

# Women Mathematicians in History: Contributions, Recognition, and Historical Context

**Dr. Prahlad Singh**

Assistant Professor & Incharge  
Department of Mathematics  
Govt PG College Bisalpur, Pilibhit, Uttar Pradesh, 262201

**Abstract-** Mathematics was often portrayed as the story of great men, but history proves otherwise. In ancient times, the Early Modern Era, during the development of the research university in the nineteenth century, and through the modern scientific state, women played roles in the development of mathematical thought and practice. They commented on mathematics, taught mathematics, produced textbooks, and made groundbreaking contributions to number theory, algebra, logic, geometry, elasticity theory, and computing. However, their success did not always translate into recognition. Women lacked access to education, entry into academies and universities, resorted to anonymous publications, received precarious or unwaged appointments, and were known for their relationships with eminent men. In this essay, it will be argued that the major historical trend lies in women's active involvement in mathematics coupled with their systematic exclusion from the processes of certifying achievements, awarding rewards, archiving accomplishments, and recalling mathematicians in institutional memory. Among the most notable women who worked in the field of mathematics will be mentioned Hypatia, Maria Gaetana Agnesi, Sophie Germain, Sofia Kovalevskaya, Emmy Noether, Grace Hopper, Julia Robinson, Euphemia Lofton Haynes, Maryam Mirzakhani, Karen Uhlenbeck, and Maryna Viazovska.

**Keywords-** Women in Mathematics, History of Mathematics, Gender and Science, Institutional Memory, Systematic Exclusion, Sophie Germain, Sofia Kovalevskaya, Emmy Noether, Grace Hopper, Julia Robinson, Euphemia Lofton Haynes, Maryam Mirzakhani, Karen Uhlenbeck, Maryna Viazovska, STEM Equity

## I. INTRODUCTION

An excellent history of women in mathematics will necessarily start by dispelling one popular misunderstanding: the idea that women have always been excluded from the practice of mathematics. The more accurate claim, based on contemporary historical research, is that women were indeed present but institutionally excluded, which in turn influenced the development of their potential and subsequent historiography. Gloria Hewitt notes that ignoring the role of women in the history of mathematics contributes to reinforcing the fallacy that math belongs to men, and the vast amount of documentation compiled by Judy Green and Jeanne LaDuke about women holding mathematics PhDs in America before 1940 shows that the involvement of women was more extensive than generally assumed. Yet the question remains, not just whether women contributed but whether women were allowed to study, write, lecture, occupy offices, win awards, or be recognized as canonized figures in textbooks.

### 1.1. Historical context: access, exclusion, and the making of mathematical authority

Throughout the greater part of recorded history, the challenges to be overcome by women

mathematicians have been largely institutional and not intellectual. The institutionality of mathematical prestige meant that it resided in places that women were forbidden to enter; whether these were ancient philosophical academies, medieval and early modern European universities, academies of science, professorial positions, journal editorial boards, or mathematical societies, they all represented institutions dominated by male scholars.

When women managed to participate in mathematical communities, they did so either in exceptional domestic situations, under tutelage, at convents, privately, or via scholarly letter exchange. If their results were sound, recognition would be slow in coming, since certification of merit lay firmly in male hands. In this way, one can understand why the contributions of women mathematicians have taken such diverse shapes. Some women have contributed through activities such as editing, commentary, and teaching rather than by writing a research article; some have written books that organized complex subject matter for their students; some have been employed in applications of mathematics such as wartime computation, aeronautical engineering, and education. The professionalization of mathematics

in the nineteenth and twentieth centuries created more avenues for participation, particularly with the expansion of universities and doctoral programs, but professionalization also raised the importance of credentials, which were not equally available to women.

## II. EARLY AND EARLY MODERN PIONEERS

Hypatia of Alexandria is the first female mathematician whose life story is fairly well-documented. Her significance is therefore symbolic and substantive. She was "the first woman to have made important contributions to the history of mathematics," says MacTutor, served as head of the Platonist school in Alexandria circa 400 CE, taught mathematics and philosophy, and worked on commenting on mathematical works related to the *Almagest* by Ptolemy. It is clear from what has survived from her era that she was important particularly for her teaching, transmission of knowledge, and intellectual leadership rather than for the existence of a body of her own scholarly work. The historical value of this point alone should be noted: in the late classical period, it was a major achievement to preserve and interpret knowledge in mathematics, not merely a subsidiary one.

