Emmy Noether Steps Onstage: Her Place in Mathematical Communities, Past and Present

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This column is a forum for discussion of mathematical communities throughout the world, and through all time. Our definition of "mathematical community" is the broadest: "schools" of mathematics, circles of correspondence, mathematical societies, student organizations, extracurricular educational activities (math camps, math museums, math clubs), and more. What we say about the communities is just as unrestricted. We welcome contributions from mathematicians of all kinds and in all places, and also from scientists, historians, anthropologists, and others.

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Emmy Noether's name and fame are familiar to nearly everyone who has studied mathematics or theoretical physics, but far less so among other groups. Yet even for those familiar with her work, she would seem highly unlikely as a stage figure. That's surely what I thought, too, up until June 2019. I quickly changed my mind, though, after seeing the premiere performance of a play about her life, produced by the ensemble Portraittheater Vienna and presented at the Freie Universität Berlin (FU). In September 2022, audiences at nine academic institutions across the United States had the chance to see the English-language version of that play, *Diving into Math with Emmy Noether*. For many who did, they experienced not only how this famous figure moved in the mathematical communities of her day but also the sense in which her importance as a historical figure reaches over to the present time. Indeed, one could hardly exaggerate her relevance today for mathematical communities and the role of women in them.

Sandra Schüddekopf (director) and Anita Zieher (actress) first decided to take on this project in the fall of 2018. That decision confronted them with a truly herculean task, because they had to write, produce, and rehearse the original German version, *Mathematische Spaziergänge mit Emmy Noether*, within a period of around eight months. Indeed, their play would be performed on June 4, 2019, the 100th anniversary of Noether's lecture performance in Göttingen. That lecture was the final formal act in her habilitation, through which she became the very first woman entitled to teach at a Prussian university. Noether's breakthrough came almost exactly four years after the mathematicians in Göttingen initially tried to have her appointed as a private lecturer (*Privatdozent*), a move staunchly opposed by nearly all the humanists on the philosophical faculty.

Before plans for a play emerged, Mechthild Koreuber had been busy organizing a major interdisciplinary conference that took this historic event as its theme. Mechthild is a historian of mathematics, author of a standard study of Noether's career, and chief gender equality officer at FU. The conference would combine reflections on Noether's career with larger gender issues in mathematics, while celebrating the formation of the Berlin Mathematics Research Center MATH+. The latter came about as an initiative framed by its three universities (FU, TU, and HU)[1] that aimed to promote mathematical applications in the digital realm. The possibility of staging a play about Emmy Noether in this context came to Mechthild only as an afterthought. She then asked me to join her as a scientific advisor. Soon, she managed to line up funding

[1]Acronyms for Freie Universität, Technische Universität, and Humboldt Universität.

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from the three Berlin universities and a number of others (Erlangen, Göttingen, Mainz, and Bielefeld). Thus, the original intent of the play was to celebrate Emmy Noether's habilitation as a symbolic event in her stellar career that also marks an important turning point for women in higher mathematics.

The mixture of talks at the conference stirred up much interesting discussion, but for many who attended, its high point came with the play, which gave participants the chance to imagine Emmy brought back to life. That final night, Mechthild and I sat on the edge of our front-row seats in the theater of the Henry Ford Building, not really knowing what to expect. We had seen an earlier performance in the same locality of Portraittheater's *Kernfragen*, a play about Lise Meitner's relationships with Otto Hahn and Max von Laue. That work set a high bar, and we hoped that their new play about Emmy Noether might approach the same standard.

Still, a play focused on Noether's love for abstract algebra posed real difficulties for Sandra and Anita, neither of whom had any familiarity with higher mathematics. All of us recognized that it would be far harder to pull this off than to produce a play centered on the more familiar ideas and themes associated with nuclear fission. Compounding that difficulty was another. Portraittheater bases its scripts on historical sources, such as, for example, the correspondence between Meitner and von Laue. This enables them to produce scenes and character portrayals with a high degree of authenticity, and yet for the life of Emmy Noether, few such sources have survived. Nevertheless, several leading mathematicians who knew her, including some of her most important collaborators, emphasized her ability to dialogue with others as one of the secrets to her influence and success. Four key figures appear on screen in scenes that visually enhance the importance of such personal interactions, while Emmy's reflections on stage help to illuminate her relationships with these four very different types of mathematicians.

