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Remembering “Der Noether”: The Gendered Image and Memory of Women in Mathematics

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Abstract: German mathematician Emmy Noether (1882-1935) is known today for her contributions to abstract algebra and a 1918 theorem foundational to many theories of physics. She is also remembered as one of the most notable women mathematicians of the early 20th century and a significant figure in the history of women in science. Due to her position as an early female mathematician, her memory has been continually gendered in the decades since her death, reflecting the ways in which the image of the mathematician has frequently been constructed as heroic and masculine.

The shelves of mathematician Emmy Noether's personal library were lined with dozens of books, mostly in German, containing various proofs and theories of algebra. Among the titles of this library, however, was also a somewhat smaller collection of non-mathematical works, including books on art, history, and music – including a novel, written in 1857 by the British priest Charles Kingsley entitled *Hypatia*.[1] Although it was quite popular in Germany, the presence of this novel is notable, given the strange relationship between its content and the owner of the collection. *Hypatia* is a fictionalized account of the titular ancient Greek philosopher and early woman mathematician, perversely crafted as a deeply anti-Semitic and sexist Christian apologia in which Hypatia is persecuted for her pagan beliefs. The owner of the book, Emmy Noether (1882-1935), was a distinguished Jewish mathematician who faced considerable discrimination and was forced to leave her home in Germany under the Nazi regime. Both women made significant contributions to mathematics at a time when few women were accepted into or recognized by intellectual circles. Additionally, both have been memorialized in the history of science and mathematics to varying degrees over the years for these contributions, and for various purposes.

There is no indication in the bibliography of her library what Noether thought of Kingsley's portrayal of Hypatia, a woman whose life contained clear parallels to her own. Would she, for instance, have objected to the distortion of Hypatia's story to further an Anglican agenda? Would she have known of the philosopher's contributions to math outside of the fictionalized account? Would she have predicted, as a century of hindsight has proved, that her own memory would be similarly altered and appropriated at different points in history to align

[1] "Library of Emmy Noether," Emmy Noether collection, Special Collections Archives and Manuscripts, Bryn Mawr College, Bryn Mawr, PA.

with certain narratives about who can be a mathematician?[2] Just as Kingsley used Hypatia's position as a pagan intellectual to advance his religious views, memories of women including Noether have been characterized to convey gendered ideas about the nature of mathematics.

Demonstrating the lasting impact of Hypatia's story, Londa Schiebinger's 1999 text *Has Feminism Changed Science?* opens with a chapter titled "Hypatia's Heritage" which sets out to summarize developments in the history and historiography of women in science and mathematics "from Hypatia, the renowned mathematician of ancient Greece, to Marie Curie." For those invested in promoting women scientists, this documentation of unacknowledged women's careers was a central goal beginning in the 1970s.[3] The heritage Schiebinger details extends to the life of Emmy Noether as well, and the historiography she involves in her analysis is central to understanding how Noether, as one highly consequential woman scientist, has been honored over the past century. Since her death in 1935, the way Noether is remembered has changed to follow society's evolving perception of gender and science.

Before the history of science was developed as an academic discipline in the mid-20th century, commemorative practices often took an encyclopedic style to ensure that pioneering scientists and their discoveries are remembered, and to map a progression toward the research of the present day. Its primary role was, according to historian Thomas Hankins, "the assigning of priorities—every worker at the temple of science receiving credit for the bricks that he personally laid."[4] The history told was an uncritical series of biographies outlining key discoveries. It thus generated a straightforward narrative of progress in which discovery

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[2] For more on the Victorian gender politics in the novel see: Victoria Mills, "Charles Kingsley's *Hypatia*, Visual Culture and Late-Victorian Gender Politics," *Journal of Victorian Culture* 25, iss. 2 (April 2020), 240-263, https://doi.org/10.1093/jvcult/vcz059.
[3] Londa Schiebinger, *Has Feminism Changed Science?* Cambridge: Harvard University Press (1999), 21.
[4] Thomas L. Hankins, "In Defense of Biography: The Use of Biography in the History of Science," *History of Science* 17, no. 1 (March 1979): 3.

inevitably advances society toward betterment, as well as a perception of scientific practices as completely objective. This is the context in which Emmy Noether was initially remembered by fellow mathematicians upon her death in 1935.

By the 1960s, however, the history of science had been established as a dedicated academic discipline. In 1963, for example, historian Joseph Agassi published his book *Towards an Historiography of Science*, in which he criticized the state of science history as "pseudo-scholarly and largely unreadable," and chastises it as "scientific ancestor-worship."[5] The evaluation presented by Agassi and others took hold, and a more rigorously academic history of science grew. Helge Kragh's 1987 work *An Introduction to the Historiography of Science* outlines a number of the resultant trends, including a rejection of the biographical approach. Kragh explains that "in the new, professional history of science it has been regarded as a less-esteemed form of history," due to a tendency toward hagiography and a mythical form of history.[6] To engage readers, the biography requires connections to modern science or human drama, thus tending to deify the heroic scientist, though, Kragh states, "this kind of myth is not confined to the mere popular type of history of science."[7] Biography was not universally dismissed as a glorifying genre,[8] but by this point in time there was an awareness that the biographical approach can be vulnerable to an uncritical telling of history.

At the same time, biography became essential in the feminist approaches to science that were emerging in the 1970s parallel to the growth of a critical history of science. Feminist scholars aimed to recover the accomplishments of women scientists in order to counter the

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[5] Joseph Agassi, *Science and its history: a reassessment of the historiography of science*, (Dordrecht, The Netherlands: Springer, 2008), 119-129.
[6] Helge Kragh, *An Introduction to the Historiography of Science* (Cambridge: Cambridge University Press, 1987), 168.
[7] Kragh, *An Introduction to the Historiography of Science*, 169.
[8] See Thomas L. Hankins, "In Defense of Biography: The Use of Biography in the History of Science," *History of Science* 17, no. 1 (March 1979): 1-16.

notion that women are incapable of doing science, and to create role models for young scientists. Biography, therefore, became a central task.[9] Furthermore, mathematics in particular has often served as a prototypical example of pure, objective science. By this logic, if women can succeed in the fundamental field of mathematics, the foundation of all sciences, then surely they are capable in other areas as well. In this framework, Noether's story was picked up by feminists invested in elevating the lives of women like her.