Maria Gaetana Agnesi in eighteenth century Europe exemplifies another route to mathematics: advanced private tutoring along with outstanding scholarly diligence. The main accomplishment of Agnesi was the two-volume *Instituzioni analitiche ad uso della gioventù italiana* completed by her in 1748-1749 and contributing to her great renown as well as to presenting analysis systematically and clearly to Italian audiences. According to MacTutor, Agnesi's work did not include any substantial mathematical discoveries, and this should not be considered an indicator diminishing its importance. On the contrary, synthesis was the intellectual feat of that time since the stabilization of both calculus and analysis were needed in order to ensure their further development. Agnesi proved that women were able to influence significantly the mathematics community in terms of educational works despite the difficulty of joining the academic establishment. Moreover, it seems that the history of mathematics was misremembered in relation to Agnesi since the title she is mostly remembered for today is the witch of Agnesi.

The life story of Sophie Germain provides an even more dramatic illustration of the role played by exclusion in processes of recognition. After being

denied admission to the *École Polytechnique*, Germain acquired lecture notes on her own and sent in solutions under the male name "M. LeBlanc." According to MacTutor, Lagrange was impressed with the originality of the solutions and took up her cause, while Germain herself communicated with mathematician Gauss, using the male name out of fear of being overlooked due to her gender. The achievements of Germain were significant both in the field of number theory and elasticity theory. MacTutor informs that Germain contributed greatly to the development of theories of prime numbers, acoustics, and elasticity, and adds that only after years of work she managed to win the prize of the Paris Academy for studies of vibrations in elastic surfaces, though was not recognized adequately by the scientific community.

## III. THE NINETEENTH CENTURY AND THE RESEARCH UNIVERSITY

In the nineteenth century, mathematics underwent an evolution via research universities, specialized journals, and doctoral studies. These developments opened up new possibilities for women, yet also established new barriers. Sofia Kovalevskaya is one of the most important figures in this evolution. According to MacTutor, she was a Russian mathematician who contributed greatly to the field of differential equations and holds the record for being the first female after Laura Bassi and Maria Gaetana Agnesi to be appointed to a chair in a European university in 1889. She spent some years of her career working on research, teaching, and editing at Stockholm, where she worked with *Acta Mathematica*. However, her journey was not easy because there was explicit discrimination against women in academia, as indicated by the hostile statement preserved by MacTutor that the appointment of a female professor was "a monstrosity."

It is also true in the American example. As is pointed out by historical work cited by the American Mathematical Society, Columbia was the first university in the United States to grant a Ph.D. in mathematics to a woman, Winifred Edgerton Merrill, in 1886. However, an equally relevant example illustrates just how precarious even that accomplishment was, in that Christine Ladd-Franklin met all requirements for a Ph.D. in mathematics and logic from Johns Hopkins in 1882, only to have it conferred on her in 1926 after forty-four years had passed. The issue is succinctly stated in *Scientific American*: the lack of requirement was male gender, not academic excellence. Both cases

illustrate that women were participating in mathematics seriously in the last quarter of the nineteenth century; what makes the point unusual is where they did so.

The bigger context is just as important as the familiar faces. Green & LaDuke's supplementary volume about American women who earned mathematics PhDs before 1940 includes 228 biographies that extend the story substantially. Instead of a few lone geniuses, one discovers a generation of women who were college teachers, who published their research, who contributed to scholarly circles, and who were building American mathematics before World War II. These women's historical invisibility was not because of their lack of participation but rather due to selective memory.

#### **IV. TWENTIETH-CENTURY TRANSFORMATIONS: ABSTRACTION, COMPUTING, LOGIC, AND EDUCATION**

The twentieth-century woman mathematician who epitomizes both original thinking and systemic discrimination is Emmy Noether. According to Britannica, she was a German mathematician who pioneered innovations in higher algebra to become the most innovative algebraist in modern history. Britannica further states that at the time she began her university education, women were permitted to attend lectures only with special permission at Erlangen, and at first she audited courses at Göttingen without any permanent position.

