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ABOUT EMMY NOETHER

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Human beings are often characterized in terms of dichotomous classifications: "X or not X". There seem to be three such classifications that were very relevant to Emmy Noether's life.

Probably the most serious was religious/ethnic ancestry: she was a Jew living in Nazi Germany, at a time when being a Jew there put one at high risk of persecution or even death.

She was also a woman, which subjected her (and many women of many nationalities) to being classified as inferior in skills such as thinking and, in particular, mathematics. Nonetheless, she pursued a profession in mathematics and did well in it, defying the stereotype. In addition, her high quality of mathematical research led to her being offered a position in mathematics at Bryn Mawr College in the United States, thus avoiding the worst possibilities for a Jew in Germany at that time.

Each of these two dichotomies is familiar to most people. But there is another dichotomy that (at least in Noether's time) existed *within* the profession of mathematics: it existed between those who approached mathematics in concrete terms and those who approached it in abstract terms. Emmy Noether was in the latter group. This is described well in the following quote from Franz Lemmermeyer and Peter Roquette's book, [3]:

> The name of one of the correspondents, Emmy Noether (1882–1935), is known throughout the worldwide mathematical community. She has been said to be
> - "the creator of a new direction in algebra",
> - "the greatest woman mathematician who ever lived".
>
> These are only some of the attributes which have meanwhile been bestowed upon her in so many articles and speeches. A number of

FIGURE 1. CLEAR COPY OF THE COVER. Portrait of Emmy Noether, circa 1900.

scientific institutions and projects carry her name as an icon. There is a serious Noether literature trying to understand and evaluate her impact on the development of mathematics up to the present time. In the course of time her "new direction in algebra" has become standard not only in algebra but also in general mathematical thinking, namely to work with mathematical structures, these structures being based on abstract axioms. In a way our book can be viewed as part of this Noether literature, presenting a new and unique collection of Noetheriana. These Hasse–Noether letters are packed with mathematics, and they throw new light on how Emmy Noether arrived at her ideas and how she conveyed them to her peers. Through her open, unconventional and impulsive style, she allows us to have a glimpse not only into the working of her brain but also into her heart.

One of Noether's earliest and most noted results from this abstract approach was an important result in physics: *Noether's theorem* (or *Noether's first theorem*), which states that every differentiable symmetry of the action of a physical system with conservative forces has a corresponding conservation law. (See Nina Byer's paper [1] for more detail.)

Noether's abstract approach also has had lasting influence on the teaching of mathematics. Several of her students (and later *their* students) have written textbooks based on her lectures. These include:

- Van der Waerden's *Algebra* [4, 5]. This is based on lectures by E. Artin and Noether; see reviews at `https://books.google.com/books/about/Algebra.html?id=XDN8yR8R1OUC`.
- Serge Lang's *Algebra* [2]. In turn, Artin's student Serge Lang says in the preface to his textbook, *Algebra* (1965), "Since Artin taught me algebra, my indebtedness to him is all-pervasive", and "The order of the book is still remarkably like that given by Artin–Noether–Van der Waerden some thirty years ago."

References

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