics were due to AWM? Judy Roitman noted that “This is a false question... The AWM is the expression in the mathematical community of the broader feminist movement ... But without the AWM or some similar group (and I think it was an act of brilliance to form it outside of the existing mathematical organizations rather than a caucus within...) the changes for women would have been fuzzier and less specific, driven by affirmative action necessities (which are pretty minimal) and vague changes in public perception, and not directed by our own understanding of what has to be done” [Blum, 1991].

For example, although women’s participation and recognition were improving by the late 1970s, not many women were invited to deliver major lectures at important meetings. Measures were needed to encourage selection committees to be more attentive to the inclusion of members of underrepresented groups, but this campaign promised to be a lengthy one. At the 1978 ICM over five hundred people attended a special meeting called by AWM to protest the absence of women speakers [Blum, 1991]. Rather than wait for what did prove to be glacial change (it wasn’t until 1990 that Karen Uhlenbeck delivered the second ICM plenary lecture by a woman—a 58-year gap from Emmy Noether’s 1932 lecture) in 1980 AWM inaugurated the Emmy Noether Lecture series at the Joint Mathematics Meetings (JMM). What an achievement for a nine-year-old organization! This wonderful lecture series, now in its fourth decade of honoring women for their “fundamental and sustained contributions to the mathematical sciences” [AWM, 2014b], has showcased the work of eminent women mathematicians in a wide range of fields. A commemorative booklet called *Profiles of Women in Mathematics: The Emmy Noether Lectures* was published in 1994 to celebrate the depth and breadth of the work and lives of the early lecturers (an expanded version is now available online). That year also marked the beginning of an international Emmy Noether Lecture series, to be delivered at the ICM. Originally an ad-hoc lecture, with the presenter chosen jointly by AWM and European Women in Mathematics (EWM), it soon became a temporary plenary lecture of the ICM. In 2010 it was officially approved as a permanent plenary lecture, now called the ICM Emmy Noether Lecture, with the speaker to be chosen by the International Mathematical Union (IMU).

Based on the success of both Noether Lectures, in 1996 AWM and MAA launched a lecture series at MathFest to honor distinguished women in the mathematical sciences or mathematics education. It was renamed in honor of mathematician Etta Z. Falconer in 2004. During her lifetime, Falconer cited both Lee Lorch and fellow African American mathematician Evelyn Boyd Granville as mentors and was quoted as saying “My entire career has been devoted to increasing the number of African American women in mathematics and mathematics-related careers” [NAM, 1996].

In 2003, the AWM-SIAM Sonia Kovalevsky Lecture series was established; the lectureship may be awarded to anyone in the scientific or engineering community whose work highlights the achievements of women in applied and computational mathematics (we do not know if any have been nominated, but thus far no male speakers have been chosen).

The first Olga Taussky-Todd lecture at the International Congress of Applied Mathematicians (ICIAM) was given in 2007, under the auspices of AWM, EWM, and the organizers of ICIAM07. In 2008, this lecture became a permanent feature of ICIAMs, chosen by the officers and board of the International Council for Industrial and Applied Mathematics (also ICIAM); it honors outstanding women in applied mathematics and/or scientific computing. The lecture series is named in tribute to and in memory of Olga Taussky-Todd, whose scientific legacy is in both theoretical and applied mathematics, and whose work exemplifies the qualities to be recognized.

In 2013, the JMM Noether Lecture was renamed the AWM-AMS Noether Lecture, with the change formally debuting at the 2015 San Antonio meetings. Looking back, the inaugural Emmy Noether Lecture in 1980, “A Survey of Coding Theory” by F. Jessie MacWilliams (also in San Antonio), led to the successful establishment of five lecture series, one now sponsored by each of the IMU and the ICIAM and the others now co-sponsored by AWM and each of AMS, MAA and SIAM, the three major mathematical societies.

