

Sophia Jaffer, 2nd year (BA History)
College of Humanities, University of Exeter

Sofia Kovalevskaya



Figure 1: An image of Sofia Kovalevskaya (©Creative Commons)

Far Side of the Moon: The Life and Work of Sofia Kovalevskaya (1850-1891)

Hidden from our sight on the far side of the moon, the prominent lunar impact crater Kovalevskaya spans 115,000 metres in diameter. Alongside ‘Asteroid 1859 Kovalevskaya’, located in the asteroid belt between Mars and Jupiter and discovered in 1972 by L. V. Zhuravleva, these astronomical phenomena document the legacy of Russian mathematician Sofia Kovalevskaya.¹ Sofia Kovalevskaya (also Sofya, Sonia, Sonja, Sonya and Sofie) is most well-known for her contributions to analysis, partial differential equations and mechanics, and her position as the first woman to receive a doctorate in mathematics in modern Europe.² However, Kovalevskaya is also recognised for her influence in literature and for her role in advancing women’s right in the nineteenth century. As such, Kovalevskaya was heralded as an example of women’s abilities in her contemporary Russia, and we can similarly recognise her for her scholarly importance in the modern world of mathematics and beyond.³

Sofia was born on 15 January 1850, to Lieutenant Colonel Vasily Vasilyevich Korvin-Krukovsky and Yelizaveta Fedorovna Schubert.⁴ Kovalevskaya came from a line of talented mathematicians; her mother’s father was a military topographer and her grandfather, an

¹ D. R. Altschuler, and F. J. Ballesteros, *The Women of the Moon: Tales of Science, Love, Sorrow, and Courage* (Oxford: Oxford University Press, 2019), p. 125.

² M. A. Rygiel, ‘Sofya Kovalevskaya’s A Russian Childhood As Poetic Autobiography,’ *Biography*, Vol. 10 (3), (1987), p. 209.

³ E. V. Shabily, *The Early Women’s Emancipation Movement: Formation of New Female Identity in the Russian and Late-Victorian Novel* (Tulane University, 2016), p. 136.

⁴ D. R. Altschuler, and F. J. Ballesteros, *The Women of the Moon: Tales of Science, Love, Sorrow, and Courage* (Oxford: Oxford University Press, 2019), p. 117.

accomplished astronomer.⁵ In her youth, her interest in mathematics was sparked when she wallpapered her room in Palibino with notes from Professor Mikhail Vasilyevich Ostrogradsky on integral and differential calculus. Her adept interest was second only to her natural talent, which fuelled her desire to pursue a mathematical career, despite contemporary expectations for her gender. Russian women were thought of as intellectually inferior to men and expected to raise children, maintain a home, and serve their husbands.⁶ Kovalevskaya entered marriage to Vladimir Onufrievich Kovalevsky (in name only) to travel, joining a group that aspired to free female members to travel abroad and pursue higher education.⁷ Kovalevskaya faced opposition primarily from university administration and society throughout her career, rather than from mathematicians.⁸

Her requests to enrol in the University of Heidelberg were consistently denied, but some professors –including the mathematician Leo Königsberger –allowed Sofia to unofficially attend their classes.⁹ For much of her early career, Kovalevskaya studied privately under the supervision of Karl Weierstrass (1815-1897), an influential figure in mathematical analysis.¹⁰ Her work with Weierstrass culminated in three papers considered by the University of Göttingen: on –respectively –the geometry of Saturn’s rings, Abel integrals and partial differential equations. Based on these papers, the University granted her a doctorate in absentia, summa cum laude, in 1874 at only twenty-four years of age. Kovalevskaya became a member of the Mathematical Society of Paris in 1882 and shaped history when she gave her first class on differential equations to twelve enrolled students at the University of Stockholm. Furthermore, she was appointed as the first female editor of the prestigious *Acta Mathematica* by Gösta Mittag-Leffler.¹¹ Kovalevskaya was well-respected in her field and fostered fruitful working relationships with mathematicians across Europe, including Jules Henri Poincaré (1854-1912), Charles Émile Picard (1856-1941) and Pafnuty Lvovich Chebyshev (1821-1894).¹²

Alongside her achievements in mathematics, Kovalevskaya is also recognised for her work in literature and women’s rights. Certainly, Kovalevskaya navigated circles of women who were all influential ‘firsts’ in their respective fields.¹³ Scholars have paid particular attention to her

⁵ M. A. Rygiel, ‘Sofya Kovalevskaya’s A Russian Childhood As Poetic Autobiography,’ *Biography*, Vol. 10 (3), (1987), p. 208.

