

## A Princess of Science? Becoming the first Woman Professor in Mathematics in Modern Europe

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### *Abstract*

In this paper I look at the process of becoming the first Woman Professor in Mathematics in Modern Europe by reading the personal and literary writings of Sofia Kovalevskaya. The paper emerges from a wider Leverhulme funded project of writing a feminist genealogy of 'automathographies', tracing women mathematicians' historical emergence as subjects of scientific knowledge, as well as creators of philosophy and culture. What I argue is that it is essential to throw light onto the social, cultural and political practices that some women mathematicians deployed in surpassing the restrictions and limitations of their gendered position and excel in the field of mathematical sciences and beyond. In this light I initiate a process of intense memory work against a wider background within which women mathematicians figure as exceptional, albeit marginalized, and largely unknown subjects, and not as active agents, whose scientific, philosophical and literary work has had a huge impact on the cultural formations of modernity and beyond. By highlighting the importance of memory work, as a way of understanding the lasting effects of the past into the present, I trace new paths in the field of gender and science studies to confront women mathematicians' marginalization within the archive and beyond.

Key words: archive, gender science studies, memory work, women mathematicians

‘Today we are announcing not the arrival of some vulgar member of royalty or another, high-ranking but insignificant person. No, the princess of science, Mme Kovalevskaya, has honoured our city with her visit and will be the first woman *privat docent* [lecturer] in all of Sweden.’<sup>1</sup> In November 1883, this is how Sofia Kovalevskaya’s arrival in Sweden was celebrated by a ‘democratic’ newspaper in Stockholm, as Kovalevskaya described it in a letter to her brother-in-law, Alexander Kovalevskii, written in December 1883. Kovalevskaya was both pleased and cynical about this exuberant but also immaterial celebration: ‘You see, I have been made into a princess too! They would be better to assign me a salary. Well, yes, perhaps they will do that too’<sup>2</sup>, she wrote in the same letter, already prefiguring her tenure, which would happen six years later.

Kovalevskaya’s disbelief notwithstanding, not everybody in Sweden, shared the joy of having the first woman professor in mathematics in modern history. After all, Stockholm University was a newly founded institution dominated by liberal minds. Kovalevskaya’s arrival was very differently received in Uppsala, a competing university, ‘the conservative centre of orthodox science and old tradition’,<sup>3</sup> as Kovalevskaya wrote to her friend Maria Jankowska-Mendelson, on 26 December 1883. In the same letter she also wrote about some aggressive events that occurred in Uppsala as a reaction to her academic appointment:

When the official announcement about my lectures was made in Stockholm, the Upsala mathematics students immediately posted these announcements in their society, and that led to a complete explosion of indignation among the Uppsala professors. One meeting, which went on all evening, was dedicated to vilifying me; they denied that I had any academic merits, hinted at the most monstrous and, at the same time, funny reasons for my arrival in Stockholm, etc.<sup>4</sup>

Kovalevskaya was both surprised and afraid by the Uppsala professors’ attitude, since ‘I did not expect so much fire from these honest and peaceful Swedes’,<sup>5</sup> as she confessed to her friend, noting that this animosity might have had wider effects: ‘Unfortunately, among the professors in Uppsala, are people who have great influence in Sweden. The King, who was the patron of the University of Stockholm, is now convinced that this educational institution could become a centre of freethinking and radical aspirations and has therefore turned his back on it’<sup>6</sup>, her letter concluded.

Moreover, her ‘princess’ status was demoted to a ‘Lady of Mathematics’ by the famous playwright August Strindberg in an article in *Dagens Krönika*, published a year later, after Kovalevskaya was formally appointed as associate professor, on 28 June, 1884: ‘To invite a

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<sup>1</sup> Sofia Kovalevskaya, *Memories and Letters* (Moscow: AN SSSR, 1951), 276. All translations from this collection are credited to ‘Knockhundred translations’, generously funded by the Leverhulme Trust.

<sup>2</sup> Kovalevskaya (1951), 276.

<sup>3</sup> *Ibid.*, 274.

<sup>4</sup> *Ibid.*

<sup>5</sup> *Ibid.*, 274.

<sup>6</sup> *Ibid.*

Russian Lady to Stockholm was only an expression of old-fashioned gallantry—and did not respond to the need of mathematics for the citizens in Stockholm’, he wrote.<sup>7</sup> Not only did Strindberg seem to know about the mathematical needs of his compatriots, but he also knew about what the world needed most: ‘At this moment the world has far more need of able mothers than professors in mathematics’.<sup>8</sup> Kovalevskaya’s appointment was thus a monstrosity for Strindberg, since ‘such abnormalities can be produced at any desired amount if one allows persons with special talent of mathematics to be narrowly educated into mathematical monsters.’<sup>9</sup> The worst thing that ‘a Lady in Mathematics’ could do was to ‘create unnecessary ambitions in the minds of young girls’.<sup>10</sup> The Uppsala Professors’ sexist attacks and Strindberg’s misogynistic and paternalistic arguments are not difficult to deconstruct in the twenty-first century. What I want to focus on in this paper, however, is the slow process of becoming a woman mathematician. In doing so I also consider how the wounding language of sexism, combined with the empty celebration of ‘gender equality’ reaches our days in different modalities and forms.

The paper emerges from a wider Leverhulme funded research project of writing a feminist genealogy of ‘automathographies’, a concept denoting the autobiographical desire of becoming a mathematician, which was coined by Paul Halmos in his influential book, *I want to be a mathematician: an automathography*.<sup>11</sup> In Halmos’ view, an automathography should not be conflated with an autobiography. But is there such a divide or separation possible? Throughout his book Halmos refers to childhood memories, desires, relations with significant others, impressions of places and spaces, as well as political and cultural events that shaped his desire to become a mathematician. Halmos’ automathography is written from the perspective of a male mathematician, who followed the networks and opportunities available to his gender in the long run of the twentieth century. This does not mean that he did not face the prejudices of being a Jewish immigrant and of carrying his Hungarian accent, despite the fact that he was educated in the USA: ‘Then there was the accent. I was a foreigner, with or without pejorative adjectives, I felt like one, and I sounded like one’, Halmos has poignantly noted.<sup>12</sup> And yet, while reading his automathography I often wondered how different things would be for a woman becoming a mathematician in the same period. By thus gendering Halmos’ desire, what I argue in this paper, is that it is essential to throw light onto the social, cultural and political practices that some women mathematicians deployed in surpassing the restrictions and limitations of their gendered position and follow an academic career in the field of mathematical sciences. In this light I enter a process of intense memory work against a wider background within which women mathematicians figure as exceptional, albeit marginalized, and largely unknown subjects, and not as active agents, whose scientific,

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<sup>7</sup> cited in Jan-Erik Björk, ‘Sonja Kovalevsky: Her Life and Professorship at Stockholm’. *Operator Theory: Advances and Applications*, 132 (2002), 36.

<sup>8</sup> cited in *ibid.*

<sup>9</sup> cited in *ibid.*

<sup>10</sup> cited in *ibid.*

<sup>11</sup> Paul Halmos, *I want to become a mathematician: an automathography*, (New York: Springer, 1985).