But while the surface-level promotion of women in science continued through the end of the 20th century, academic feminist engagements in the history of science largely failed to go beyond this biographical approach and stagnated. The budding analyses of how gender influences scientific practices were depoliticized and discussions of a "feminist science" were replaced with those of "women in science."[10] Though often treated as synonymous, these discourses are not interchangeable. Simply highlighting Noether and others as important women in science without addressing the gendered terms that the history is cast in falls short of the potential these biographies present. Alternatively, interrogating how she, as a representative of mathematics, has been associated with traits perceived as feminine or masculine may allow us to move beyond a mythologized narrative of science as a heroic quest.

These trends clearly emerge when evaluating the way in which Emmy Noether has been remembered, in particular how her memory has been gendered. In the preface to the 1999 volume of the academic research journal *Osiris* dedicated to commemorative practices in science, historian Charles Maier states, "As an enterprise claiming canons of rational procedure, its commemorations reveal not that these claims are false, but that in science too, many agendas, strategic sites, and heroes are possible—and commemorators will often compete by constructing

[9] Schiebinger, *Has Feminism Changed Science?,* 21.
[10] Schiebinger, *Has Feminism Changed Science?*, 9.

persuasive, yet contrasting, representations of the past."[11] This is certainly true for the commemoration of Noether, and it is demonstrated by the gendering of her memory.

Accounts of Emmy Noether's life tend to revolve around a set of key moments. Amalie "Emmy" Noether was born on March 23, 1882 in Erlangen, Germany to an upper-middle class Jewish family of academics. Her father, Max Noether, was a noted mathematician himself. After a traditional upbringing and schooling, Noether decided to continue in her education and pursue mathematics alongside her father at the University of Erlangen—a choice discouraged for women, who were not allowed to enroll in classes. After two years of auditing courses, she was admitted as a graduate student and received her doctorate in 1903. Noether was then solicited to work at the University of Göttingen. Though she was never afforded the same official position or pay as other professors at the university due to her sex, Noether built a successful career filled with lecturing and mathematical research, and she formed close relationships with her colleagues and students, dubbed "the Noether Boys." In 1933, she was forced to leave Göttingen due to new anti-Semitic laws and moved to Bryn Mawr College outside of Philadelphia, Pennsylvania. Only two years later, Noether underwent an operation on a uterine tumor and died unexpectedly from complications on April 14, 1935. Although she took on a nurturing role for her students, Noether never married or had children. There is little indication of what personal life she might have had outside of her professional connections. Thus, the close relationships she developed with the Noether Boys and other mathematicians defined her early legacy, filling the role which biological descendants would typically take.

In the mathematics community as a whole, there was an outpouring of admiration for Noether immediately after her death. But since this was a male-dominated field, her femininity

[11] Charles S. Maier, "Commemorative Practice in Science: Historical Perspectives on the Politics of Collective Memory," *Osiris*, 2nd Series, 14 (1999), ix.

was presented as paradoxical in order to maintain the image of a heroic, masculine mathematician dedicated to a search for objective truth. Her position in the public discourse soon receded, but a few decades later, beginning in the late 1960s, her memory was revived and expanded when biographers took interest in her story as a woman mathematician. Noether's status as a woman and the discrimination she faced became a point of emphasis in these biographies, and she was presented as an exceptional woman rather than an exception to women. Recently, with the centennial of some of her most important work, including a famed 1918 theorem, she has again been celebrated by the mathematics community and the public. These commemorations have maintained an emphasis on Noether's achievements as a woman in mathematics, but they also recommit to an image of mathematicians as a solitary, hyperrational pursuit and inscribe traits that are typically associated with heroism and masculinity. In what follows, I map these trends in how Noether was remembered by her male colleagues in the 1930s, by other women during second wave feminism, and by 21st century journalists. I further observe how the tributes in each moment are representative of shifting perspectives on gender, science, and mathematics in and around the academic community.

I. Obituaries of 1935

Just weeks before the end of her second year at Bryn Mawr College, Emmy Noether underwent the surgery that would bring about her death. The procedure to remove a uterine tumor had been scheduled to take place the following summer in Germany, one year after a similar surgery, but her doctor in the United States believed the delay would be fatal.[12] Although Noether was aware of the seriousness of her illness, she informed few colleagues and even in the

[12] David E. Rowe and Mechthild Koreuber, *Proving It Her Way: Emmy Noether, a Life in Mathematics*, (Cham, Switzerland: Springer, 2020), 209.

last letter she wrote neglected to mention the operation.[13] It is not clear why she kept this part of her life hidden, whether an aversion to vulnerability, social taboos, or some other factor, but it is notable that her disregarded illness was inherently linked to reproductive organs associated with femininity. Regardless of why she kept this part of her life hidden, it came as a surprise to many of her closest friends and coworkers when she died suddenly of complications from the surgery a few days later. She was only 53 years old. To memorialize her unexpected death, a number of high-profile colleagues spoke of her life and work in obituaries and various addresses. Among these were public memorials given by colleagues and former students, including Albert Einstein, B. L. van der Waerden, P. S. Alexandrov, and Hermann Weyl.

Though perhaps unsurprising, it is important to note that these obituaries were all written by her male colleagues. Women, including her colleagues Anna Pell Wheeler and Olga Taussky Todd, did both speak at her Bryn Mawr memorial service, but it was Hermann Weyl who gave the primary eulogy and who has become one of the primary sources of information on her life. Public written addresses similarly appear under male colleagues' names. In the pivotal period immediately after Noether's death, therefore, her memory was being crafted by men for an audience of primarily male academics. For these men, the way in which Noether's memory was brought into or excluded from the broader history of mathematics was tied to the shaping of the image of a twentieth-century mathematician – in particular, a masculine image. As Sara Hottinger describes in her book *Inventing the Mathematician*, "those traits we ascribe to the mathematical author reflect our understanding of mathematics itself."[14] For both the discipline and the person, as feminist scholars have described, there is a widespread focus on objectivity and emotional detachment. Mathematicians and scientists are made to be rational actors who

[13] Rowe and Koreuber, *Proving It Her Way*, 210.
[14] Sara N. Hottinger, "Mathematical Subjectivity in Historical Accounts," *Inventing the Mathematician: Gender, Race, and Our Cultural Understanding of Mathematics* (Albany: SUNY Press, 2016), 73.

embody a heroic role and work in solitude, sacrificing community for grand discovery – characteristics that are frequently coded as masculine. As Naomi Oreskes writes, referring to the common narrative of late-night scientific discover, "Midnight is the hour of uninterrupted work. But if the scientist in the story were a woman, with children at home, would we still admire her dedication?"[15] While intellectual men are supposed to embody emotional detachment, women as caretakers cannot take on the same role. Thus, reflecting the underlying gendered assumptions of the time, each author was faced with a dilemma when crafting their memorials of Noether: How does one honor the life of a woman mathematician while maintaining a sense of mathematics as distinctly masculine?

