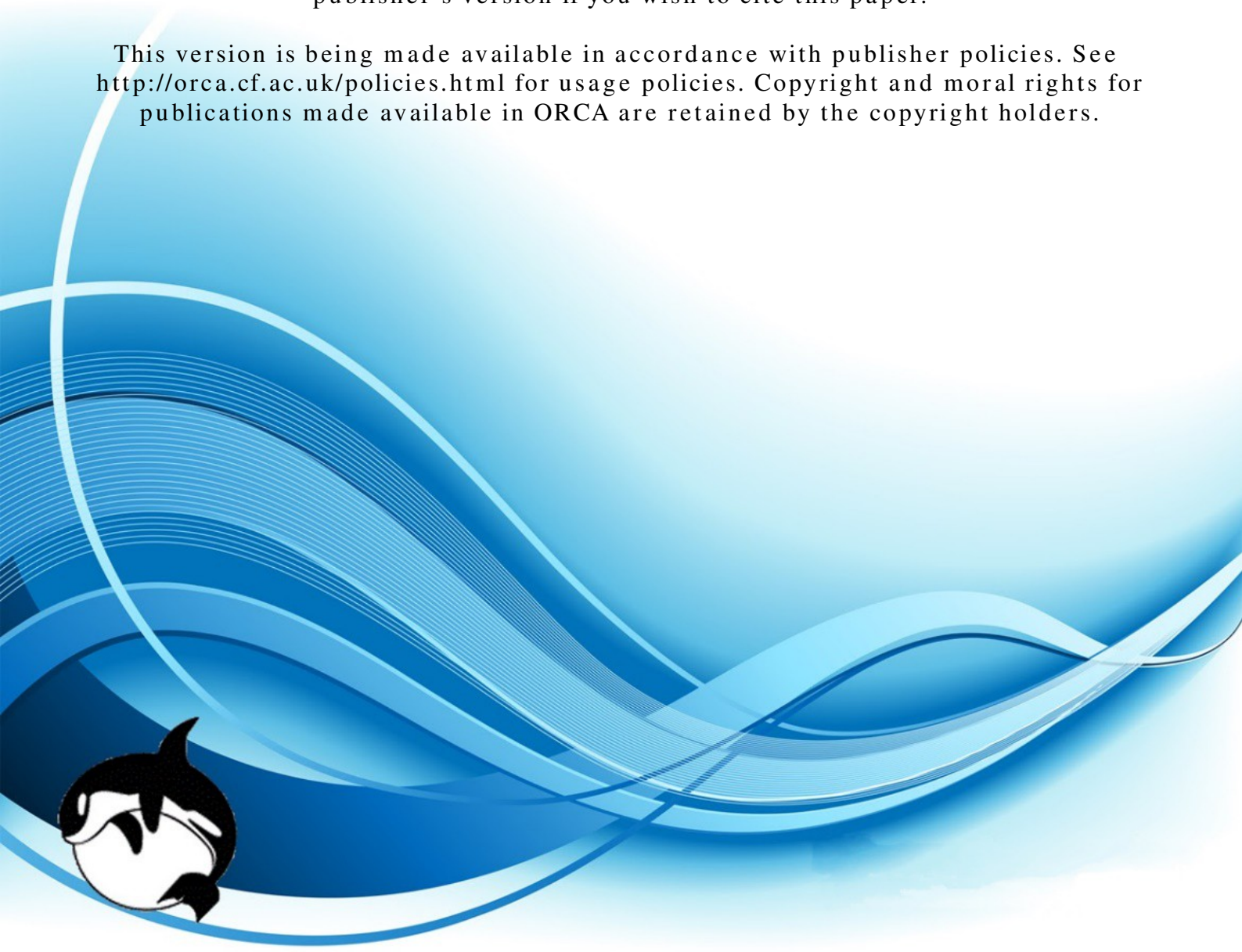
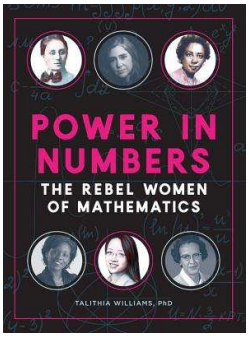


Power in Numbers: The Rebel Women of Mathematics

by Talithia Williams, Race Point Publishing, 2018, ISBN: 978-1-63106-485-2

Review by L. Angela Mihai



"Power in Numbers: The Rebel Women of Mathematics" by Talithia Williams is a celebration of the temerity of women mathematicians who made history through their contributions to mathematics, while breaking down barriers that stood in the way of equal opportunity and freedom from discrimination, in science and beyond. From Hypatia's conic sections and violent death in 415, to 19th century first PhD graduates, to WWII code breakers and modern day leaders, the list was bound to be whittled down. And the selection could not have been easy.