<sup>12</sup> *Ibid.*, 15.

philosophical and literary work has had a huge impact on the cultural formations of modernity and beyond.<sup>13</sup>

In focussing on process, the paper draws on Alfred North Whitehead's philosophy of the organism<sup>14</sup> and unfolds in four parts. After this introduction, I briefly sketch Sofia Kovalevskaya's pen portrait, then I look at her academic career between 1874, when she was awarded her doctoral degree, till 1884, the year of her first tenure, a grey period overall in her life and academic work. By way of conclusion, I consider the importance of memory work in understanding the lasting effects of the past into the present. Here it is important to note the well-known fact that Kovalevskaya's academic career took off after the year of her tenure and her hard work was awarded with prestigious prizes both from the Paris and the Swedish Academies of Sciences, but scholarly engagement with this period of her life and work goes well beyond the limitations of this paper and has been treated well in the literature.<sup>15</sup>

### A sketch for Sofia Kovalevskaya

Sofia Vasilevna Korvin-Krukovskaia was born in Moscow on 15 January, 1850, the second child of a Russian aristocratic family. Her early education was framed within this heteropatriarchal regime, but she was lucky in that her father was persuaded to get her a mathematics tutor, when they moved to their country estate in Palibino<sup>16</sup>, when she was eight years old. From her tutor's reminiscences we have some glimpses into Kovalevskaya's creative mind from the very beginning: 'But then we came in geometry to the ratio of the circumference to the diameter, which I presented with all the proofs and inferences, and I was amazed when my pupil made her presentation of the material at the next lesson, coming to the same conclusion but in her own way and using special combinations.'<sup>17</sup> In her own autobiography, Kovalevskaya has further written that her first interest in mathematics was triggered by the preparatory wall paper of one of the nursery rooms in their house, which consisted of the lithographed

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<sup>13</sup> There is already a rich body of literature around women's position in mathematics, mostly deriving from feminist historians of philosophy, science and mathematics. For an overview of this literature see the website of the project:

<https://sites.google.com/view/numbersandnarratives/a-feminist-genealogy-of-automathographies> [Accessed, October 3, 2023]

<sup>14</sup> Alfred, North Whitehead, *Process and Reality* [Corrected Edition], ed. David Ray Griffin and Donald W. Sheburne, (New York: The Free Press, 1985 [1929]).

<sup>15</sup> See Pelageya Kochina, *Love and Mathematics: Sofia Kovalevskaya*, trans. Michael Burov, (Moscow: Mir Publishers, 1985); Koblitz, *A Convergence of Lives: Sofia Kovalevskaya: Scientist, Writer, revolutionary*. New Brunswick and London: Rutgers University Press, 1993[1983] and Don H. Kennedy, *Little Sparrow: A portrait of Sophia Kovalevskaya*. (Athens OH: Ohio University Press, 1983).

<sup>16</sup> Palibino is situated about 600 kilometers south of St. Petersburg and close to the border of Lithuania. The estate has been restored and serves nowadays as the Kovalevsky Museum, see <https://usefultravelarticles.com/5320-sophia-kovalevskaya-estate-museum-description-and-photos-russia-northwest-velikiye-luki.html> [Accessed, 3 May, 2023]

<sup>17</sup> Cited in Kochina, *Love and Mathematics*, 24.

lectures of Professor Ostrogradsky on differential and integral calculus that her father had bought when he was young:

These sheets all speckled over with strange, unintelligible formulas, soon attracted my attention. I remember as a child standing for hours on end in front of this mysterious wall, trying to figure out at least some isolated sentences and to find the sequence in which the sheets should follow one another. From this protracted daily contemplation, the outer appearance of many of these formulas imprinted themselves in my memory; indeed, their very text left a deep trace in my brain, although they were incomprehensible to me while I was reading them.<sup>18</sup>

Imagining a little girl being attracted to some ‘unintelligible’ mathematical formulas on the wallpaper of a nursery room, we are presented here with a lively scene of what the mathematician/philosopher Alfred North Whitehead has configured as ‘prehensions’, a concept denoting understanding not necessarily linked to cognition: ‘I will use the word prehension for uncognitive apprehension: apprehension that may or may not be cognitive’.<sup>19</sup> Prehensions for Whitehead are ‘ways of grasping the world’<sup>20</sup>; they are used to configure how an ‘actual entity’ becomes through the awareness, that is the feeling of its environment.<sup>21</sup> In our case, Kovalevskaya becoming a mathematician through feeling the formulas inscribed on the wallpaper of the nursery room. In this light ‘prehensions’ in Whitehead’s vocabulary could be rendered as feelings. However, Whitehead’s insistence to use ‘prehensions’ instead of ‘feelings’ derives from the fact that he wants to differentiate his approach from a subject-centred understanding of feelings. For Whitehead it is not subjects who have feelings—mathematicians, who understand figures and equations. It is actually in the process of feeling the world —being attracted to a wall of ‘unintelligible’ mathematical formulas and symbols— that subjects as actual entities are being constituted.

In this context, Whitehead argues ‘that every prehension consists of three factors: (a) the ‘subject’ which is prehending, namely the actual entity in which that prehension is a concrete element; (b) the ‘datum’ which is prehended; (c) the ‘subjective form’ which is how that subject prehends that datum.’<sup>22</sup> It is within this schema of prehensions that the three factors cannot be considered separately or as pre-existent, irrespective of their relations and entanglements. In this light there are no ‘subjects’ or ‘objects’ in Whitehead’s philosophy of organism, which is what makes it distinctive in the philosophical tradition: ‘The philosophies of substance presuppose a subject which then encounters a datum, and then reacts to the datum. The philosophy of organism presupposes a datum which is met with feelings, and progressively attains the unity of a subject. But with this doctrine, ‘superject’ would be a better term than ‘subject.’<sup>23</sup> I therefore think that Whitehead’s notion of prehensions, can be

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<sup>18</sup> Sofia Kovalevskaya, *A Russian Childhood*, trans. Beatrice Stillman, (New York: Springer-Verlag, 1978[1895]), 122.

<sup>19</sup> Alfred, North Whitehead, *Science and the Modern World*, (New York: Free Press, 1967 [1925]), 69.

<sup>20</sup> Whitehead, *Modes of Thought*. (New York: Free Press, 1968. [1938]), 151.

<sup>21</sup> See Whitehead (1985), Chapter 1 in Part III.

<sup>22</sup> *Ibid.*, 23.