These remembrances take different approaches to memorializing Noether, however the resolution of this question appears to be the same across the board. In each, Noether is set apart as an exception, categorically different from most women, and certainly distinct from other mathematicians. If accepted as a woman, her achievements are diminished; if, conversely, she is presented as a fully-fledged mathematician, she is not allowed to fully exhibit qualities that were regarded as feminine. By distinguishing her as "other," van der Waerden, Alexandrov, Weyl, and Einstein are able to honor her without conceding to a less masculine image of mathematics or the potential for an increased role of women writ large in the discipline.

Albert Einstein

Early in her career, Einstein's colleagues recruited Emmy Noether to help resolve an issue found within the mathematics behind the theory of general relativity. In 1915, she brought her expertise to the group and found a solution, which she further generalized in a highly

[15] Naomi Oreskes, "Objectivity or Heroism? On the Invisibility of Women in Science," *Osiris* 11 (1996), 111.

consequential theorem published three years later. This 1918 discovery, now known as Noether's Theorem, has since been applied across many areas of physics to relate symmetries of physical systems to conserved quantities, like energy or momentum. It was at this moment that Albert Einstein was introduced to Noether's work. Their lives continued to overlap at various times until Noether's death, when both were employed at American institutions following exile from Nazi Germany. In honor of her contributions, Einstein wrote a brief obituary to be published in *The New York Times*.

Due to the fame of the author, Einstein's brief letter to the editor of *The New York Times* regarding "The Late Emmy Noether" has become one of the most frequently cited sources used to note her influence on mathematics. Often this citation takes the form of one quote from the letter praising Noether, in which Einstein states, "In the judgement of the most competent living mathematicians, Fraulein Noether was the most significant creative mathematical genius thus far produced since the higher education of women began."[16] While the quotation demonstrates the admiration of the iconic scientist, there is much more to be said about it and the surrounding obituary. Einstein's characterization exalts Noether, but also presents a qualified and diminished view of Noether as a woman mathematician, and it sets her apart from other scientists.

The obituary begins with a lofty, generalized description of Noether's privilege in being able to pursue mathematics. Unlike most upper-class people, Einstein states that she was part of a minority of individuals who seek fulfillment in creative and intellectual pursuits. Though not explicitly gendered, the comment about her socio-economic status reflects an understanding that women who pursued science did so for personal fulfillment to supplement their otherwise simple, domestic lives.[17] Furthermore, he continues, "However inconspicuously the life of these

[16] Albert Einstein, "The Late Emmy Noether," *The New York Times*, May 1, 1935.
[17] Margaret Rossiter, "'Women's Work' in Science, 1880-1910," *ISIS* 71 no. 3 (September 1980), 381.

individuals runs its course, none the less the fruits of their endeavors are the most valuable contributions which one generation can make to its successors."[18] Contrasting with his own position as a highly conspicuous scientist, he characterizes Noether as meek, her contributions as vital yet fading to the background. In reality, Noether's presence was far from inconspicuous, but Einstein's depiction reinscribes a perception of women's work, in science and in general, as taking on a supporting role.

For the remainder of the letter, Einstein continues to portray her "simple life" as undistinguished, including few personal details. Instead, he continues to rely on generalized statements. In describing her contributions to algebra, for example, he offers the noted reference to her "most significant creative mathematical genius," but quickly transitions to larger praise of the poetic nature of "pure mathematics." He concludes with a brief description of her forced migration from Germany, despite the importance of her "unselfish" work – again emphasizing a supportive role – and notes the brief happiness she found in America.[19] When considering the overall content of the letter, Einstein's admiration reads like a backhanded compliment.

This portrayal of Noether stands in stark contrast to the depictions of Einstein himself found elsewhere in the pages of this issue of the newspaper. Two different articles, including one just two columns over, detail the famed scientist's role in the ongoing debates of quantum theory and describe the passionate disagreements. In these articles, Einstein is a key figure in a masculine battle to uncover the truth. He is lauded as "a sort of grandfather" to the theory and given a legendary status. As demonstrated by these writings, Einstein had already taken on an iconic status. Even among advertisements in the newspaper, his name appears, emblematic of the image of a genius; to promote the work of an advertiser, one notice makes a comparison to the

[18] Albert Einstein, "The Late Emmy Noether," *The New York Times*, May 1, 1935.
[19] Ibid.

scientist and asks, "Who is the Einstein of advertising?"[20] The disparity found in Noether's depiction as a forgettable background figure is therefore striking. While Noether is described as an unparalleled woman, she is not afforded the same status as a scientist or mathematician among her male counterparts.

B. L. van der Waerden

B. L. van der Waerden was one of the "Noether Boys," a group of dedicated students taught by Noether at the University of Göttingen in Germany. With no children or family left in Germany at the time of her death, these young academics became the keepers of her legacy. By 1935, van der Waerden was himself an established mathematician and was able to write an obituary of his mentor for publication in a German mathematics research journal, *Mathematische Annalen*. The article also appears reprinted as one of the key obituaries in two prominent biographies later published by Auguste Dick (1968) and James Brewer (1981). With a target audience of mathematicians, van der Waerden's obituary focuses on her contributions to the field, rather than personal components of her biography. The lack of ink dedicated to her character and background, however, may have as much to do with the views of the author. In fact, van der Waerden acknowledges an understanding of mathematics as independent of cultural influences, asserting that "Her originality, absolute beyond comparison, was not a matter of her bearing … Nor did it exhaust itself in the fact that this highly gifted mathematician was a woman. Rather, it lay in the fundamental structure of her creative mind."[21] He therefore