⁶ D. R. Altschuler, and F. J. Ballesteros, *The Women of the Moon: Tales of Science, Love, Sorrow, and Courage* (Oxford: Oxford University Press, 2019), p. 117.

⁷ M. A. Rygiel, ‘Sofya Kovalevskaya’s A Russian Childhood As Poetic Autobiography,’ *Biography*, Vol. 10 (3), (1987), p. 208.

⁸ E. V. Shabily, *The Early Women’s Emancipation Movement: Formation of New Female Identity in the Russian and Late-Victorian Novel* (Tulane University, 2016), p. 138.

⁹ D. R. Altschuler, and F. J. Ballesteros, *The Women of the Moon: Tales of Science, Love, Sorrow, and Courage* (Oxford: Oxford University Press, 2019), p. 119.

¹⁰ E. V. Shabily, *The Early Women’s Emancipation Movement: Formation of New Female Identity in the Russian and Late-Victorian Novel* (Tulane University, 2016), pp. 158-159

¹¹ D. R. Altschuler, and F. J. Ballesteros, *The Women of the Moon: Tales of Science, Love, Sorrow, and Courage* (Oxford: Oxford University Press, 2019), pp. 120-122.

¹² E. V. Shabily, *The Early Women’s Emancipation Movement: Formation of New Female Identity in the Russian and Late-Victorian Novel* (Tulane University, 2016), p. 158.

¹³ M. A. Rygiel, ‘Sofya Kovalevskaya’s A Russian Childhood As Poetic Autobiography,’ *Biography*, Vol. 10 (3), (1987), p. 209.

novel *A Nihilist Girl* (1890) and memoir *A Russian Childhood* (1889), which reflects the experience of upper-class girls in 1860s Russia.¹⁴ Despite the opposition she faced throughout her career, Kovalevskaya was raised amid a wider “nihilist” movement which saw science as the key to a better future and advocated for equal rights for men and women. Her tumultuous marriage to Vladimir Onufrievich Kovalevsky initially established to allow her freedom of travel and access to higher education, led to the birth of her daughter Fufa in 1878 but ended with Vladimir’s suicide in 1883.¹⁵ Experiences in her personal life reflect her wider interest in advancing women’s rights. Kovalevskaya was deeply concerned with the ‘woman question’ and dedicated herself to social activism; in 1878, she organised the ‘Higher Courses for Women,’ seen as a ‘stepping stone’ to the creation of the first women’s university.¹⁶

Her varied and influential work has culminated in significant interest from scholars and laymen alike, including a particular interest in physical descriptions of her appearance.¹⁷ Kovalevskaya has received unsubstantiated allegations of affairs, likely due to her position as a woman in a predominantly male field.¹⁸ While her autobiography was initially well-received, it subsequently fell into obscurity, primarily due to its inaccessibility in English and a general disinterest in the lives of mathematicians. However, more recent interest in Rygiel’s *A Russian Childhood* brings the compassion and understanding she so meticulously provided to the fore. In the words of Rygiel, Kovalevskaya presents ‘a reflection on a childhood past by a mature mathematician.’¹⁹

In many ways, the legacy of Sofia Kovalevskaya falls into the same traps that haunt many talented and influential women; scholarly preoccupation with appearance and a more general disinterest that emanates from a divide between mathematicians and non-mathematicians. As a mathematician, Kovalevskaya has left her legacy in analysis, mechanics, and partial differential equations. As a woman, Sofia Kovalevskaya’s life and work demonstrate her struggle to overcome adversity in an imbalanced society. Whether we are looking down at a book or up to the moon, the work of women like Kovalevskaya should remind us to continue working towards a world that provides equal opportunities for all.

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¹⁵ D. R. Altschuler, and F. J. Ballesteros, *The Women of the Moon: Tales of Science, Love, Sorrow, and Courage* (Oxford: Oxford University Press, 2019), pp. 117-122.

¹⁶ E. V. Shabily, *The Early Women’s Emancipation Movement: Formation of New Female Identity in the Russian and Late-Victorian Novel* (Tulane University, 2016), p. 160.

¹⁷ E. Kaufholz-Soldat, “[...] the first handsome mathematical lady I’ve ever seen!’ On the role of beauty in portrayals of Sofia Kovalevskaya,’ *BSHM Bulletin* Vol. 32 (3), (2017), pp. 198-199.

¹⁸ *Ibid.*, pp. 210-211.

¹⁹ M. A. Rygiel, ‘Sofya Kovalevskaya’s *A Russian Childhood* As Poetic Autobiography,’ *Biography*, Vol. 10 (3), (1987), pp. 210:222.

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