<sup>23</sup> *Ibid.*, 155.

very well transposed in the wallpaper event, through which Kovalevskaya emerges as a subject, or rather 'superject', in mathematics. As she recounts in her autobiography, the memory of the nursery room had long-lasting effects in her mathematical education, learning and understanding:

Many years later when I was already fifteen, I took my first lesson in differential calculus from the eminent Petersburg professor Alexander Nikolayevich Strannolyubsky. He was amazed at the speed with which I grasped and assimilated the concepts of limit and of derivatives, 'exactly as if you knew them in advance.' I recall that he expressed himself in just those words. And as a matter of fact, at the moment when he was explaining these concepts, I suddenly had a vivid memory of all this, written on the memorable sheets of Ostrogradsky; and the concept of limit appeared to me as an old friend.<sup>24</sup>

Despite her talent and love for mathematics, Kovalevskaya's formal education could not be extended to a University degree of course, since such routes for women were blocked in Russia and around the world in the nineteenth century. But there was an air of freedom in the 1860s in Russia, particularly among the younger generation, who strongly came to believe that scientific knowledge would end the dark ages of humanity and would open the road to social revolution. Education as a route to equality was at the heart of this movement, and there were many young men in Russia's radical circles, who were committed to support women in their struggle to equality.<sup>25</sup> One way to do this was through consenting to enter white marriages, thus offering their 'wives' the opportunity to take control of their lives and pursue university degrees abroad. Vladimir Kovalevskii was among those radical young men.<sup>26</sup> He and Sofia got married in September 1867, and after a short stay in St Petersburg, they eventually moved to Vienna, taking Kovalevskaya's elder sister Anyuta<sup>27</sup> with them. Kovalevskaya went on to study mathematics and physics, in Heidelberg where she was exceptionally admitted on the grounds of being married into a well-known scientific family in Europe.<sup>28</sup>

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<sup>24</sup> Kovalevskaya (1978), 123.

<sup>25</sup> See Ann Hibner Koblitz, 'Science, Women, and the Russian Intelligentsia: The Generation of the 1860s', *The History of Science Society* 79, no. 2 (1998).

<sup>26</sup> Vladimir Onufrievich Kovalevskii (1842–1883) came from a Russian–Polish landowners' family. He got involved in the Russian radical circles and was the first to translate and publish Darwin's work in Russian. For more biographical details, see Koblitz, *A Convergence of Lives*, and Kennedy, *Little Sparrow*.

<sup>27</sup> Anna Vasilyevna Korvin-Krukovskaya (1843–1887) was a socialist and feminist revolutionary. After following her sister Sofia in Europe, she eventually settled in Paris where she met Victor Jaclard, whom she eventually married. She was an active member of the Parisian commune, but after its demise she had to leave France with Jaclard. For more biographical details, see Kennedy (1983), Koblitz (1993) and Joan Spicci, *Beyond the Limit: The Dream of Sofya Kovalevskaya*, (London: Forge Books, 2002).

<sup>28</sup> Both Vladimir Kovalevskii and his elder brother Aleksader (1840–1901), also an academic, had studied at the University of Heidelberg.

On completing her studies at Heidelberg in 1870, Kovalevskaya moved to Berlin, where she followed doctoral studies in private, under the supervision of Karl Weierstrass, a major figure in modern mathematical analysis.<sup>29</sup> Her doctoral thesis was submitted in 1874 to the University of Göttingen, which was known for awarding degrees to foreigners in absentia. Kovalevskaya got her doctoral degree cum laude, and returned to Russia, where personal life took precedence. After three years of emotional tensions, the white marriage was consummated and their daughter, Fufa was born.<sup>30</sup>

Things did not go very well in the couple's professional life, however. While Kovalevskaya started travelling to Europe again, trying to resume her interrupted academic career, her husband made some very bad financial investments that led to bankruptcy and eventually to his suicide in the spring of 1883. Thus, when an invitation to join the newly founded department of Mathematics in Stockholm University came from Gösta Mittag-Leffler<sup>31</sup>— who was among Weierstrass' disciples—Kovalevskaya accepted, despite her reservations around the financial arrangements of her new post. It is her struggle to open a path in the wild male academic world that I will now discuss in the next section.

## Academic Prehensions

I was twenty-two years old when I moved to Petersburg. Three months earlier I had graduated from a university abroad and returned to Russia, PhD in hand. After five years of isolated, cloistered existence in a small university town, life in Petersburg immediately enveloped and, as it were, intoxicated me. Putting aside for a while the consideration of analytic functions, space and the four dimensions, which had so recently obsessed me, I threw myself into new interests. I made acquaintances left and right. I tried to penetrate the most varied circles. With greedy curiosity I turned my attention to all the essentially empty but initially so engaging manifestations of the complex hubbub that we call life in

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<sup>29</sup> Karl Weierstrass (1815-1897) is often cited as the father of modern analysis. He became a professor of mathematics in Berlin, without finishing his university degree and perhaps his unorthodox academic career might have influenced his willingness to take up Kovalevskaya's supervision outside the formal university procedures. For more details about his life and mathematical work, see O'Connor, John J.; Robertson, Edmund F., 'Karl Weierstrass', MacTutor History of Mathematics archive, University of St Andrews, <https://mathshistory.st-andrews.ac.uk/Biographies/Weierstrass/>, (accessed, 15 May, 2023).

<sup>30</sup> Nickname for Sofia Vladimirovna Kovalevskaya, (1878–1952). After her mother's death Fufa lived in Stockholm with family friends, until she finished secondary school and then returned to live with Iulia Lemontova, Sofia's friend, in Russia. She became a doctor and worked for the Red Cross in Russia and abroad. After her retirement she became a medical librarian and translator, and she got very much involved in publishing her mother's literary work.

<sup>31</sup> Gösta Mittag-Leffler (1846–1927) was a Swedish mathematician. He founded the journal *Acta Mathematica* and the Mathematics Institute of the Swedish Academy of Sciences that bears his name. For biographical details, see Arild Stubhaug, *Gösta Mittag-Leffler: A Man of Conviction*, trans. Tiina Nunnally, (London: Springer, 2010).

## Petersburg.<sup>32</sup>

From the very first pages of Kovalevskaya's largely autobiographical novel, *The Nihilist Girl* we can have some glimpses of her life in Russia in the wake of her doctoral degree. The fact that she wrote a novel is partly attributed to her literary interests and talent, but also to the problem that an academic career in Russia was out of the question, even for an aristocratic woman who had got her doctoral degree from a prestigious European University. In any case, the overall ambience in Russia was not conducive to Kovalevskaya's mathematical work, despite her promises to Weierstrass that she would do so. Their correspondence between 1874-1875 shows that Weierstrass had advised her to have a rest first and also that he had somehow anticipated that her new social life in Russia would create a distraction: 'I took it for granted from the very beginning that after a period when you had long been deprived of the chance to move in society, you would not start constant and serious work during the first period of your stay in Petersburg'<sup>33</sup> he wrote to her on 16 December, 1874. He did not seem to be concerned about it, since he believed in the strength of her mathematical mind: 'I am firmly sure that your serious mind and your attraction to ideal aspirations will not allow you to restrain from research for too long'<sup>34</sup>, he wrote in the same letter. His conviction that Kovalevskaya was a mathematical mind to be trusted is also expressed in his New Year letter, dated 1 January 1875, where he shared his research plans for the future, which included publication of his work, which was gradually becoming unacknowledged by the younger generation:

At the present moment, since young mathematicians have found that writing large books (by the way, without references) is the most reliable means to win the esteem of the crowd and gain a good place in the field of analysis, to whose thorough investigation I devoted the best part of my life, they have become too outrageous, and it is high time to put an end in it. [...] It is too bad that in this country, as in other countries, textbooks are written by incompetent people [...] But the highest and most difficult realms of the science, where something can only be attained by those who contribute their every effort, should not be handed over to those who write lightweight books.<sup>35</sup>

Having won her doctorate with flying colours Kovalevskaya was thus much more than Weierstrass' graduate student; she had become his friend and confidante: 'forgive me, my sweet friend, this digression in which you would see the proof of how deep I have the habit of making you a confidante in my thoughts, even the most joyless ones'<sup>36</sup>, he wrote in the same letter. What Weierstrass could sense in Kovalevskaya was the poetic beauty of her mathematical mind that in his view, marked high level scientific work: 'The highest point within our science is accessible only to one who is to a certain extent a poet and has prophetic

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<sup>32</sup> Kovalevskaya, *Nihilist Girl*, trans. Natasha Kolchevska with Mary Zirin, (New York: The Modern Language Association of America, 2001[1892]), 3.