[20] "Display Ad 3," *The New York Times*, May 4 1935.
[21] B. L. van der Waerden, "Obituary of Emmy Noether," in *Emmy Noether: 1882-1935*, ed. Auguste Dick (Birkenhauser: Boston, 1981), 100.
The translation of these lines differs significantly in the version found in Brewer and Smith's biography of Noether: "Her absolute, incomparable uniqueness cannot be explained by her outward appearance only … Her individuality is also by no means exclusively a consequence of the fact that she was an extremely

intentionally distances her mathematics from her gender or any related cultural influences, ignoring her position as a woman. Similarly, the struggles and discrimination she faced in her career are only noted briefly and in coded language. Embedded in a summary of the research toward the end of her life, van der Waerden states, "Untiringly, and in spite of unfavorable external circumstances, she pursued the path indicated by the concepts she had created."[22] In van der Waerden's view, mathematics lies strictly outside of the influence of personal background.

Van der Waerden's denial of cultural and gender influences on Noether's work is further illuminated by correspondences he had with Austrian mathematician and historian Auguste Dick in the 1960s during the development of her biography of Noether. In a series of letters with the author about her interest in Noether, van der Waerden expressed his disagreement with one of Dick's stated motivations for writing the biography – to demonstrate that, contrary to the standard view of the time, women were as capable as men of doing creative work in mathematics but were shut out of the field. In response, he conducted a statistical test to analyze the gender of mathematicians between 1900 and 1950, coming to a "hopelessly naive" conclusion that women were in fact less capable in mathematics.[23] Additionally, in these letters van der Waerden expressed sexist and anti-Semitic views that "Emmy Noether was unique and altogether different from all other Jews that I know. … She was motherly, without being typically feminine, just as she was not typically Jewish."[24] While these statements are from decades after his 1935 obituary, it is not unreasonable to read these views back into the earlier writing. Despite his insistence that Noether's unique genius was unrelated to her background, his description of her career include overt references to her gender and religion. It is no coincidence, for example, that van der

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talented mathematician, but lies in the whole structure of her creative personality." Translation clearly provides another filter through which we must understand these writings.

[22] B. L. van der Waerden, "Obituary of Emmy Noether," 109.

[23] Rowe and Koreuber, *Proving It Her Way*, xvii.

[24] Ibid.

Waerden repeatedly emphasizes Noether's originality and ability to think abstractly; this portrayal follows to a tee the stereotypical view in Weimar Germany that Jewish people were particularly gifted in abstract theorizing.[25] Similarly, van der Waerden's perception of Noether as "motherly" takes shape in his depiction of her as "entirely free of egotism and vanity," fostering the work of her students before her own interests.[26] Positioning her in in a maternal role relative to himself and the other Noether Boys recognizes the substantial impact she had on the young men, but in doing so it hearkens back to the themes of Einstein's obituary and again relegates her to a facilitative role.

Regardless of his insistence on an isolated mathematics independent of cultural influences, van der Waerden's own descriptions of Noether demonstrate a undoubtedly gendered view of the mathematician. The perceived objectivity of mathematics and science employed in his comments has frequently been associated with masculine detachment. Van der Waerden's insistence in his obituary of Noether on an isolated, independent mathematics therefore defends the masculine perception he holds of the field, and it discounts the gendering of Noether he himself perpetuates.

Hermann Weyl and P. S. Alexandrov

Hermann Weyl's memorial address of Noether given at Bryn Mawr following her death was the most influential and substantial obituary, given in English with considerable lyricism and poetry. Weyl's address is deeply personal, providing a rich portrait of Noether unparalleled by the other initial remembrances of her. More so than the other obituaries, Weyl's portrait of Noether also pays considerable attention to her position as a woman, simultaneously

[25] Rowe and Koreuber, *Proving It Her Way*, xviii.
[26] B. L. van der Waerden, "Obituary of Emmy Noether," 111.

emphasizing her lack of traditionally feminine qualities while also painting her as a warm, caring figure. For example, she is alternatively described as "warm like a loaf of bread" with "a broad, comforting, vital warmth" and "heavy of build and loud of voice."[27]

Weyl makes one of his strongest assertions about Noether's gender in the comparison he draws to Sonya Kovalevskaya, practically the only other noted woman mathematician in 1935. Despite the dramatic differences in their lives and the math each woman studied, Weyl contrasts the two by noting Kovalevskaya's femininity, and the strain she felt as a woman mathematician; unlike Noether, for Kovalevskaya, pursuing math led to a life of unhappiness. As scholars David Rowe and Mechthild Koreuber state regarding the comparison, "The larger implication would seem clear: if a woman wants to pursue a life in mathematics, she will have to give up certain things; such a life demands sacrifices, and these diminish her chances of becoming a 'complete woman.'"[28] The comparison makes clear that Noether is, in Weyl's eyes, an anomaly. She is exceptional as a mathematician, but also an exception as a woman.

Several analyses have criticized Weyl's condescension in his remarks about her lack of femininity.[29] These comments, however, often simply replace Weyl's blunt observations with other gendered notions. For example, one of Noether's closest friends, P.S. Alexandrov[30] aimed to replace Weyl's notes on her physicality with a characterization of her "brilliant, original, and fascinating personality" in his eulogy given to a gathering of the Moscow Mathematical Society a few months after her death.[31] Particularly in the final section of the eulogy, Alexandrov changes Weyl's physical description to a focus on character, but maintains the paradoxical

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[27] Auguste Dick, *Emmy Noether: 1882-1935*, trans. H.I. Blocker (Birkenhauser: Boston, 1981), 116, 149.
[28] Rowe and Koreuber, *Proving It Her Way: Emmy Noether, a Life in Mathematics*, 14.
[29] Ibid, x.
[30] In many sources, "Alexandrov" is alternatively spelled "Alexandroff." In this paper, I will use the former version of the name and modify any quotations for consistency.
[31] Dick, *Emmy Noether: 1882-1935*, 157.

femininity, simultaneously kind and warm as well as strong-willed and temperamental. The final words of his address read:

> "To be sure, Weyl said in his obituary, 'No one could contend that the Graces had stood by her cradle,' and he is right, if we have in mind her well-known heavy build. But at this point, Weyl is speaking of her not only as a major scientist, but as a major woman! And this she was–her feminine psyche came through in the gentle and delicate lyricism that lay at the foundation of the wide-ranging but never superficial relationships connecting her with people, with her avocation, with the interests of all mankind. She loved people, science, life with all the warmth, all the joy, all the selflessness and all the tenderness of which a deeply feeling heart–and a woman's heart–was capable."[32]

Like Weyl, Alexandrov explicitly draws a distinction between Noether and other women academics, but also draws attention to her perceived femininity in interpersonal relationships. As the originator of her masculine nickname "der Noether," Alexandrov clearly held gendered ideas of what it meant to be a mathematician. These beliefs are clearly reflected in the image of Noether he presents.

