Reviews

Emmy Noether – mathematician extraordinaire by David E. Rowe, pp 339, £74.99 (paper), ISBN 978-3-03063-812-2, Springer Verlag (2021)

In 2021, Springer published '*Proving it Her Way: Emmy Noether, a Life in Mathematics*', which was co-authored by David E. Rowe and Mechthild Koreube. That book, which emphasises the circumstances of Emmy Noether's personal life, is not prerequisite reading for this later volume, which, written solely by David Rowe, is a companion volume with the emphases reversed. Its general aim is to examine Noether's role in 'transforming the mathematics of the twentieth century'. However, the political and social milieu of early twentieth century Europe, and its effect on her professional development, are the subject of extended discussion here.

Emmy Noether (1882-1935) was the daughter of the renowned algebraic geometer Max Noether, and she eventually became far more famous than he was. Indeed, she was described by Hermann Weyl as not only the greatest mathematician her sex had ever produced, but a great mathematician *per se*. Her achievements were all the more impressive because she had to overcome prejudice against women in the German universities. In the 1930s, she faced the increasing persecution against Jewish persons from the Nazi regime, and she therefore relocated to the USA in 1933.

David Rowe begins with an account of Noether's family background and the difficulties she faced in gaining entry to university education. She was endowed with sanguine perseverance that enabled her to overcome prejudice towards female participation in higher education and which eventually led to her achievement of doctoral status in 1907. Having attended lectures by Paul Gordan, David Hilbert and other mathematical luminaries, she formed contacts that proved to be significant for her ongoing mathematical development.

Early in her career, as a specialist in invariant theory, Noether acted as a mathematical intermediary between David Hilbert and Albert Einstein on mathematical aspects of general relativity. Her understanding of invariant theory established a connection between Hilbert's energy vector and Einstein's pseudo tensor for gravitational energy. Possibly because he was so preoccupied with his own intellectual endeavours, Einstein provided little acknowledgement of Noether's contributions.

Following collaboration with Alexander Ostrowski, Noether's interests gradually shifted towards algebra. With encouragement from Felix Klein, and continuing support from David Hilbert, she eventually became a notable algebraist. In 1921, aged 39, she published a highly innovative paper on ideal theory that greatly influenced subsequent trends in ring theory.

Described as the 'mother of modern algebra', Noether became the central figure in the dynamic school that was the heart of the Göttingen mathematical community. Participants included B. L. van der Waerden, P. S. Alexandrov, Helmut Hasse and Olga Taussky. Moreover, Noether's papers on ideal theory inspired van der Waerden's work in algebraic geometry, while her lectures on group theory led Alexandrov to develop links between topology and combinatorial methods.

Emmy Noether's achievements were not restricted to her own mathematical research. She provided great support for young mathematicians and was most generous with her time and the sharing of her expertise. Although her lectures were generally regarded as poorly presented, she excelled in small group discussions and was equally adept at listening and explaining. The final years of her mathematical life were spent at Bryn Mawr women's college in the USA and she died in 1935 at the age of 53.

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Throughout this book there is discussion of a great variety of mathematical topics, many of which I had forgotten or about which I had little prior knowledge (class field theory, dimension theory, Noetherian modules and ascending/descending chain conditions, etc). There are many extracts from letters between mathematicians on such matters, and much concentration is needed to maintain a grip on the narrative. But David Rowe is to be congratulated on the production of this fine book. He provides a vivid presentation of Emmy Noether as a warmly magnanimous person and gives an exact account of her achievements in the context of early twentieth century mathematics.

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The new era in American mathematics: 1920-1950 by Karen Hunger Parshall, pp. 640, £40 (paper), ISBN 978-0-69123-524-0, Princeton University Press (2022)

In the history of mathematics, a few decades can make a huge difference. Research mathematics came fairly late to the United States, and it was not until the end of the nineteenth century that the United States began really to develop a research agenda. At the beginning of the twentieth century, the US was hardly a mathematical superpower. But by 1945, things had improved to the point where John Kline, who at the time was Secretary of the American Mathematical Society, could write that the US "has assumed world leadership in mathematics".

This book, by historian and mathematician Karen Hunger Parshall (co-author, with David Rowe, of *The Emergence of the American Mathematical Research Community, 1876-1900,* reviewed in the March 2000 issue of this journal), tells the story of how the United States got to that position. It is an interesting and important book, meticulously researched and engagingly written, and will no doubt become the definitive account of this chapter in mathematical history.

Prior to looking at this book, I had not given a great deal of thought to the question of how mathematics in the United States developed. I suppose I just assumed that its growth was the result of the influx, starting in the late 1930s, of European mathematicians fleeing from a continent that was about to be ravaged by war. Certainly this was a factor, but Parshall compellingly argues that there were significant additional considerations.

The book is divided into three multi-chapter parts, each part corresponding (to within a year or two) to one of the decades from 1920 to 1950. In the first part (1920–1929), Parshall begins by surveying the initial state of American research, discussing not only the mathematicians involved but where they were located. She also discusses important developments that allowed for future mathematical research, such as Veblen's successful efforts in persuading the Rockefeller Foundation to extend their research grants to cover mathematics as well as physics and chemistry.

The stock market crash of late 1929 ushered in the Great Depression of the 1930s, a decade that was also characterised by several waves of mathematicians emigrating from Europe to the United States. These events are chronicled in Part II of the book, covering the time period 1929–1941. This period saw the development of several mathematical institutions, including the Institute for Advanced Study. Parshall discusses the development of these programs, and surveys the research landscape in such areas as algebra and topology.

The 1940s were, of course, dominated by World War II. In Part III of the book (1941–1950) Parshall looks at the effect of the war and its aftermath on the development of American mathematics. Unlike the situation in World War I, mathematicians were not