The first part concentrates on "The Pioneers", who laid the foundation of modern university education and made significant mathematical breakthroughs. It begins with brief biographical sketches of Marie Crous, the French mathematician who introduced the decimal system in the 17th century, Émilie du Châtelet (1706-1749), who published "Institutions de Physique" (Foundations of Physics), where she explained and analysed the mathematical ideas introduced by Gottfried Leibniz, and Maria Gaetana Agnesi (1718-1799), who wrote "Instituzioni Analittiche" (Analytical Institutions), an early textbook on calculus, which includes also an illustration of the curve known today as the 'Witch of Agnesi' (p. 13). In recognition of their work, du Châtele was elected to the Academy of Science of the Institute of Bologna (1746), and Agnesi was appointed by Pope Benedict XIV to the chair of mathematics and natural philosophy at the University of Bologna (1750). The short biographical profiles continue with Philippa Fawcett (1868-1948), the first woman to score a top mark in the Mathematical Tripos exam at the University of Cambridge, England, though she was not officially ranked, then Isabel Maddison (1869-1950) and Grace Chisholm (1868-1944), who earned the equivalent of first-class degree at Cambridge, but were not allowed to receive a degree, and later continued their education abroad. More extensive biographical portraits commence with Wang Zhenyi (1768-1797), who studied astronomy and mathematics, and whose scientific work included a five-volume guide, "The Simple Calculation Principles", a paper on gravity, and the article "The Explanation of a Lunar Eclipse". Zheny was also an accomplished poet, concerned with important social issues, such as the gap between rich and poor, and equal opportunities for women and men. Portrayed next is Sophie Germain (1776-1831), who used a male pseudonym to sign her work before Joseph-Louis Lagrange, and then Carl-Friedrich Gauss, with whom she corresponded anonymously, impressed by her mathematical proofs, met with her in person. Then, follow Winifred Edgerton Merrill (1862-1951), the first American woman to graduate with a PhD in mathematics, and the celebrated Sophia Kovalevskaya (1850-1891) and Emmy Noether (1882-1935), who need no introduction. It is noted that Kovaleskaya also published anonymously (p. 31), while her personal profile emerges as romantic and passionate. Noether, who "lived for mathematics", is described as "warm, caring and tough" (pp. 40-41). There is also a picture of a postcard scribbled with algebra, which she sent to Ernst Fisher in 1915, looking very much like tweet or an email message today (p. 38). This part concludes with a spotlight on Euphemia Haynes (1890-1980), the first African-American woman to earn a PhD in mathematics, who denounced the segregated system, and remained an advocate for equal education throughout her life as well. She also spoke of the connection between the pursuit of mathematics and world peace.

The second part, "From Code Breaking to Rocket Science", is probably the heart of the book, and is dedicated to those glorious times when the door was

thrown wide open with a blast. Unfortunately, it was not peace but war that made this happen. Featured first is the American Navy officer and creator of the first computer compiler, Grace Hopper (1906-1992), whose team came up with the terminology 'bug' and 'debugging' in computer software (p. 59). Then, the Cherokee-American rocket scientist Mary Golds Ross (1908-2008), and the African-American 'human computers' and Hidden Figures, Dorothy Vaughan (1910-2008), Katherine Johnson (b. 1918), and Mary Jackson (1921 -2005), who, until their contribution proved vital, endured both gender discrimination and racial segregation at NASA of the time. In recognition of her life-time work, Katherine Johnson was awarded the Presidential Medal of Freedom by Barack Obama in 2015. However, the spotlight here is on the Indian writer ,and extraordinary 'mental calculator', Shakuntala Devi (1929-2013), who, in 1977, beat a Univac computer by extracting the 23rd root of a 201-digit number in under a minute, and, in 1982, made it into the Guinness Book of World Records after multiplying two 13-digit numbers in her head. Concluding this part is the Apollo scientist Margaret Hamilton (b. 1936), who coined the expression 'software engineering' (p. 93), a field which she helped to create, and who was awarded NASA's Exceptional Space Act Award in 2003. A picture also shows Barack Obama awarding her the Presidential Medal of Freedom in 2016.

The book's third and final part is devoted to the "Modern Math Mavens", where the list, though quite extensive, is naturally open to new additions. Portrayed here are, among others: the first African-American Section Governor in the Mathematical Association of America Sylvia Bozeman (b. 1947); the mathematician and pianist Eugenia Cheng (b. 1976), who authored several popular books and appeared also on television shows; the only female winner of the 2016 European Mathematical Society Prize, Iranian-born, Sara Zahedi (b. 1981); and the first, and so far, the only woman Fields Medallist Maryam Mirzakhani (1977-2017). Although this part's spotlight is on Daina Taimina's research (b. 1954), and her out-of this-world 'crochet models of hyperbolic planes' (p. 137), the mathematical contributions of these contemporary women range across all different areas, including: algebraic geometry, Bayesian networks, dynamical systems, mathematical biology, probability theory, quantum mechanics, wavelet analysis, and much more.

This beautifully printed and well documented book provides inspiration for all who strive to live in a world free from bias, while honouring the creative spirit of women mathematicians throughout history. Talithia Williams' new book is definitely a most welcome contribution that will educate and encourage many aspiring mathematicians.

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