<sup>33</sup> Cited in Kochina (1985), 93.

<sup>34</sup> Ibid.

<sup>35</sup> Ibid., 94.

<sup>36</sup> Ibid.



vision and a sense of beauty'<sup>37</sup> he had said to the group of auditors who attended his lessons between 1874-1875. And yet Weierstrass certainty was idealistic rather than pragmatic and it was indeed the materiality of life that temporarily won over Kovalevskaya's spirit. Prehensions worked differently in Russia, in carrying Kovalevskaya's mind away from mathematics. Kovalevskaya's entanglement in the demands of sociality within a heteropatriarchal regime, is a very good example of the constant interplay between negative and positive prehensions in Whitehead's philosophy: 'There are two species of prehensions: (a) 'positive prehensions' which are termed 'feelings', and (b) negative prehensions, which are said to 'eliminate from feeling'<sup>38</sup>. While positive prehensions are processes by which an actual entity takes in or apprehends other entities in its environment —Kovalevskaya taking in mathematical formulas from the nursery wall paper, as we have seen above—negative prehensions involve the exclusion of certain aspects, experiences or feeling in the becoming of an entity—an academic career in mathematics for Kovalevskaya. In this light, life in Russia triggered negative prehensions, processes in which Kovalevskaya's passion for mathematical work was played down and/or became dormant: 'A negative prehension holds its datum inoperative in the progressive concrescence of prehensions constituting the unity of the subject',<sup>39</sup> as Whitehead has written.

It was in the interplay of positive and negative prehensions that Kovalevskaya's mathematical work took the back seat and a visit to Germany planned for the spring/summer of 1875 never happened. After the death of her father in the fall of 1875, her correspondence with Weierstrass was interrupted for almost three years; it was resumed in the summer of 1878, while Kovalevskaya was expecting a baby and had subsequently reduced her social activities. Her return to science coincided with her forthcoming motherhood, not a usual coincidence, even in our own days. Kovalevskaya was actually pleased that she had resumed her mathematical work during her pregnancy. In her view, the intellectual development of the child was linked to the mental state of the mother: 'Thank heavens I had not completely lost my strength in the study of mathematics; now at least, my little girl will inherit fresh intellectual capabilities' she wrote to Elizaveta Litvinova.<sup>40</sup> During her three-year silence, Kovalevskaya had met with Gösta Mittag-Leffler, who had visited her in St Petersburg in 1876 and had written enthusiastically about his first impression of her in a letter to the Swedish mathematician Carl Malmsten:

What most deeply interested me in St Petersburg was getting to know Madame Kovalevsky. Today [10 February 1876] I spent several hours at her house. As a woman, she is delightful. She is beautiful and when she speaks, her face illuminates with such an expression of feminine kindness and superior intelligence, that the effect is dazzling. Her manner is simple and natural without the slightest trace of

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<sup>37</sup> Cited in *ibid.*, 118.

<sup>38</sup> Whitehead (1985), 23.

<sup>39</sup> *Ibid.*, 23-24.

<sup>40</sup> Cited in Koblitz (1993), 138. Elizaveta Fedorovna Litvinova (1845–1919) was the second woman to get a doctorate in mathematics from the University of Bern in 1878. She was Kovalevskaya's friend and wrote her biography in 1893. For more biographical details about Litvinova, see Koblitz 'Elizaveta Fedorovna Litvinova (1845–1919) – Russian Mathematician and Pedagogue.' Association of Women in Mathematics (AWM) Newsletter 14, no. 1(1984).

pedantry or pretence. She is in all respects a complete 'woman of the high world'. As a scholar she is characterized by her unusual clarity and precision of expression. The depth of her knowledge becomes clear then and I understand fully why Weierstrass considers her the most gifted of his students. (Mittag-Leffler 1923, 172)

Despite the fact that Kovalevskaya's beauty and aristocratic demeanour seems to take more space than her scholarly spirit in Mittag-Leffler's letter above, their encounter was to become an important event in Kovalevskaya's career. Weierstrass might have foreseen it: when their correspondence was resumed in the summer of 1878, he praised Mittag-Leffler to Kovalevskaya and advised her that 'if you continue your friendship with him, it would be a stimulus for you'<sup>41</sup>, in a letter dated 15 August 1878.

Kovalevskaya's awakened interest in mathematical research was further delayed for two more years however, following the birth of her daughter, in October 1878. It was an opportunity to present her work at the Sixth Congress of Natural Scientists and Physicians, held in St Petersburg between January 1-10, 1880, that marked her return to the scientific world. Despite being a young mother and under the shadow of the family's financial disaster, Kovalevskaya accepted an invitation to contribute to the mathematics section of the congress and as Litvinova's memoir records, she prepared her work 'with a feeling of joy and pride'<sup>42</sup>, honouring the trust bestowed upon her: 'in the morning I delivered my abstract at the congress, made a great impression, merited praise from Chebysev and joined the ranks of scientists again'.<sup>43</sup>

Mittag-Leffler was among the congress participants and soon after this event they started a correspondence that eventually took Kovalevskaya to Sweden and lasted till the end of her life. In her first letter to Mittag-Leffler, dated 14 October, 1880, Kovalevskaya asked about his university position vis-à-vis women: 'I would be very grateful if you were so kind as to inform me clearly with respect to the attitude your University holds to us: does it open the doors for us without restraints, or does it admit us only in exceptional cases and a special favour, or does it refuse us completely?'<sup>44</sup> (in Kochina 1985, 120) We can see how Kovalevskaya's own university experience is summarised in the length of a short epistolary question, interestingly situated herself in the 'us', or differently 'the women's question' in science. Her overall thoughts on women and science have been recorded in Litvinova's reminiscences:

My destiny, or if you wish, the main goal of my life, but I like more the word destiny, because the goal of my life is in myself, while destiny is of divine origin. I feel that my destiny is to serve the truth, that is, science, and to blaze the trail for women, because that means to serve justice. I am very glad that I was born a woman, because this gives me a chance to serve both truth and justice at the same time. But it is not always easy to follow your destiny.<sup>45</sup>

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<sup>41</sup> Cited in Kochina (1985), 104.

<sup>42</sup> Ibid. 105.

<sup>43</sup> Ibid. Pafnuty Lvovich Chebyshev (1821-1894) was a Russian mathematician and is considered to be the founding father of Russian mathematics.

<sup>44</sup> Cited in Kochina (1985), 120.

<sup>45</sup> Cited in *ibid.*, 75-76.