Since Noether probably never wrote anything about herself beyond the bare facts, only a few scant sources have survived that shed any light on her inner life. Instead, published sources have relied heavily on the testimonials that appeared shortly after her death. The three most important were by Bartel Leendert van der Waerden, Hermann Weyl, and Pavel Alexandrov, mathematicians who knew her quite intimately. Reading them carefully, one notices that their assessments hardly agreed on all points. Yet everyone concurred in the opinion that Emmy Noether's ability to communicate with and to inspire her fellow mathematicians was truly astounding. That theme resonates throughout the play, which begins as biography but eventually employs a series of videos that feature Noether in dialogue with van der Waerden, Helmut Hasse, Olga Taussky, and Alexandrov. By this means, viewers gain a real sense of Emmy's world.

Photo taken after the premiere performance at the Freie Universität Berlin: Sandra Schüddekopf, Mechthild Koreuber, Anita Zieher, David Rowe.

Emmy Noether's world in the 1920s—and even up to the time of her unexpected death after fleeing from Nazi Germany—was deeply rooted in the Göttingen

Emmy recalling her friendship with Pavel Alexandrov.

mathematical community. Only experts can read the papers in her collected works with real understanding, but these final products of her ongoing mathematical efforts hardly hold the key to understanding her remarkable success story. She stood at the very center of a truly remarkable community of mathematicians, among whom she was the most accessible of all. That was how Weyl remembered her during the early 1930s, when they taught as fellow colleagues in Göttingen.

In the play, Emmy doesn't try to explain mathematics (except in a park scene in which she and van der Waerden go walking), but she does speak often and in some detail about what mathematics meant for her. That requires alluding to all sorts of abstract things that reflect Noether's conceptual approach. The way Schüddekopf and Zieher conceived her role thus gives a new sense to Bertrand Russell's humorous characterization of mathematics as "the subject in which we never know what we are talking about, nor whether what we are saying is true." Still, since the play is primarily about Noether's place in and influence on mathematics, almost anyone can gain some sense of her unique importance for her contemporaries.

At the reception that followed the premiere, we discussed the possibility of an English version, and soon I began translating the German text. In the meantime, Portraittheater performed the play at a number of universities in Germany, but also numerous times at the Theater Drachengasse in Vienna, while I tried to arrange a tour in the United States. Mechthild and I also talked about writing a short book as a companion to *Diving into Math*. This plan gained the support of Catriona Byrne and Rémi Lodh at Springer and led to the publication of *Proving It Her Way: Emmy Noether, A Life in Mathematics*. It came out in 2020—just in time for the Covid pandemic! As everyone knows, the world of performing arts was one of its major casualties. Two attempts to launch a tour for *Diving into Math* in the United States ended up canceled, but we scrambled to put a third one together for September 2022: a whirlwind affair with nine stops in three weeks. What follows are a few glimpses of events along the way.

Emmy recalling a stroll with Olga Taussky near Bryn Mawr College, 1934/35.

On Sunday, September 4, I picked up Sandra, Anita, and Rudi Hausmann at the Charlotte, North Carolina, airport, from where we drove to Columbia, South Carolina, for the initial performance at the University of South Carolina's Longstreet Theatre. We received a warm welcome in Columbia from Leah McClimans and Allison Marsh, codirectors of the Ann Johnson Institute for Science, Technology and Society, along with Bethany Johnson. Their choice of the venerable Longstreet, a theater in the round, fit nicely with Emmy's penchant for dialogue and Anita's interactions with her audience. Leah and Allison also arranged for a lively Q&A session at the conclusion of the play. The relaxed atmosphere and friendly crowd made for a perfect launch of the tour, which continued two days later with a performance at the University of Virginia (UVA).

Ken Ono, chair of the UVA math department, made all the local arrangements with the help of some colleagues in other fields. They chose the impressive theater in Old Cabell Hall, a venue normally used for musical performances. Sandra's first task before rehearsals involved scoping out the technical facilities available, beginning with the sound system. She runs the audio-visual components from her laptop computer, while in most cases, a technician coordinates with her to create lighting effects. That arrangement proved unfeasible at UVA, however, so she opted to do both jobs at once from a hallway offstage, which sometimes proved physically challenging. Anita put on an impressive showing before a crowd of some 150 appreciative attendees, including the *Mathematical Intelligencer*'s co-editor-in-chief Karen Parshall and historian of mathematics Adrian Rice. Ken Ono also hosted a lunchtime gathering earlier that day, which gave students and faculty a chance to converse with the director and actress.