There have been many other AWM activities, both at its own conferences and other national and international conferences, which have built upon earlier successes and are designed to spotlight women and create new opportunities for community building. For example, there have been numerous symposia organized in honor or memory of individual women mathematicians—Emmy Noether, Sonya Kovalevsky, and Julia Robinson, to name a few. Special Sessions at the JMM have been organized by the Noether Lecturer for over twenty years to further highlight the work of the lecturer, along with showcasing the work of other women and of underrepresented groups. AWM expects the speaker lists for these special sessions to be especially sensitive to the latter goal, while still being open to male speakers. The 1991 20th anniversary celebration of AWM’s founding included the first in a successful series of annual workshops at the JMM and SIAM Annual Meetings for graduate students and postdocs. These workshops are but one example of AWM programs designed to provide financial assistance for students and early career women to travel to conferences and to interact with senior mathematicians. Although the student poster session component of these workshops remains open to all fields, AWM has recently changed the workshop itself to focus on a different field each time, in order to assist junior women to become integrated into their larger research communities. Community-building among

women researchers in particular fields is also the motivation behind the AWM conference series, which recently emerged from the success of the 40th anniversary celebration. A contract with Springer Publishing for proceedings of these conferences provides additional recognition for the participants and a lasting record of events. AWM panels at conferences are another ongoing activity that is intended to address a diverse array of topics that are of interest to AWM members. These discussions, which date back to the early seventies, have sometimes been contentious and even raucous, but at the same time they serve as a way to build community and address emerging issues.

The *AWM Newsletter* continues to be a primary means for communication among members. Its production methods and content have evolved with the organization and with the rapidly changing electronic world. Two of the authors of this article are currently deeply involved with the newsletter: Anne M. Leggett, Newsletter Editor since 1977, puts together six issues per year, with the assistance of Sarah J. Greenwald, Associate Editor since 2011. For Anne it was a particular pleasure no longer to produce camera-ready copy (whether by typewriter or by computer), as had been the case for many years, when in 2005 AWM began employing a graphic design professional. In 2009, under the guidance of a task force, the newsletter was redesigned and a new AWM logo was created. The organization retained its green and white colors, which had originally been chosen to match the Equal Rights Amendment (ERA) color scheme. For each issue, the Newsletter Team produces the Book Review column, Education Column, and Media Column. Other regular features include the President's Report and Mathematics Live!, a series of interviews with a wide range of women mathematicians. Recently the organization, via its website, has moved to an open access model for the newsletter to reach out to a broader community and bring together people who might not have been connected otherwise.

From the very beginnings of the organization local grassroots efforts were as important to women mathematicians as were meetings at conferences. Originally organized geographically, AWM members gathered in places like Berkeley, Boston, New Jersey and Philadelphia. International groups of women also organized, like European Women in Mathematics, who began meeting after the 1974 ICM but officially organized in 1986. Korean Women in Mathematical Sciences was founded in 2004. Unlike AWM, these two societies are open only to women members. As the number of women mathematicians grew, organization by geographic location has been complemented by conferences for women in various fields, such as Women in Numbers (WIN) and Women in Shape (WiSh). Students also organized groups—the AWM student chapter program was approved in 2002— to build communities at schools and universities.

The phrase “and girls” was not officially added to AWM's mission statement until the beginning of the 21st century, but its activities extended to younger women and girls much earlier and continue to evolve over time. The first Sonya Kovalevsky High School (SKHS) Mathematics Day was held concurrently with the Kovalevsky Symposium in 1985 [Case and Leggett, 2005]. Although the initial audience was high school girls and their teachers, the program has since expanded to include middle school girls. Historically Black Colleges and Universities and programs targeted toward inner city or rural high schools have been especially encouraged, given the additional difficulties that are often faced by minority women and girls who want to pursue careers in mathematics or other STEM fields. AWM has also

worked with students in other STEM venues, including the USA Science and Engineering Festival, where the AWM booths have been very successful. AWM honors both its second president and undergraduate women with the Alice T. Schafer Prize, awarded annually since 1990 to an undergraduate woman for excellence in mathematics. The annual Essay Contest, recently co-sponsored by AWM and Math for America, encourages interactions between students in middle school through college and women mathematicians in government, academia and industry.