But to return to her appointment, in the spring of 1881, Mittag-Leffler wrote again advising Kovalevskaya that his efforts to find a teaching position for her at Helsingfors [Helsinki] University were unsuccessful, not because she was a woman, but because she was considered a Russian intellectual involved in the radical circles of nihilism: 'All my university friends know about your outstanding talent, so do not doubt that you would be invited here if you were Finnish or of any other nation except Russian'<sup>46</sup>, he wrote on 18 March, 1881. (120). The fear was that a Russian radical lecturer in Finland would be followed 'by some Russian women students, and one can never guarantee that among these there will be none belonging to a revolutionary party.' This time it was not her gender, but her politics that created hindrances in her academic career. As Pelageya Kochina has commented, wherever Kovalevskaya went, 'government circles feared that she would be accompanied by a penetration of "nihilism" into the institution she was going to teach in'.<sup>47</sup>

Despite his disappointment with the Helsingfors failure, Mittag-Leffler advised Kovalevskaya that he was moving to the newly opened University of Stockholm, and he was hoping that he would invite her there. It took some time for Kovalevskaya to respond, but on 7 June, 1881 she wrote: 'I have no intention of placing too high hopes on Stockholm; however, I will admit that I would be delighted if I were to have the opportunity to apply my mathematical knowledge to teaching in a higher education institution — the functions of a professor comprise something noble which has attracted me greatly'.<sup>48</sup> Mittag-Leffler's response was swift: he wrote on 19 June, 1881, asking Kovalevskaya whether she would be willing to take the position of professor in the new Department of Mathematics of the University of Stockholm, but there would be no salary attached to this proposal, at least in its first stage. Being offered a job without salary would be unimaginable for any male academic and yet Kovalevskaya wrote back from Berlin on 8 July 1881, to confirm that she would accept it:

I will always accept with joy the position of assistant professor at the university. I have never counted on any other position and, will admit to you openly, will feel less discomfited holding a modest position; I am striving to apply my knowledge and to teach at a higher educational establishment in order to make university accessible to women; at present, as it were, this access is an exception or a dispensation which can always be taken away, as has happened in the majority of German universities.<sup>49</sup>

At the time she was still under the false impression that her finances were in good order: 'Although I am not rich, I do possess [enough] funds to live completely independently'<sup>50</sup>, she wrote, emphasizing the fact that her decision was not dependent on the salary, but rather on her determination to work among peer minds, but also 'to serve to the best of my ability the cause that is dear to me',<sup>51</sup> that is women's access to university education.

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<sup>46</sup> Cited in *ibid.*, 120.

<sup>47</sup> *Ibid.*, 121.

<sup>48</sup> Kovalevskaya (1951), 258.

<sup>49</sup> *Ibid.*

<sup>50</sup> *Ibid.*

<sup>51</sup> *Ibid.*

Leaving the question of the salary aside, what is important to highlight here is Kovalevskaya's insistence on the fact that she wanted to be accepted not as a woman, but as a mathematician with an important contribution to the discipline of mathematics: 'the appearance of a woman in the position of docent at a university chair is so serious a step (which may have serious consequences for the cause that I basically want to serve) that I do not have the right to take it *until I prove my abilities by my purely scientific work*'<sup>52</sup>, she wrote to Mittag-Leffler on 21 November, 1881. It was almost two years later after her husband's suicide, and only when she had finished the paper 'On the refraction of light in a crystalline medium'—which she presented at the 7<sup>th</sup> Congress of Russian Natural Scientists and Physicians, held in Odessa from August 30 to September 9, 1883—that she felt ready to go to Stockholm. 'I am deeply grateful to the University of Stockholm, for so kindly opening its doors to me and I am ready with all my heart to love Stockholm and Sweden as I do my homeland'<sup>53</sup> she wrote to Mittag-Leffler on 28 August 1883 from Russia. It was in the same letter however, that she expressed doubts about her academic abilities:

I do not consider myself entitled to conceal from you that in many aspects, I admit that I am very little prepared to perform the duties of a docent. I doubt myself to such a degree that I am afraid that you, who has always treated me with such benevolence, will be disappointed upon seeing that I am little suited for the occupation I have chosen.<sup>54</sup>

Kovalevskaya's ambivalence about the value of her scientific work is neither surprising, nor unexpected. 'This attitude is the exclusive property of women who blaze completely new paths' Litvinova wrote about Kovalevskaya, very much reflecting on her own experiences as well.<sup>55</sup> It is the internalization of prejudices that create such states of mind, Litvinova has persuasively argued, extending Kovalevskaya's impostor feeling to all talented women, while 'the thought that he was not well enough prepared to assume the duties of docent would not even pass the mind of the most mediocre man.'<sup>56</sup> In this light Kovalevskaya's lived experiences of her first years in Sweden were crucial in the long process of becoming a professor in mathematics, as I will further discuss.

### The Researcher Superject

Apart from dealing with the daily practicalities of tuning into Stockholm life, meeting the academic community, making new friends, and looking for a flat, Kovalevskaya prepared her lectures carefully. She felt delighted at the opportunity to talk about her own research and scientific contribution to this field,<sup>57</sup> but still she sought her supervisor's guidance and advice, as her only extant letter to Weierstrass, written in December 1883, shows: 'It is true that I regret somewhat that I did not choose from the first to lecture on the calculus of variations

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<sup>52</sup> Cited in Kochina (1985), 125, (my emphasis).

<sup>53</sup> Kovalevskaya (1951), 268.

<sup>54</sup> Ibid.

<sup>55</sup> Cited in Koblitz (1993), 176.

<sup>56</sup> Cited in *ibid.*

<sup>57</sup> See Kochina (1985), 129.

[...] But please, be so kind, my dear best friend, and help me by giving me your advice in my distress'.<sup>58</sup>

But it was not only teaching, but also research and publications that Kovalevskaya needed a mentor for: 'I wish to turn to the detailed work [Ausarbeitung] on my last study, as it is most necessary that it appear this winter in *Acta Mathematica*, and without your help I cannot take a step forward'<sup>59</sup>, she wrote to Weierstrass in the December 1883 letter. Her paper was eventually published in the volume 6 of *Acta Mathematica*<sup>60</sup>, as Kovalevskaya was keen to publish while waiting for her tenure to come through. Apart from publishing work that was already completed, Kovalevskaya also started a new research project on the problem of the rotation of a solid body about a fixed point, which would eventually become the highlight of her academic career. This is what she wrote to her friend Maria Jankowska-Mendelson on 19 January 1884:

I am currently very busy and completely wrapped up in my worries about consolidating my position at the university so as to open this path for women in this way. The new mathematical work I have recently embarked upon fascinates me now, and I would not like to die without having discovered what it is I am looking for. If I manage to solve the problem I am currently working on, then my name will be entered among the names of the most eminent mathematicians.<sup>61</sup>

Being in the fever of preparing for her first lectures, Kovalevskaya was also entering the process of establishing herself in the field not as a 'woman professor', but as 'an eminent mathematician'. She knew that the process would be long: 'By my reckoning, I need another five years to achieve good results'<sup>62</sup>, she wrote in the same letter, 'but I hope that in five years, more than one woman will be capable of replacing me here and I will then surrender myself to the other ambitions of my gypsy nature'.<sup>63</sup>

On 30 January, 1884 Kovalevskaya delivered her first lecture,<sup>64</sup> which was received enthusiastically not only in terms of its subject content and lively presentation, but also as an event that opened up a new chapter in the field of gender and science: 'the auditorium was full; people were aware of the historic nature of the occasion'<sup>65</sup>, Mittag-Leffler wrote to Weierstrass on 18 February, 1884. Her lecture became a public event, since apart from the

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<sup>58</sup> Cited in Reinhard Bölling, '... Deine Sonia: A Reading from a Burned Letter', *The Mathematical Intelligencer* 14, no.3 (1992), 27. Weierstrass burnt all of Kovalevskaya's letters after her death, but this draft letter was found in the Mittag-Leffler Institute Archives by Bölling, in January 1990.

