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Features

Against the odds

by Danielle Stretch

Emmy Amalie Noether

Emmy Amalie Noether was born on March 23rd 1882 to a middle class Jewish family in the small Bavarian town of Erlangen. Her father, Max Noether, was a distinguished professor of mathematics at the University of Erlangen.

She was described as a "clever, friendly and rather endearing" child who grew up to love parties and dancing as well as absorbing the family atmosphere of mathematics and education. Educational opportunities at the time for a girl growing up in German were few with German schools for middle−class girls being little more than finishing schools.

For three years Emmy studied to pass the teacher training program that would allow her to teach English and French in a girls school. Totally unexpectedly, at the age of eighteen, Emmy decided that she would not become a schoolteacher but that instead she would spend the next two years auditing classes at the University of Erlangen.

German women were not then allowed to obtain university degrees but could ask for a professor's permission to sit in on his classes. It was by no means certain that this would be granted but, fortunately for Emmy, she was asking permission from family friends and they agreed.

Still intending to become a schoolteacher, Emmy signed up to audit foreign language classes but took some mathematics classes as well. (There were two women auditors and two thousand male students at Erlangen between 1900 and 1903). As a result of these classes, Emmy made the radical decision to abandon school teaching and make a career as a mathematician.

In 1904 a relaxation in the rules forbidding women to be awarded degrees meant that Emmy was allowed to matriculate and she went on to complete a virtuoso doctorate filled with computations and manipulations in 1907. With typical earthy frankness she later went on to describe her thesis as "crap". Women were not allowed to fill academic posts so Noether spent the next eight years working for the university without pay or position and helping her increasingly frail father with his teaching responsibilities.

David Hilbert, widely considered to be the greatest mathematician of his time, met Emmy and her father when they paid an extended visit to the University of Göttingen. Hilbert and Felix Klein persuaded Emmy Noether to come to Göttingen and then embarked on a long campaign to have her appointed to a faculty position in spite of the Prussian law passed in 1908 which prohibited this. Noether was refused a university position but permitted a compromise − she could lecture but only if the lecture was listed under Hilbert's name rather than her own.

Albert Einstein wrote to Felix Klein in 1918, "On receiving the new work from Fraülein Noether, I again find it a great injustice that she cannot lecture officially". Finally, in 1919, Noether was granted the lowest faculty rank of "Privatdozent" and, although still unpaid, began teaching that autumn.

In 1922 Noether was appointed to the position of "unofficial, extraordinary professor", in effect, a volunteer professor without pay or official status and she was later granted a tiny salary which was barely at subsistence level. When postwar hyperinflation destroyed the value of her small inheritance Emmy had very little left to live on. She pared her life down to the essentials, "She didn't have very much money, but also she didn't care" her nephew, Herman Noether, explained. During the week, Noether ate the same dinner at the same table in the same cheap restaurant.

Noether published what is generally known as her most important paper, "Theory of Ideals in Rings" in 1921 which was of fundamental importance in the development of modern algebra. From a physicist's perspective her most important accomplishment came to be known as "Noether's Theorem", which proves a relationship between symmetries in physics and conservation principles. For example, the equations describing ordinary dynamics do not depend on where the origin of the co−ordinate system is. Noether's theorem shows that this implies that momentum is conserved.

German mathematics, like much else, became highly politicised in the 1930's. Few German academics opposed Hitler's rise to power and one of Noether's research students, Werner Weber, organised a boycott of Professor Edmund Landau's classes because he was Jewish. Hitler then began firing Jewish professors from the Universities in a bid to remove Germany from the "satanic power" of the Jews. Noether was one of the first six professors fired from Göttingen because she was both Jewish and politically liberal. The expulsion of Jewish academics devastated the University of Göttingen. Hilbert, asked by a Nazi official on the state of mathematics in Göttingen replied, "Mathematics in Göttingen? There really is none any more".

Noether's friends started a frantic search to find her a university position abroad. Eventually, she was granted a temporary one−year position on a modest salary at a small women's college, Bryn Mawr, in the United States. Finding her a permanent position proved difficult, as there were too many Jewish refugees and too few places who wanted to hire them. By 1935 enough funds were scraped together together to support Noether at a reduced salary for another two years.

Emmy then went into hospital to have surgery for the removal of a large ovarian tumour. For a few days it appeared that the surgery had been successful but then she suddenly lost consciousness and died of what appeared to be a post−operative infection. Sadly, Emmy died in exile in her early fifties at the height of her creativity and powers.

Hermann Weyl said of Emmy Noether during the troubled Summer of 1933 when the Nazis rose to power, "Her courage, her frankness, her unconcern about her own fate, her conciliatory spirit were, in the midst of all the hatred and meanness, despair and sorrow surrounding us, a moral solace".

About the author

Danielle Stretch has spent the past eight years working for the Department of Applied Mathematics and Theoretical Physics at Cambridge University. Prior to that, she worked in various administrative positions for visual artists, politicians, writers and engineers. She says that working for a mathematics department has changed the way that she thinks about the subject. "Before working here I did not have any conception of how mathematical research operated or how, in a different way, it is every bit as creative and exciting as working in the arts and with its own sort of beauty".

Plus is part of the family of activities in the Millennium Mathematics Project, which also includes the NRICH and MOTIVATE sites.