The Institute for Advanced Study highlights the extent of her influence: By the mid-1920s, she had contributed fundamentally to the development of commutative algebra and invariants, and her Noether theorem illustrated profound relationships between symmetries and conservation laws in physics. Her keynote address at the International Congress of Mathematicians in 1932 marked the pinnacle of an illustrious career that combined exceptional accomplishment with systematic exclusion. Even the legacy after her death reveals a story of discrimination: While her genius earned Einstein's praise, public canonization did not occur until after many years of unpaid or underpaid work. The twentieth century also expanded the concept of mathematical activity beyond the pure/applied dichotomy. An important illustration here is Grace Hopper, who received her Yale PhD in mathematics in 1934 and worked on the Harvard Mark I computer during World War II. Later, she would go on to create FLOW-MATIC, the first English-language

programming language for data processing on the UNIVAC I computer, and become a prominent figure in promoting the standardization of computer programming languages. As this biography shows, women mathematicians contributed not just to abstract mathematical theory but to computational technology as well. The Human Computer Project at the Smithsonian Institution provides additional context, stating that in the late nineteenth and early twentieth centuries, a lot of computational work was performed by women because of the low wages they received and their classification as subprofessional workers. However, many technological advancements in science, engineering, and technology were made possible through their efforts, and these women became the first users and programmers of mechanical computers.

The efforts of women in transforming mathematics were also made possible through logic, education, and institutional development. Julia Robinson provided groundbreaking research on decision problems and is acknowledged by the AMS as the first female president of the American Mathematical Society during 1983–1984. Euphemia Lofton Haynes, according to the University of the District of Columbia, was the first African American woman to receive a doctorate degree in mathematics in 1943, established the mathematics program at Miner Teachers College, and connected mathematics with the question of educational equity in her future work in Washington, D.C.'s public schools. It is noteworthy that both careers expand the lens beyond scholarly contributions. The symbolic leadership of Robinson in the AMS and the teacher-training activities of Haynes, along with their opposition to segregationist schooling policies, indicate that women mathematicians also transformed mathematical knowledge through institutions.

#### **V. RECOGNITION, PRIZES, AND THE POLITICS OF VISIBILITY**

There have been a number of ways for mathematicians to receive recognition in mathematics throughout history – appointments, positions in societies, invited talks, awards, textbooks, and being included in historical accounts. For a long time, women were severely underrepresented in all those categories. In Hewitt's discussion of the place of women in mathematics, it is noted that the exclusion of women from history books reinforced the impression that mathematics is not a female endeavor. And this is still a very important issue because awards and positions, in addition to recognizing achievements, establish a

particular identity in the discipline. The formation of specific organizations concerned with visibility was thus crucial. According to the Association for Women in Mathematics, the association was established in 1971 and became a key player in terms of raising the visibility of women in mathematics.

This is even more apparent when we consider the importance of prizes in the international mathematics community. As Stanford notes in 2014, "Maryam Mirzakhani [had just] become the first woman ever to be awarded a Fields Medal, in recognition of her work on the geometry and dynamics of Riemann surfaces and their moduli spaces." According to a profile of Maryna Viazovska from an organization associated with the IMU in 2022, "Maryna Viazovska is only the second female recipient of a Fields Medal," which she received for work on sphere packing and extremal problems. The timing of the achievements here is important: The Fields Medal itself dates back to the 1930s, yet women did not receive it until 2014, with the second award coming only in 2022.

This is seen also in the case of the Abel prize. According to the press release of the Norwegian Academy of Science and Letters, the year 2019 saw the naming of Karen Uhlenbeck as the first woman recipient of the Abel prize for her pathbreaking contributions to geometry, partial differential equations, gauge theory, and integrable systems. It should be noted that according to this same press release, during the 1990 International Congress of Mathematicians, Karen Uhlenbeck was just the second woman to deliver a plenary lecture at the event – the first being Emmy Noether in 1932. Clearly, there is a connection between the two events that span over eighty years.

## VI. WHY RECOGNITION LAGGED BEHIND CONTRIBUTION

The following patterns of dynamics help to account for this gap. To start with, there was a lack of access to formal education and professionalization. Noether was initially allowed only to attend lectures as an auditor; Germain relied on informal instruction; Ladd-Franklin undertook dissertation-level work before completing a Ph.D. certificate. Next, there was the issue of attribution. The labor of women became integrated into broader networks of instruction, correspondence, editing, and practical application, resulting in fewer iconic achievements than the lone-authored theorems or treatises. Then, professional communities tended to regard women as exceptional cases. From the outright hostility

directed at Kovalevskaya, to the patronizing tone towards Germain, to the historical undervaluation of women who performed computations, similar tendencies emerge. Finally, the process of historiography itself sometimes repeated the exclusions of its object of analysis.