<sup>59</sup> Cited in *ibid.*, 27.

<sup>60</sup> Kovalevskaya, 'Über die Brechung des Lichtes in crystallinischen Mitteln.' *Acta Mathematica* 6 (1885), 249-304.

<sup>61</sup> Kovalevskaya (1951), 279.

<sup>62</sup> *Ibid.*

<sup>63</sup> *Ibid.*

<sup>64</sup> Although Kovalevskaya's diary indicated January 30, it was actually February 11 in the Gregorian calendar.

<sup>65</sup> Cited in Kochina (1985), 130.

twelve enrolled students, ‘professors, university officials, and interested citizens came to see “the princess of science” begin her teaching career’<sup>66</sup>, Mittag-Leffler’s letter went on, concluding with the claim that ‘it was clear even from the first class that she would be a good lecturer’.<sup>67</sup> Kovalevskaya’s diary gives a different taste of ‘the princess’ experience: ‘Gave the first lecture today. Don’t know whether it was good or bad, but I know that it was very sad to go home and feel so lonely in this world. The feeling was extremely strong in those moments. *Encore une étape de la vie derrière moi.* [One more stage in my life left behind]’<sup>68</sup>

Her diary goes on with daily entries and all her lectures and preparations for them in February are listed as important events in the process of her becoming an academic.<sup>69</sup> ‘The actual world is a process and process is the becoming of actual entities’ Whitehead has famously written in his major philosophical work *Process and Reality*.<sup>70</sup> Process is a fundamental fact of experience for Whitehead and ‘involves the notion of a creative activity belonging to the very essence of each occasion’<sup>71</sup>— Kovalevskaya’s weekly lectures, meticulously recorded in her diary in our case. Whitehead, however, differentiates his own approach to process from the long philosophical tradition of flows and fluxes that goes back to Heraclitus. There are two kinds of fluency for Whitehead: the fluency of becoming a particular existent, which he calls ‘conrescence’ and the fluency whereby an entity that has already become enters a process of new becomings — what he calls ‘transition’.<sup>72</sup> In marking conrescence and transition as two kinds of fluency in the constitution of reality, Whitehead keeps flux and permanence together in his philosophy of the organism.

Kovalevskaya’s diary entries in February leave marks of her ‘conrescence’—the fluency of becoming a particular existent, that is an academic. Every lecture is ‘an event’, a particular occasion that enters the fluency of becoming as a novelty, an experience that is new and creative in the overall process. As Whitehead has written, ‘in each conrescent occasion its subjective aim originates novelty [which] in the case of higher organisms amounts to *thinking* about the diverse experiences’<sup>73</sup>— Kovalevskaya *thinking* about the experience of lecturing and thus marking their preparation and occurrence in her diary. Then, after February there is a pause in the recording of her lectures and the last lecture entry is dated 16 April.<sup>74</sup> Were her lectures not prehended as ‘events’ anymore? As entities that had already been realized, her lectures had entered a process of new becomings, not as novelties anymore — and perhaps this why they were not marked or recorded — but rather as what Whitehead calls ‘the stubborn fact of the past’:

In the philosophy of organism it is held that the notion of ‘organism’ has two meanings, interconnected but intellectually separable, namely the microscopic

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<sup>66</sup> Ibid.

<sup>67</sup> Ibid.

<sup>68</sup> Kovaleskaya (1951), 178.

<sup>69</sup> Ibid., 178-179.

<sup>70</sup> Whitehead (1985), 22.

<sup>71</sup> Whitehead (1968), 151.

<sup>72</sup> Whitehead (1985), 210.

<sup>73</sup> Ibid., 102.

<sup>74</sup> Kovaleskaya (1951), 178-179.

meaning and the macroscopic meaning. The microscopic meaning is concerned with the formal constitution of an actual occasion, considered as a process of realizing an individual unity of experience. The macroscopic meaning is concerned with the givenness of the actual world, considered as the stubborn fact which at once limits and provides opportunity for the actual occasion.<sup>75</sup>

In this light 'the stubborn fact', which belongs to the past, inheres in the flowing present wherein actualities are being constituted, as such Kovalevskaya's lectures as realized unities of her academic experience, within the microscopic meaning of the 'organism', became the part of the macroscopic meaning, the givenness of the academic world. This co-existence of permanence and flux creates conditions of possibility for the future, which is anchored in the present but has not been actualised yet. Each actual entity is thus an organic process that 'repeats in microcosm what the universe is in macrocosm [and] although complete as far as concerns its microscopic process, is yet incomplete by reason of its objective inclusion of the macroscopic process'<sup>76</sup>— Kovalevskaya's 'complete lectures' included in her yet incomplete future as the first chair in mathematics in modern Europe, her future becomings.

Apart from her lectures delivered twice a week, Kovalevskaya also participated in the mathematical seminars held at Mittag-Leffler's house every other week. Not only did she give talks herself, but also acted as a supervisor and advisor for students' presentations. According to Mittag-Leffler's evaluation in his correspondence with the University authorities: 'the work at these mathematical seminars has led to the completion of several investigations of decisive importance for the development of mathematical science'.<sup>77</sup> Mittag-Leffler was keen to highlight that 'much of this progress has relied on the contributions from Mrs. Kovalevsky's knowledge in different branches of higher mathematics which she has given to the mathematical community at our university, and by her sound judgement and sharp-wittedness when she has helped her pupils in their work'<sup>78</sup>. His appraisal was part of his attempt to secure a more permanent position for Kovalevskaya, as will become apparent.

Kovalevskaya gave her last lecture in the spring semester and then returned to Russia. As she wrote to her brother-in-law in early May 1884, the students made an enthusiastic adieu speech and gave her 'as a memento of my first lectures their group photograph in a wonderful frame',<sup>79</sup> which made her feel 'terribly happy and touched'.<sup>80</sup> Students' reminiscences from her first lectures show that in the beginning she did not feel quite at ease. This is how the astronomer-topographer V.V. Vitkovsky, one of her auditors during her first lectures in Stockholm remembers her:

Sofya Kovalevskaya was dressed in a black velvet frock and wore no decorations. She armed herself with some chalk and started the lecture before 15 auditors very simply and whole-heartedly, about the Dirichlet principle. But she seemed to feel

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<sup>75</sup> Whitehead (1985), 128-9.