II. Biography and Feminism: 1960s-1980s

Beginning in the late 1960s, Emmy Noether's memory was reintroduced to the public discourse in the United States, concurrent with the rise of second wave feminism and an emphasis on highlighting key figures in women's history. At this point, Noether's story was reclaimed as part of the efforts characteristic of the period to use biography as a means of promoting women's contributions to science and mathematics. Whereas her colleagues previously memorialized Noether as an aberrant example of both women and mathematicians, these authors set her apart as exceptional in both categories.

These biographical accounts also make concerted efforts to subvert the typical image of a scientist. As demonstrated by Marcel C. LaFollette's 1988 article "Eyes on the Stars," by the

[32] Dick, *Emmy Noether: 1882-1935*, 179.

1980s there was a growing awareness of what the image of a scientist entailed.[33] Analyzing representations of women scientists in magazines and other popular sources, LaFollette notes that the mass media "purveyed a strongly negative image of women scientists, depicting them as both atypical scientists and atypical women."[34] Tracing the path of women scientists in magazines from the early 20th century, she notes that women were largely absent until the 1930s, when the lives of scientists like Marie Curie were portrayed negatively as requiring extraordinary sacrifice to lead lives irreconcilable with their "'feminine' side." Presented with this model, women were required to demonstrate extraordinary brilliance far beyond their male counterparts to succeed in science, and they additionally had to maintain their household responsibilities to prove they were still "real" women.[35] These demanding stereotypes contributed to broader cultural perceptions of women scientists for much of the 20th century, necessitating the alternative representation found in Noether's biographies.

Olga Taussky-Todd

As one of the few women Noether mentored, both at Göttingen and Bryn Mawr, Olga Taussky Todd provides a different perspective from most of the "Noether Boys." Although she did speak at the Bryn Mawr funeral service,[36] Taussky Todd's recollections of Noether were not recorded until fifty years later when published as part of her own autobiography written in 1979-80 for the California Institute of Technology Archives and in an essay as part of James Brewer's

[33] As noted by Margaret Rossiter in her article "Women's Work," this masculine scientist did not include all people involved in scientific work. Women at the turn of the 20th century were widely employed in scientific positions that were feminized and made subordinate. Notably, Noether's creative mathematical work is not easily devalued as domestic or feminine. See also Naomi Orestes' "Objectivity or Heroism?"
[34] Marcel C. LaFollette, "Eyes on the Stars: Images of Women Scientists in Popular Magazines," 262.
[35] LaFollette, "Eyes on the Stars," 268.
[36] Qinna Shen, "A Refugee Scholar from Nazi Germany: Emmy Noether and Bryn Mawr College," *The Mathematical Intelligencer* (2019), 62.

1981 biography.[37] Her recollections serve as a combination of the eulogies written by other students and colleagues and the later biographies providing the context of these memories.

At first glance, Taussky-Todd's memories of Noether seem to echo much of the paradoxical gendering found in previous obituaries. She recalls, for example, her first impressions of Noether as friendly and kind, but also loud and sloppy; at a lunch they shared, she says that Noether "spilled her food constantly and wiped it off from her dress, completely unperturbed."[38] Similarly, Taussky-Todd also presents Noether as a divisive figure in her interpersonal relationships. While loved by many of her students, her confidence irritated some male colleagues. However, "she was a person who did not mind criticism" and did not hold strong grievances.[39] Noether's contradictory femininity is most clearly stated regarding her personality. Taussky-Todd states, "In some respects she was like a moody child. But she could also be motherly, understanding, and charitable."[40] Her words recall Weyl's comparison to a warm loaf of bread.

Although Taussky-Todd's recollections are not exempt from these gendered notions, the way they are presented introduces a different sense with greater nuance. In particular, since Taussky-Todd was herself a woman mathematician, these descriptions of Noether, embedded within memories of her own life and career, do not take on the task of representing an entire class of women academics. Instead, they portray the subtle and sometimes incongruent qualities of an individual. Of Noether's students noted in this paper, Taussky-Todd is the only one who

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[37] Olga Taussky-Todd, "Autobiography of Olga Taussky-Todd," *California Institute of Technology Oral History Project*, 1980.
Olga Taussky, "My Personal Recollections of Emmy Noether," in *Emmy Noether: A Tribute to Her Life and Work*, ed. James Brewer (Marel Decker, Inc: New York, 1981), 79-92.
[38] James Brewer, *Emmy Noether: A Tribute to Her Life and Work* (Marel Decker, Inc: New York, 1981), 80.
[39] Brewer, *Emmy Noether*, 81.
[40] Ibid 87.

gives any indication of the mathematician's own beliefs about the role of women in mathematics. In her 1981 essay, she recalled, "Emmy was not uninterested in the many problem women face." Taussky-Todd notes, however, that "She was very naïve and knew very little about life. She saw women as being protected by their families and even admitted to me that she gave young men preference in her recommendations for jobs so they could start a family."[41] Nevertheless, Noether worked hard to support Taussky-Todd and other women at Bryn Mawr, indicating a complexity in her feelings and actions toward other women. Additionally, in this case the mentorship she describes Noether providing as a "motherly" figure lifts up the voices of other women, rather than pushing her own achievements to the side to make room for her "Boys."

Due to her own identity, Taussky-Todd also has a greater appreciation for the ways in which Noether was subject to conflicting societal expectations as a woman mathematician. Prior to her death, Taussky-Todd recalls, "Emmy considered herself a 'tough guy' who would not yield to sickness. She did not take her surgery too seriously and did not expect the sad outcome. She was looking forward to a somewhat slimmer body."[42] Noether's commitment to presenting a persona of masculine strength and stoicism, in line with the image of a mathematician, thus took a serious toll on her health. At the same time, she humorously acknowledges her lack of physical qualities expected and desired for women.