On the other hand, many women mathematicians have historically revolutionized the discipline by operating within domains that were historically deemed secondary to the “primary” mathematical pursuits outlined in the standard canon. Agnesi influenced mathematical instruction; Hypatia was involved in textual analysis; Hopper contributed to the development of modern computing; and Haynes brought mathematical skill to bear on democratic pedagogy. In cases where such work was considered secondary to “primary” mathematical discovery, such endeavors were still necessary for the dissemination, growth, and social significance of the discipline. The improved historical narrative thus does not simply involve adding a few female figures to the same canon.

## VII. CONCLUSION

Women in the history of mathematics are not simply a footnote to the field; rather, the history of women in mathematics offers one of the most obvious insights into the social structure of the discipline. Throughout history, women have participated in the development of mathematics through teaching, commentaries, textbook writing, theorizing, logic, geometry, education, and computation. Their contributions were genuine, diverse, and fundamental. However, what hindered their visibility in history was not any lack of contribution on their part, but the institutional system of gatekeeping that decided who had access, influence, and legacy within mathematics. Whether through Hypatia’s scholarship, Germain’s anonymous correspondence, Kovalevskaya’s disputed professorship, Noether’s posthumous fame, Haynes’s educational leadership, Mirzakhani’s and Uhlenbeck’s groundbreaking awards, the story is consistently the same: Women have developed mathematics even if mathematics has not always acknowledged them. Therefore, reconstructing this history is not merely an act of inclusivity. It is a rectification of the intellectual history of the discipline.

## REFERENCES

1. **Case, B. A., & Leggett, A. M. (Eds.). (2005).** Complexities: Women in mathematics. Princeton University Press.
2. **Grier, D. A. (2005).** When computers were human. Princeton University Press.
3. **Green, J., & LaDuke, J. (2009).** Pioneering women in American mathematics: The pre-1940 PhD's. American Mathematical Society.
4. **Mazzotti, M. (2007).** The world of Maria Gaetana Agnesi, mathematician of God. Johns Hopkins University Press.
5. **Albree, J., & Brown, S. H. (2009).** A valuable monument of mathematical genius: The Ladies' Diary (1704–1840). *Historia Mathematica*, 36(1), 10–47.
6. **Watts, E. J. (2006).** City and school in late antique Athens and Alexandria: Hypatia and pagan philosophical culture. University of California Press.
7. **Zinsser, J. P. (2006).** La Dame d'Esprit: A biography of the Marquise du Châtelet. Viking.
8. **Frize, M. (2009).** The bold and the brave: A history of women in science and engineering. University of Ottawa Press.
9. **Deakin, M. A. (2007).** Hypatia of Alexandria: Mathematician and martyr. Prometheus Books.
10. **Bradley, M. J. (2006).** The birth of mathematics: Ancient times to 1700. Chelsea House.
11. **Del Centina, A. (2005).** Letters of Sophie Germain preserved in Florence. *Historia Mathematica*, 32(1), 60–75.
12. **Del Centina, A. (2008).** Unpublished manuscripts of Sophie Germain and a revaluation of her work on Fermat's Last Theorem. *Archive for History of Exact Sciences*, 62(4), 349–392.
13. **Del Centina, A., & Fiocca, A. (2012).** The correspondence between Sophie Germain and Carl Friedrich Gauss. *Archive for History of Exact Sciences*, 66(6), 585–700.
14. **Cipra, B. A. (2008).** A woman who counted. *Science*, 319(5865), 899.
15. **Dzielska, M. (1996).** Hypatia of Alexandria. Harvard University Press.
16. **Waithe, M. E. (Ed.). (1987–1995).** A history of women philosophers (Vols. 1–4). Kluwer Academic Publishers.
17. **Kimberling, C. (2003).** Emmy Noether: Aspects of her life and work. In *Emmy Noether (1882–1935)*. Birkhäuser.
18. **Cooke, R. (2002).** The mathematics of Sonya Kovalevskaya. Springer.
19. **Albers, D. J., & Reid, C. (2008).** Julia: A life in mathematics. Mathematical Association of America.
20. **Reid, C. (1996).** Julia Robinson: The life of a mathematician. Mathematical Association of America.
21. **Dick, A. (1981).** Emmy Noether: 1882–1935. Birkhäuser.
22. **Osen, L. M. (1974).** Women in mathematics. MIT Press.
23. **Williams, K. (2004).** Grace Hopper: Admiral of the cyber sea. Naval Institute Press.
24. **Ceci, S. J., & Williams, W. M. (2011).** Understanding current causes of women's underrepresentation in science. *Proceedings of the National Academy of Sciences*, 108(8), 3157–3162.
25. **Lederman, M., & Bartsch, I. (Eds.). (2001).** The gender and science reader. Routledge.