<sup>76</sup> *Ibid.*, 215.

<sup>77</sup> Cited in Björk (2002), 23.

<sup>78</sup> Cited in *ibid.*

<sup>79</sup> Kovalevskaya (1951), 281.

<sup>80</sup> *Ibid.*

constrained because she did not once turn from the blackboard and left directly when she finished the lecture.<sup>81</sup>

In a letter to Alexander Kovalevskii, sent in the autumn of 1884, Kovalevskaya had written that her lectures were ‘a great trouble’<sup>82</sup>, always fluctuating between success and failure: ‘I try hard to give them properly and clearly; sometimes I succeed and then I am happy, but sometimes things don’t go so smoothly’.<sup>83</sup> Kovalevskaya was particularly attentive to her students’ expression in understanding whether they were interested or not: ‘I notice that I don’t manage to interest my listeners and to present everything in a clear light, and this makes me very sad’, she wrote in the same letter.<sup>84</sup> It took time for Kovalevskaya to ‘realize’ herself as an academic, but she eventually became a lecturer who could see through the eyes of her students, realizing their abilities and indeed awakening and strengthening them. As her friend Ellen Key<sup>85</sup> wrote in her memorial article, published in the Swedish journal *Dagny* in 1892, Kovalevskaya was an outstanding teacher, who took into account the existential uniqueness of her students and thus inspired and triggered their creative abilities.<sup>86</sup> A young woman, who was among her students, wrote after her death: ‘I felt as if I was completely seen through by Mrs Kovalevsky could, as if I was made of glass’.<sup>87</sup> The student further added that she would always feel calm ‘under this affectionate, confident look’, as well as her teacher’s conviction that ‘real mathematics is the least dry of all sciences, opening up a vast field of creative fantasy and speculative views’.<sup>88</sup>

Despite the fact that Kovalevskaya remained ambivalent about the quality of her lectures, her successful first course opened the doors of her formal appointment. Securing a position for Kovalevskaya however, was not easy, despite her success, and included a Byzantine form of diplomacy: Mittag-Leffler, the geographer-explorer Eric Nordenskjöld and the astronomer Hugo Gylden agreed to withdraw their opposition to the promotion of two private docents from Uppsala to a full professorship, in exchange of Kovalevskaya’s appointment to a five years’ ‘extraordinary professorship’. Kovalevskaya responded with humour to this trade in a letter to her brother-in-law, in early May, 1884: ‘my election didn’t pass by without resistance. My friends have also had to pay an extremely high price for me [...] Do you see how much I am worth: two full professors!’<sup>89</sup>

Her appointment was officially announced on 28 June 1884, much to Mittag-Leffler’s delight who had written to her on 2 June, 1884: ‘God knows I have not accomplished much in life, but one really big thing will always be written in my list of merits. God grant us only strength

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<sup>81</sup> Cited in Kochina (1985), 130.

<sup>82</sup> Kovaleskaya (1951), 508n287[3].

<sup>83</sup> Ibid.

<sup>84</sup> Ibid.

<sup>85</sup> Ellen Key (1849-1926) was a Swedish feminist and writer, whose ideas on children’s education, sex, family and marriage were largely influential in Sweden and beyond. For her biography, see Nyström-Hamilton, 1913.

<sup>86</sup> Ellen Key. ‘Sofia Kovalevskaya’, in Kovalevskaya, (1951), 413.

<sup>87</sup> Cited in *ibid.*

<sup>88</sup> Ibid.

<sup>89</sup> Kovalevskaya (1951), 281.



and health enough to work together long! Maybe we shall achieve much in due course'.<sup>90</sup> In her May letter to Alexander Kovalevskii, Kovalevskaya had already written that her salary would be 4000 Swedish Kronor a year, which was far less than her male colleagues' 6000 usual annual income'.<sup>91</sup> Moreover, only half of this reduced salary would come from the university; the rest would be generated from private subscriptions, which included Mittag-Leffler and Gylden, as well as several women who wanted to be Kovalevskaya's students.<sup>92</sup>

Despite the fact that Kovalevskaya's appointment was a struggle and only half of her salary was covered by the university, her appointment was part of Mittag-Leffler's wider attempt to establish mathematical sciences in Sweden, by recruiting *la crème de la crème* in Europe, as far as he could, given that Sweden was a rising centre, but still in the peripheries of the European mathematical circles, mostly revolving around Berlin and Paris. His aspirations were clearly articulated in a letter to Kovalevskaya, dated, 19 June 1881, during the early planning of her appointment: 'I do not doubt that with you in Stockholm our faculty will be one of the most advanced in the mathematical world'.<sup>93</sup> His enthusiasm and admiration notwithstanding, Mittag-Leffler closely supervised her work: Kovalevskaya had to write her lectures, so that they could be checked in advance, and Mittag-Leffler would always attend the first lecture of her courses. 'Please have a look at my lecture for tomorrow and return it no later than noon so that I can look through it once more'<sup>94</sup>, Kovalevskaya wrote in a message, as late as in February 1885, well after her extraordinary professorship had gone through.

But teaching was only a part of Kovalevskaya's contribution to the Swedish world of mathematical sciences. As already noted earlier in this paper, in 1882, Mittag-Leffler founded a new journal, the *Acta Mathematica* and in 1884 he asked Kovalevskaya to join the editorial board first and then take over as editor. As Kochina has commented, Mittag-Leffler was very keen to establish *Acta Mathematica* as a prestigious international journal, attract submissions from well-known mathematicians in Europe, as well as secure institutional subscriptions to the journal for the sake of its financial stability.<sup>95</sup> Kovalevskaya was to oversee all of these objectives not only through publishing her own articles and reviewing the work of her peers, but also through her multifarious connections with the mathematical circles in Russia, Germany and France.

### **On being a woman professor: the private and the public**

As we have seen in the previous section, Kovalevskaya seemed to be defiant of her opponents, although the controversy around her appointment was to colour her overall experience as a woman professor for years to come. But it was not only her position as an

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<sup>90</sup> Cited in Kochina (1985), 132.

<sup>91</sup> See, Lars Hörmander, 'The First Woman Professor and Her Male Colleague', *Miscellanea Mathematica*, Berlin: Springer, 1991), 195.

<sup>92</sup> See Koblitz (1993), 187.

<sup>93</sup> Cited in Kochina (1985), 133.