From Charlottesville, we flew to Boston and boarded a taxi for the ride from Logan Airport to Cambridge, where we were the guests of Harvard's Department of Mathematics. The rehearsal took place early on Saturday, September 10, in preparation for a late-afternoon performance at the Hilles Student Center, just off Garden Street. Preceding this was a brief panel session, at which I spoke alongside Harvard's Barry Mazur and Melissa Franklin. The panel also featured Monica Noether, a grandniece of Emmy Noether. Her cousin, Margaret Noether Stevens, also attended this performance. The Harvard staff did a marvelous job in organizing this event, especially in preparing the lavish reception that took place afterward. Many lingered to share their excitement over the play and congratulate the two women who created it. An amusing moment came when Barry Mazur began telling a small group around him about how much he liked the performance. In the meantime, Anita had changed into a party dress and appeared as her "real self" for the reception, a transformation that fooled Barry completely. He hadn't realized at all that "Emmy" was standing right next to him as he spoke.

The second leg of the tour took us to the Midwest, following the same Tuesday, Thursday, Saturday schedule as before. On Monday, we flew from Boston to Detroit and then drove to Ann Arbor, where the University of Michigan's Departments of Mathematics and Physics rolled out

the red carpet. The Inn at the Michigan League, where we stayed, is part of its majestic alumnae building on the old campus, a place I hadn't visited in almost fifty years. We walked around the quad, marveling at the architecture while enjoying its overall scenic beauty. Sandra and Anita also took special delight in another aspect of the campus that many take for granted: its wildlife, especially the numerous squirrels hanging on tree limbs and the occasional chipmunks they spotted darting around bushes. Our living quarters could not have been more conveniently located either, since the Michigan League building also houses the Lydia Mendelssohn Theatre, a massive auditorium with excellent acoustics. Sandra had the opportunity to work with a highly professional theater crew who helped her sharpen the lighting effects during the rehearsal. Both she and the Michigan team were delighted with the results.

Advance publicity for the performance was also very successful; we learned afterward that the organizers sold 301 tickets for the event. That large crowd in Ann Arbor was certainly upbeat, and Anita brought down the house with a stunning performance. She also had the pleasure of meeting the physicist Jens Zorn, son of the algebraist Max Zorn (of Zorn's lemma fame), whose work was appreciated by Emmy Noether. In fact, the Zorn family came to the United States on the same ship that brought Emmy to Philadelphia on her way to Bryn Mawr College. Jens was only three years old at the time, and when his mother became seasick during the journey, Emmy offered to take care of him. Since then, he enjoys telling his story about how he became the youngest-ever "Noether boy."

Physicists also came out in large numbers on the next two stops, starting with Notre Dame, where another large crowd saw *Diving into Math* at the Debartolo Performing Art Center. Sandra and Anita again had the opportunity to work with a staff of professional theater technicians, a luxury most places could not make available. The director of the Joint Institute for Nuclear Astrophysics, Michael Wiescher, spearheaded this invitation to South Bend, ably assisted by Janet Weikel. We were fortunate that he was also able to take a good deal of time out of his busy schedule to devote to our little group, including a tour of Notre Dame's impressive Nuclear Science Laboratory.

Michael has enjoyed a longstanding collaboration with Hendrik Schatz, a professor at Michigan State's gigantic Facility for Rare Isotope Beams (FRIB). Both institutions hosted Portraittheater five years ago, when they performed their play *Curie, Meitner, Lamarr—Indivisible*, so they welcomed this opportunity to return with Emmy (even though she likes to poke fun at the physicists' efforts to claim her as one of their own!). Ana Becerril Reyes, the director of FRIB, helped ensure that all went smoothly, and the audience for the Saturday performance was surprisingly large and enthusiastic. At Michigan State University, Rudi Hausmann took charge of operating the lights at the back of the auditorium, in addition to his usual tasks assisting with the props at rehearsals and following performances. He dubbed us the "Noether boys," though my workload only amounted to running occasional errands, such as buying pudding, a critically important prop.