Taussky-Todd was clearly invested in sharing Noether's story. In addition to the two pieces she herself wrote, Taussky-Todd is cited in the acknowledgements of Dick's English version of Noether's biography as one of the main proponents of the translation; Dick states that "Over the years, Professor Olga Taussky Todd has repeatedly urged me to make my biography

[41] Brewer, *Emmy Noether*, 85.
[42] Ibid, 90.

of Emmy Noether available to readers of English."[43] By sharing recollections of Noether as well as her own life as a mathematician, Taussky-Todd contributes to the feminist mission to subvert the image of the male scientist.

Emiliana Noether

In 1976, Emmy Noether's niece and professor of Italian history Emiliana Noether[44] wrote a short tribute piece about her aunt in the newsletter of the *Association for Women in Mathematics* which also introduces feminist sensibilities into her biography with additional information about Emmy's early life. At the time of its publication, Noether was beginning to gain more public recognition, although the first major biography of her written by Auguste Dick had not yet been translated to English and there were few English sources available. Perhaps due to this lack of sources, the author – who married into the Noether family after Emmy's death – relies heavily on the 1935 obituaries as virtually her only cited sources, particularly Hermann Weyl's.[45] Despite Emiliana's position as a trained historian, she takes his words at face value and presents them as an honest reflection of Emmy.

Throughout the article, in fact, the author offers biographical information hinting at feminist themes but lacking in explicit analysis, including specific references to the difficulties she faced as a woman in universities. For example, about halfway through the article Emiliana discusses the struggle Emmy faced in obtaining a professorship in Germany and pulls two paragraphs directly from a biography of Emmy's mentor David Hilbert describing the opposition. Not even mentioning the source of this long quotation, apart from a footnote, it is

[43] Dick, *Emmy Noether*, x.
[44] In this section, I refer to Emmy and Emiliana Noether by their first names to avoid confusion.
[45] Emiliana Noether, "Emmy Noether: Twentieth Century Mathematician and Woman," *Association for Women in Mathematics Newsletter* 6 no. 7 (1976), 2.

integrated with Emiliana's own writing as part of a single narrative. The content of the quote largely speaks for itself, but it is surprising how understated the surrounding material is, given the context of the *AWM* newsletter. The strongest claim Emiliana makes regarding the sexist opposition is that "while in 1915 Göttingen had a more liberal policy towards women students, it was not ready to admit women to the faculty."[46] Shortly after this article, the newsletter dedicates pages to documenting the "discouraging" statistics of women in mathematics faculty positions.[47]

Although Emiliana's description of Emmy's professional life relies primarily on a few key obituaries and reflects their positions, descriptions of Emmy's childhood and family life are rarely included in such accounts since there is little documentation. As the author remarks, "none of Emmy Noether's personal papers have survived her exile from Germany, death, and dispersal of her possessions."[48] This section of Emiliana's article therefore includes few citations and presumably benefits from the author's familial connection to her subject. Interestingly, it also focuses on Emmy's femininity and conformity during this period of her life. Perhaps reflecting accounts from within the family, she describes Emmy as a child who "gave no signs of precociousness or extraordinary ability," and was "undistinguishable … except for her extreme near-sightedness and lack of outward attractiveness"[49]—a descriptor that is hard to imagine being used in reference to a man. Emiliana then states that Emmy grew into a young woman who conformed with gender roles and expectations for "a young woman of her class and breeding"; she enjoyed attending parties and dancing, learned piano as well as French and English, and was educated to become a teacher of the same languages. In her youth, Emmy was unremarkable and fairly unfeminine, but she played the role of a young woman well.

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[46] Emiliana Noether, "Emmy Noether: Twentieth Century Mathematician and Woman," 3.
[47] Judy Green, "Third Annual Report of Employment of Women in Mathematics Departments," *Association for Women in Mathematics Newsletter* 6 no. 7 (1976), 10.
[48] Emiliana Noether, "Emmy Noether: Twentieth Century Mathematician and Woman," 2.
[49] Ibid.

The article, however, then notes a departure from conformity in Noether's life when she decided to continue in her education, at which point "the story of Emmy Noether becomes interesting."[50] While other, more recent biographies indicate that Emmy had a lifelong passion for mathematics,[51] Emiliana emphasizes a discontinuity at this moment, leaning into a rebellious sensibility characteristic of 1970s feminism. Emiliana speculates about various reasons she might have made this choice, which at first seem to implicitly support a perception of her career choices as unnatural. At the same time, the speculative questions evoke a sense of determination integral to the context of second wave feminism the article is born in. In particular, the final question she considers demonstrates an awareness of feminist thought and asks of Emmy's rationale, "Was it a desire for a room of her own, as Virginia Woolf expressed it so poignantly for all women?"[52] Although Emiliana does not explicitly prod the question any further, Noether's memory began to be connected to feminist themes in the conjectures of this section of the article, written without any reference to Weyl, Einstein, or Alexandrov.

Auguste Dick

In her monograph, originally published in German in 1968 and translated to English in 1981, Auguste Dick provides an even more in-depth treatment of Noether as both a woman and a mathematician. One of Dick's motivations was, in fact, to "refute the then standard view that women were less capable of doing creative work in mathematics than men."[53] Though Dick's book does draw upon Weyl's obituary in particular, unlike earlier representations which reduce Noether's femininity, Dick instead highlights her position as a woman. In fact, the biography

[50] Emiliana Noether, "Emmy Noether: Twentieth Century Mathematician and Woman," 2.
[51] Rowe, *Proving It Her Way*, 16.
[52] Ibid, 2.
[53] Ibid, xvi.

flips the tension between her gender and mathematical ability and renders these as consistent with each other. As she stresses early in biography, for example, "Girls were not destined for the study of science, least of all mathematics. Yet, this little Jewish girl not only became a mathematician but was to become one of the most important creators in the field of abstract algebra."[54] Throughout the biographical account, Dick intersperses notes of the discrimination Noether faced, allowing her to fully embody her position as both a woman and mathematician.