AWM Volunteer Veronica Krenz Working with a Student at the AWM Booth
2014 USA Science and Engineering Festival

Choppy Seas along the Way

We don't want to give the impression that it has all been smooth sailing. Upon reflection, as with any organization, AWM has had its fair share of problems. Some of these issues were the natural result of the organization's growth and others are ongoing. It is especially fortuitous that Lee Lorch's criticism of the "of" in the early incarnation of the name came so early on in the organization's history. AWM could not have been as successful without the support of the men who are members. This name change was acted on immediately for the betterment of the organization. Other issues were not resolved so quickly (or at all). For example, one issue that has been a source of conflict within the organization from the very beginning and which remains so today is the militarization of mathematics. Some of AWM's members have felt that the organization should not accept funding from federal agencies, especially those connected with defense or intelligence (this was also a priority of MAG). However AWM currently has many programs that could not run without this funding.

In general, budgetary issues have existed from day one. These have been exacerbated by the ups and downs of the economy and the restrictions placed on federal funding. For example, many federal grants do not allow funds to be spent on staff salaries. Although the organization has occasionally obtained unrestricted funds from donor companies and organizations, it has never been very successful in fundraising. In fact, AWM has never been able to afford sufficient support staff to adequately manage

its multitude of programs, which places huge demands on volunteers. There have been other resource issues as well. After Alice Schafer's retirement, AWM had to move from its Wellesley office when the college needed the space for other purposes. It then relocated to the University of Maryland. When many AWM officers felt that the organization could no longer staff that office properly, nor afford to keep it running, AWM transitioned again to an office management firm. AWM has long felt that an Executive Director is necessary, in addition to all its volunteers. However, what sort of person best fits this position has been a source of contention among the officers. The recent model of a part-time Executive Director with release time and salary-sharing arranged with her university has been working well so far. It is not clear whether AWM will ever be able to afford the full-time position that it would prefer.

Many aspects of AWM's governance structure have been debated among its membership. To be successful as a woman mathematician, especially among the older guard, has not been easy for many, and the tactics some women have adopted to succeed, whether or not consciously, sometimes get in the way as they interact with their mathematical sisters. Strong personalities can both create and impede progress, as is true for many non-profit organizations. The transition between successive leaders has been difficult at times, due in part to differing experiences and priorities, as well as feelings of personal investment in AWM. Over the years there have also been tensions between those who identify primarily as researchers and those who identify primarily as educators, although they are hopefully less strong today.

In many ways, AWM's successful programs are an achievement of which members can be proud, but they also indicate a weakness, which is the tendency for the organization to spread itself too thin. Part of the problem is AWM's reluctance to let go of any program or project, whether or not it has been truly successful. One example is the Speakers' Bureau, a laudable initiative that just sort of fizzled out, where periodic suggestions are made that the program should be reinstated. Trying to be all things for all women mathematicians (and the girls who are potential future mathematicians) can be both exhilarating and exhausting, not to mention impossible.

Why AWM Is Still Needed

Given the changes in the professional mathematical community since 1971, there is anecdotal evidence that many young women (both students and junior faculty) wonder why they should join AWM, questioning whether it is needed in today's world. They may or may not understand that AWM members raised consciousness about professional issues including devastating cases of discrimination, undeserved differences in salary, disparaging comments about the role of women in the workforce, nepotism rules and an absence of child care at work that were once so common. The percentage of PhDs going to women has vastly improved since the dreary situation in the 1950s. Maybe the work is done: female graduate students who believe that they haven't been discriminated against yet don't expect poor treatment in the future. Those of us who have been members of AWM for many years wish they were right. Many workplace conditions that were far from optimal for women's success have improved greatly, but there remains plenty more to accomplish.

Case in point, according to a U.S. Department of Commerce report [2011], women in the United States held less than 25% of STEM jobs even though they held about half of all jobs. This government agency pointed to a lack of role models, gender stereotypes and less family-friendly flexibility in the STEM fields as possible factors. The report also highlighted the continued need to encourage and support women in STEM.