Our early flight on Sunday, September 18, from Detroit to LaGuardia Airport, in Queens, New York City, brought us back east for the last three stops on the tour. My longtime friend John McCleary took charge in hosting us at Vassar College in New York's beautiful Hudson Valley region. The night before the Tuesday performance, Sandra, Anita, and I chatted with members of John's reading group, many from Vassar's faculty, who came to discuss the book *Proving It Her Way*. Several of the same faces we saw at our discussion session reappeared again the next night. The following morning, we got up early to see the sunrise from a vantage point on Poughkeepsie's walkway over the Hudson. That marked the beginning of a long day for me.

At Bryn Mawr College, our next stop, Leslie Cheng had asked me to speak following the Math Department's Wednesday dinner gathering. Before then, she and the entire faculty would be attending a meeting. So Leslie arranged for two accommodating students to give us a tour of the campus, including Emmy Noether's gravesite at the cloisters of the old library. As it turned out, the "after dinner" talk wasn't scheduled to take place while we were finishing dessert after all, but rather back at the building that housed the Math Department. So I took yet another walk across campus, which made me wonder how many miles I'd logged by the end of that day.

Our visit to Bryn Mawr College was one of the real highlights of a tour full of memorable moments. Sandra was delighted with the technical support she received at the Hepburn Teaching Theater, and Anita's performance was probably her finest of all nine. A full house of about 140 packed into an intimate black box theater; many were young women students who already knew about Emmy Noether's years at Bryn Mawr. College president Kim Cassidy opened the play by thanking those who had made that evening's event possible. Among those she named was Qinna Shen, professor of German Studies, who happened to be away on sabbatical in Berlin. Her research—leading to an article about Emmy Noether at Bryn Mawr in the *Mathematical Intelligencer*[2]— had done much to raise local awareness of that short chapter in the college's history. Qinna had promoted efforts to bring *Diving into Math* to Bryn Mawr from the time I first wrote her about that possibility, and we all hope and imagine that she will have the opportunity to take in a performance in the near future.

For our final stop at Hunter College, City University of New York, we were also partially indebted to Qinna Shen. In early 2020, she was planning to speak about Emmy Noether at a meeting arranged by the Bryn Mawr Club of New York. That event, too, fell by the wayside due to the outbreak of the pandemic. While I was organizing the 2022 tour, Qinna suggested approaching the association of New York Bryn Mawr alumnae to see whether they could line up a venue in Manhattan, which led to the arrangement they worked out with Hunter. To make the event happen, three donors generously provided funding for that final performance:

[2]Qinna Shen. "A Refugee Scholar from Nazi Germany: Emmy Noether and Bryn Mawr College." *Mathematical Intelligencer* 41:3 (2019), 52–65.

John Ewing (president of Math for America), Matt Stanley (Gallatin School, New York University), and Michael Harris (Columbia University). Sabrina Seidner and her daughter offered technical assistance that Saturday and organized a delightful reception afterward. Several who stayed on, including another family relative, Evelyn Noether Stokvis, congratulated Anita on her ability to convey a real sense of Emmy's personality.

Since I had never before experienced the inner workings of a theatrical production, this whirlwind tour left me quite in awe of the energy that Sandra and Anita put into their work.

A great deal of behind-the-scenes effort goes into producing these types of multimedia plays, which require attention to many other aspects beyond the initial script writing. Among other tasks, the team must locate venues for the film scenes, prepare costumes and props, but also compose and record music while coordinating the audio-visual segments with lighting effects. Beyond these technical challenges, the director and actress work carefully on developing the body language used to convey the character of the person portrayed on stage. In the case of Emmy Noether, the audience also hears her reflecting on her physical presence, particularly the way others perceived her as a rather unfeminine type of woman. In the play, such reflections lend her figure a quality that stands outside time, as a selfless creature in a man's world, a realm in which selflessness seldom surfaced. Very few mathematicians offer similar possibilities for presentation on stage, but that Portraittheater Vienna was able to realize these is a truly impressive accomplishment. The play *Diving into Math with Emmy Noether* achieves yet another significant accomplishment, however. It evokes the sense of a broader kind of mathematical community uniting actors, mathematicians, physicists, and the larger public around the person of one of the most fascinating women in twentieth-century mathematics.

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