To introduce the text, for example, Dick begins by describing a scene at the 1964 World's Fair in New York City. One exhibit, titled "Men of Modern Mathematics," is used to strikingly illustrate Emmy Noether's importance, as well as her incongruent image as woman scientist, out of place among scores of men – in this case literally. She describes the display in which, "Close to eighty portraits are crowded into a space of about fourteen square feet; among them, only one is of a woman."[55] Furthermore, Dick continues by describing, "Her face—mature, intelligent, neither pretty nor handsome—may suggest her love of science and creative gift, but certainly reveals a likeable personality and a genuine kindness of heart."[56] Here, her physical appearance is connected to androgynous qualities of a scientist, as well as the same feminine warmth of character present in the 1935 obituaries.

When discussing Noether's childhood and family history, Dick also presents an interesting, if short, detour into imagining the life of Emmy's mother, whom "little is known of."[57] She notes that it is typical of German culture to only consider the genealogy of the father for notable figures. Therefore, Dick contends, "It is left to us to imagine how much strength the life of this woman, and wife of a physically handicapped and otherwise difficult man, must have

[54] Dick, *Emmy Noether*, 5.
[55] Ibid, 1.
[56] Ibid, 1-2.
[57] Ibid, 24.

required."[58] In this brief moment, Noether's biographer gives voice to one of the women in Noether's life, highlighting a feminine relationship that is often ignored in favor of her relationship with her father – a relationship often used to validate her position as a mathematician.[59] Frequently, discourses on women mathematicians emphasizing their role as a daughter, wife, or mother have been used to reinforce a sense of domesticity and assure readers that these figures are fundamentally women, more so than scientists.[60] In Noether's case, however, the connection to her father is instead used to explain her path to becoming a mathematician. The attention Dick provides to her mother allows Noether, already clearly identified as a mathematician, to also embody her role as a woman. Contrasting with earlier depictions, this form of commemoration emphasizes her feminine identity as consistent with her career path and moves toward a more complete memory of Emmy Noether.

III. Heroism and the Mathematician: 2000s-2010s

With significant anniversaries, such as the centennial of Noether's eponymous 1918 theorem, many in the mathematics community and from larger news outlets have recently lauded her contributions once again, in articles from sources including *The New York Times*, *Nature* (London), *The Smithsonian Magazine*, and many other websites. These writings tend to emphasize Noether as a pioneering figure and a role model for young women pursuing science and math. Ironically though, these depictions also conform with and reinforce aspects of the typical image of a male scientist, unaware of these implications. As Suzanne Damarin notes in

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[58] Dick, *Emmy Noether*, 25.

[59] In mathematics, there is also a paternal tradition of tracing the lineage of PhDs, where the advisor-student relationship is described as father-son. (Suzanne Damarin, "Toward Thinking Feminism and Mathematics Together," 113.) The validation provided by Noether's actual parentage doubly plays this role, and it reflects ideas of biological inheritance.

[60] Damarin, "Toward Thinking Feminism and Mathematics Together," *Signs: Journal of Women in Culture and* Society 34, no. 1 (2008), 110.

her 2008 article, "Toward Thinking Feminism and Mathematics Together," in some regards little has changed since the 1970s and 80s for women in mathematics. The work of authors writing about gender and mathematics, she states, "does not appear to be shaped by feminist theories or by attention to interdisciplinary women's studies."[61] Likewise, rather than breaking through to mainstream scientific history, many of the stories about the women whose biographies were written during the same time period were pushed back into obscurity—including Noether's. The stagnancy of how women scientists are presented is reflected in the recent biographical accounts of Emmy Noether, which do not shy away from her femininity as in 1935, but perpetuate a typically heroic image of mathematicians regardless.

A Forgotten Feminist Hero

Almost eighty years following Einstein's prominent obituary of Emmy Noether, in 2012, *The New York Times* published another brief article remembering Noether as "The Mighty Mathematician You've Never Heard Of."[62] There is a poignant irony in the title and content of the article, noting Noether's fading into the shadows, when considering the publication of Einstein's obituary in the same newspaper. In fact, the article calls attention to Einstein's praise before acknowledging, "Yet Noether herself remains utterly unknown, not only to the general public, but to many members of the scientific community as well."[63] Similarly, a 2017 piece in *Smithsonian Magazine* admits, "Albert Einstein is a household name. Emmy Noether? Never heard of her."[64] Despite a long history of acknowledging her contributions, there is a common emphasis in the mass media on the obscurity of Noether. This understanding of Noether as a

[61] Damarin, "Toward Thinking Feminism and Mathematics Together," 103.
[62] Natalie Angier, "The Mighty Mathematician You've Never Heard Of," *The New York Times* 2012.
[63] Ibid.
[64] Kat Eschner, "Mathematician Emmy Noether Should Be Your Hero," *Smithsonian Magazine*, March 23, 2017.

forgotten individual is not a coincidence. As Margaret Rossiter notes in her article coining the "Matilda effect" to describe the under-recognition of low-rank scientists, the usual persistence of scientific reputations over time does not often apply for women in science.[65] While male scientists are often venerated by academics for generations, women are easily forgotten.

In addition to presenting Noether as an obscure figure, articles like the piece in *Nature* highlight the discrimination she faced and the perseverance that allowed her to succeed regardless. Described as "one who changed the scientific world against the odds," she is made into a success story and role model.[66] Additionally, the article underlines her distinctive character, stating that "Some biographies inaccurately portray Noether as a somewhat helpless genius at the mercy of men's charitable actions. In reality, she was an assertive personality, recognized leader and the first female speaker at the renowned International Congress of Mathematics."[67] This observation thoughtfully summarizes some key points of the ways in which her earliest biographers gendered her memory, and it reflects sensibilities of modern feminism such as independence and a confidence in one's abilities.