AWM has continued to create initiatives and to adapt in response to these and other societal needs and concerns. While role models and mentors are more readily available than in the past, due to an increase in the number of women mathematicians and to the numerous programs designed to increase the participation of girls and women in mathematics, women mathematicians are still far from proportionately represented in many contexts, ranging from employment in the tip-top research departments, to conference speakers and awards and even on Wikipedia pages. Hee Oh became the first woman tenured in mathematics in the 312-year history of Yale in 2013—this is fantastic, but what took so long? New AWM research prizes are intended to help mid-career women achieve the next level of success. The dearth of women receiving major mathematical recognition has long been a concern, and AWM has continued to push for women to receive their fair share of jobs, speaking invitations and mathematics awards. Years ago professional organizations like AMS and MAA agreed to start keeping statistics on how many invited women speakers there were and how many participants in special sessions were women. This effort has helped, but people still “forget” women and underrepresented minorities if not given specific reminders. So there are still situations in which the old boys’ network seems to rear its ugly head, for example, conferences with no women speakers. The Association for Women in Science (AWIS) received an NSF ADVANCE grant for 2010–2012 to fund the project “Advancing Ways of Awarding Recognition in Disciplinary Societies (AWARDS),” designed to create a sustainable framework for assuring progress towards more equitable rewards and recognition for women and members of underrepresented groups in a wide range of scientific communities. One outcome of this grant was a document listing best practices for selection committees. This has been another big step forward, but it has not transformed selection processes overnight, either. For example, the first class of AMS Fellows had a rather higher percentage of women in its ranks (partly because major prize winners, etc., were all snapped up in the first round) than the second class, which was only about 10%. Ruth Charney, AWM president from 2013 to 2015, began facilitating nominations of women for major prizes and awards, and Marie Vitulli, chair of AWM’s Policy and Advocacy Committee, has been working on how to close the Wikipedia gender gap.

Gender stereotyping also remains, although often in much more subtle ways than in the past. For instance, in a 2011 Statement on Fairness in Testing, AWM recommended ending the practice of asking people to mark down demographic information immediately prior to or during a test, because of the wide body of research on stereotype threat. However, this practice continues to be used in many testing situations. Regarding family-friendly policies, AWM and other professional organizations are working at improving child care at conferences. Harassment at professional conferences has also been a focus of recent efforts. From a different vantage point, a female high-school student wrote an article for the Education Column in the July–August 2014 *AWM Newsletter* accusing her male fellow students

of sexist attitudes towards girls in math classes. Sadly, although we believe that this kind of thing is less prevalent than it once was, it is clear that there is still much need for improvement.

But there is good news to tell this student and others. It's August 2014, and the IMU has finally recognized that there are women doing work worthy of its highest honor! AWM is so happy that Maryam Mirzakhani has won a Fields Medal. She was a plenary speaker at the 2013 AWM Research Symposium and had earlier received numerous awards, including the 2013 AMS Ruth Lyttle Satter Prize in Mathematics. Maryam has said: "This is a great honor. I will be happy if it encourages young female scientists and mathematicians. I am sure there will be many more women winning this kind of award in coming years." Right on!

Today there are more than 3000 members (both women and men) of AWM, continuing to work to effect positive change. The membership represents a broad spectrum of the mathematical community—from the United States and around the world. There is no question that women in mathematics and in society as a whole have taken many large strides since that long-ago gathering of suffragists and supporters in Seneca Falls, but the journey continues to be an uphill climb. Many of the issues that united AWM's founders, including barriers to professional advancement and work-life balance, are still faced by today's women and girls in mathematics. However, the hard work of AWM's founders, members, and supporters continues to bring to life the vision of a nurturing environment in which success in mathematics is not a matter of gender, and where women and girls can see growing numbers of others like themselves and enjoy one another's company as mathematicians and more. Despite the difficulties, we are happy to be making the climb together.

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Sidebar:

Selections from the AWM 40th anniversary conference song titled " $((3+1) \times 3+1) \times 3 + 1$ Anniversary of the AWM," lyrics by Kristin Lauter and Ami Radunskaya and sung to the tune of "This Land is Your Land" [ICERM, 2011].

*Did you ever wonder
At the Joint Math Meetings
Why there's no line at
The door marked Ladies
You know your network
Is not just graph th-eorrry
It's a way to make your own commu-ni-ty*

*This math is *your* math
This math is *my* math
From Galois Theory
To Elliptic P-D-E
From Lattice Crypto
To Pro-ba-bil-i-ty
This math is made*BY* you and me!*