In addition to the written pieces, in 2018, there were also a number of mathematical conferences and symposia framed around Emmy Noether honoring the 100th anniversary of her 1918 theorem, demonstrating similar perceptions within the mathematics community. These events included meetings at Boston University, University of Notre Dame, and a joint meeting of the London Mathematical Society and Institute of Mathematics and Its Applications.[68] Though

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[65] Margaret W. Rossiter, "The ~~Matthew~~ Matilda Effect in Science," *Social Studies of Science* 23, no. 2 (May 1993), 328.
[66] "Celebrate the Mathematics of Emmy Noether," *Nature* (London) 561, no. 7722 (2018), 150.
[67] "Celebrate the Mathematics of Emmy Noether," 149.
[68] "Archives 2018-2019," Boston University College of Arts & Sciences Center for Philosophy & History of Science," Boston University, accessed December 1, 2021, https://www.bu.edu/cphs/colloquium/2018-2019/; "The Philosophy and Physics of Noether's Theorem," Department of Philosophy, University of Notre Dame, accessed December 1, 2021, https://philosophy.nd.edu/news/events/noether/;

primarily focused on her mathematical legacy, even the abstracts of certain presentations demonstrate a view of Noether as an icon for women in science and math. The LMS/IMA "Noether Celebration," for example, hosted five speakers, the first of whom gave a biographical account concentrating "in particular on the discrimination against her as a woman."[69] Similarly, the final speaker notes in her abstract an intent to discuss Noether's position as a "role model" for women in mathematics. This emphasis on Noether as a resilient role model reflects the same prototype for women described by LaFollette decades earlier in her 1988 article, a "'superscientist' … undeterred by discrimination."[70] Not only is she required to demonstrate exceptional ability as a scientist, but she also embodies a heroic pursuit, resolute against the obstacles faced.

The Image of a Mathematician

Published in increasingly digital formats, the photographs included in written remembrances of Noether are more and more important when considering the image –literal and figurative – of a mathematician or scientist. Online as well as in print, the visual element is, in fact, part of the construction of a given subjectivity, including that of the mathematician.[71] In the *New York Times* article, among others, the photograph included to represent this type of figure is one of a young Noether, polished in a bowtie and a button-down shirt. The image is used in almost every recent article about Noether, but it stands in stark contrast to the written

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"LMS/IMA Joint Meeting: Noether Celebration," London Mathematical Society, accessed December 1, 2021, https://www.lms.ac.uk/civicrm/event/info?reset=1&id=23.

[69] "LMS/IMA Joint Meeting: Noether Celebration," London Mathematical Society, accessed December 1, 2021, https://www.lms.ac.uk/civicrm/event/info?reset=1&id=23.

[70] LaFollette, "Eyes on the Stars," 270.

[71] Hottinger, "Mathematical Subjectivity in Historical Accounts," 96.

descriptions of her physicality and character. Here she is not the portly, laughing woman who appears in written descriptions and other photographs, but a tidy, serious young woman.


Left: Early photograph of Emmy Noether, as included in a 2012 *New York Times* article and many other recent online publications. Right: Noether in 1930 traveling to a conference.[72]

Even the article this photograph appears in describes her as fairly unkempt: "Noether lived for math and cared nothing for housework or possessions, and if her long, unruly hair began falling from its pins as she talked excitedly about math, she let it fall. She laughed often and in photos is always smiling."[73] The written description emphasizes traits that show a devotion to mathematics, but clearly contrast with the neat visual included in the article. The portrait does, however, conform to characteristics expected of her profession, imagined as consisting of "white males who work in isolation, [and] who do their best work while young."[74] These descriptors are counter to Noether's lived reality at the peak of her career as a fifty-year-old Jewish woman who worked collaboratively, but they bear a resemblance to the youth and somber solitude presented in the accompanying photograph.

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[72] Natalie Angier, "The Mighty Mathematician You've Never Heard Of," *The New York Times* 2012.; Rowe, *Proving It Her Way*, 138.
[73] Natalie Angier, "The Mighty Mathematician You've Never Heard Of," *The New York Times* 2012.
[74] Damarin, "Toward Thinking Feminism and Mathematics Together," 111.

Sara Hottinger explains in her 2016 book *Inventing the Mathematician* how the mathematician and mathematics itself are portrayed as a "difficult, cold, abstract, ultra-rational, and largely masculine," creating the mythology of a rational hero coded male and white.[75] Following a Newtonian archetype, "we attribute a thin, pale face, disheveled hair and fine fingers … to mental brilliance."[76] The portrait of Noether reinforces this stereotype by visually presenting Noether as serious with traditional elements of portraiture. Additionally, the image is associated with heroism, as the very nature of this style of portraiture establishes a grand sense of importance and worthiness.[77] Recalling Dick's description of the "Men of Modern Mathematics" exhibit, Noether thus sticks out as the lone woman among the many portraits of her peers, but in this photograph she also conforms to the same image. Whether her portrait is placed on a wall full of men, or digitally in a series of articles on historical women, key elements of her image and the accompanying text continue to present mathematicians as masculine.

IV. Conclusion

Many historians of science have petitioned the members of their field to refute the common historical narrative that science is "infallible" and inevitably progresses forward. In 2008, for instance, Joseph Agassi published an entire five-hundred page volume of the *Boston Studies in the Philosophy of Science* aiming "to encourage historians of science to write without beautifying … and to worry less about the reputation of science and more about engaging their readers in exciting intellectual adventures."[78] Acknowledging the role of gender and the image of the scientist, as it is illuminated by the memory of Emmy Noether, is one step in this direction.

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[75] Hottinger, "Mathematical Subjectivity in Historical Accounts," 90.
[76] Ibid, 108.
[77] Ibid, 105.
[78] Joseph Agassi, *Science and Its History: a reassessment of the historiography of science*, (Dordrecht, The Netherlands: Springer, 2008), vii.

Like the fictional account of Hypatia found on her bookshelf, Noether's story clearly demonstrates the influence of culture and ideology on commemorative practices, reinforcing the fact that science and its history are not isolated from culture or society.

Although increased support for scientists of all backgrounds in recent decades has allowed some women, like Noether, to take on the role of the hero, as long as this type of narrative is privileged, the narrative of our scientific history will be incomplete at its core. By perpetuating a heroic image of science, the scope of who and what is considered "heroic," and therefore who can make scientific achievements, is limited. Though closely related, addressing the influence of *gender* in science goes far beyond acknowledging *women* in science.[79] Moving toward a more inclusive understanding of science and mathematics therefore requires more than recognizing the achievements of notable women like Noether. Rather, it requires a reevaluation of the history we choose to tell, and how we tell it.

[79] See Ludmilla Jordanova, "Gender and the Historiography of Science," *The British Journal for the History of Science* 226, no. 4 (December 1993): 469-483.

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