<sup>94</sup> Cited in *ibid.*, 134

<sup>95</sup> *Ibid.*

academic that was under attack, but also her choices and lifestyle as a single mother that was also continuously under scrutiny. It is thus on the battle between the private and the public in the process of being a woman professor that this section will be focussing. When Kovalevskaya first visited Stockholm, she understood that going there with her daughter would be a huge strain for both of them and thus she decided to leave Fufa with her godmother, Iulia Lemontova, who was also Kovalevskaya's close friend, since their years as science students in Germany.<sup>96</sup>

When her extraordinary professorship was confirmed in the summer of 1884, the question of bringing her daughter to Sweden was raised again, but Kovalevskaya felt that things had not yet settled in Sweden and that it was in the child's best interest to stay in Russia. Although her friend Theresa Gylden had written to warn her that there were rumours and gossip in Sweden regarding her separation with her daughter, Kovalevskaya's response was swift and determined and she explained that together with Iulia they had decided that it would be better for Fufa to stay in Moscow, where the little girl had a sense of belonging:

You must also think of how alone we are in the world, my little Sonya and me. Her birth was welcomed by a whole, happy family; only five years have passed and now she has neither a father, nor a grandmother or grandfather, she has no natural support other than me. In these circumstances, it is entirely understandable that the link connecting her to the Lermontov family is doubly precious, and that I am not acting frivolously in not daring not only to sever but even to weaken this link.<sup>97</sup>

Lemontova had also promised that she would bring Fufa personally to Stockholm in the autumn of 1885 and would spend part of the winter there, to make sure that the child would adapt to her new environment. 'The summer before this, I will have the opportunity to be with Fufa in the Lermontova estate and I can teach her Swedish, so that she doesn't arrive in Sweden completely unprepared. Just think how dreadful she would have felt, in the first two or three months, if she had come with me to Stockholm with me this year already!'<sup>98</sup>, Kovalevskaya added.

The letter shows clearly how carefully Kovalevskaya had thought about her child's best interest, despite the pain of separation, which after all would not be very long, 'since in December I will have the opportunity to visit her again in Moscow'<sup>99</sup> she reassured her correspondent. Kovalevskaya knew that preparing for her first full year as professor in Sweden, would not be easy: 'it is vital that I can devote myself this winter to my lectures and mathematical work without interruption.'<sup>100</sup> In addition, she was aware that she was

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<sup>96</sup> Iulia Lermontova (1847–1919) was the first woman in the world to get a doctoral degree in Chemistry from the University of Göttingen in 1874, the same year as Kovalevskaya. For more details on her life and contribution to chemistry, see Koblitz, 'Science, Women, and the Russian Intelligentsia: The Generation of the 1860s', *The History of Science Society*, 79, no.2(1988), 208-226.

<sup>97</sup> Kovalevskaya (1951), 283.

<sup>98</sup> Ibid.

<sup>99</sup> Ibid.

<sup>100</sup> Ibid.

inexperienced in housekeeping and at the end of the day she did not care about ‘the fact that “people will talk”’.<sup>101</sup> While she had shown Lermontova the content of Gyldén’s letter and had explained the prejudices of the Swedish society, they both had ‘long and serious discussions about what would be better just for the girl’.<sup>102</sup> Kovalevskaya’s meticulous and detailed letter, which was articulated in concert with her friend Lermontova, is a testament of how women in science deal with ‘the personal’ and the everyday, detached from empty sentimentalisms of the heteropatriarchal assemblage. As Kovalevskaya boldly put it in her letter:

I am perfectly content to conform in all the petty details of life to the opinions of Stockholm society, both as regards how I dress, and as regards my lifestyle and my choice of acquaintances, etc., to carefully avoid everything that could offend the strictest judge – or rather, the judge of the female sex. But when the question is one of a matter of such importance to me as the welfare of my daughter, then I have to act entirely as I see fit. For my part, it would be an unforgivable weakness if I were to mix in other considerations here.<sup>103</sup>

Having carefully thought about the welfare of her daughter was not just a whim of the time for Kovalevskaya. When Fufa eventually joined her in Stockholm in the fall of 1886, she found a new family among Kovalevskaya’s circle of friends. In her ‘Reminiscences’, Fufa has written at length about her impressions of her move to Sweden: ‘At the end of August, after two and a half days by sea, we arrived in Stockholm just before sunset. The view of the beautiful Stockholm raid amazed even me, who still did not know how to appreciate pictures of nature.’<sup>104</sup> Kovalevskaya spent a lot of time with her daughter in the beginning, reading her books and taking her to the market ‘where, through visual learning, she significantly enriched my vocabulary of the Swedish language’.<sup>105</sup> It was still summer, and Kovalevskaya’s acquaintances were on holidays, but when they came back, little Fufa got to know the Lefflers, but became particularly attached to the Gyldéns, who had a boy her age and three older children: ‘I enjoyed going to them [...] they lived on the outskirts of the city, in a house with a tower, surrounded by a large garden. I began to live quite like a member of this family, particularly during the time of my mother’s frequent absences and vacations’.<sup>106</sup>

As has already been seen in the previous section, Kovalevskaya travelled a lot during the academic holidays, mostly to keep in touch with the mathematical circles in France and Germany, but also to have some time for her research writing. Fufa remembered that ‘during the summer and Christmas holidays my mother always went to France or Germany, while I stayed in Sweden or at Lermontova’s. We spent only one summer with my mother.’<sup>107</sup> She also wrote that she had not kept early memories of her mother, as ‘until the age of seven, I

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<sup>101</sup> *Ibid.*

<sup>102</sup> *Ibid.*, 284.

<sup>103</sup> *Ibid.*, 283-4.

<sup>104</sup> ‘Memories of my mother’, In Kovalevskaya (1951), 362.

<sup>105</sup> *Ibid.*

<sup>106</sup> *Ibid.*, 363.

<sup>107</sup> *Ibid.*, 362.

saw her for the most part only in fits and starts'<sup>108</sup>, but she clearly remembered her life in her uncle's family as 'the happiest period of my early childhood'.<sup>109</sup> Throughout the several recollections of her life with her mother that she wrote,<sup>110</sup> it is obvious that they did not have a close relationship : 'my feelings to mother, were rather complicated and were not as intimate as those for Iulia Lermontova' she wrote.<sup>111</sup> Fufa could open up to Iulia as 'she loved me as I was',<sup>112</sup> despite the fact that she was always careful not to display her full affection for the child of her friend: 'no doubt, she loved me but thought it improper to give vent to her tenderness, and I was almost never caressed, apart from a kiss for the night.'<sup>113</sup>

Apparently Kovalevskaya's box as 'an ideal mother' cannot be ticked, but the question arises: is there such a thing as 'an ideal mother'? Moreover, how are discourses around motherhood constructed and what are their conditions of possibility? Koblitz has written that Kovalevskaya's limited involvement in the life of her child was following the conventions of her culture and social class: 'It was the custom for women of the continental European gentry and educated classes to leave the care of their children to nursemaids and other servants'.<sup>114</sup> This was the way Kovalevskaya was brought up, and in her autobiography of her childhood her mother appears as a distant and almost fairy-tale figure:

When I recall my mother during the first phase of my childhood, I always picture her as a quite young and very beautiful woman. I see her always gay and elegantly dressed. Most often I remember her in a low-necked ball gown, with bare arms and wearing a mass of bracelets and rings. She is getting ready to go out somewhere to a party and has dropped in to say goodnight to us.<sup>115</sup>

Kovalevskaya broke the tradition on so many levels and experiences. She did not become the aristocratic woman who would socialize, but the mathematician who had to travel, get involved in scientific networks, teach, prepare for her lectures and focus on her research, publications and editorial work. The traditional expectations of motherhood could not harmonize with the life of a scientist, while care seems to have remained a thorny— and as yet unresolved issue, well into the twenty-first century. Care and the political economy of women's work is at the heart of contemporary discussions around the dangerous liaisons between gender and science and an excavation of the past can only reveal how the private and the public are inextricably entangled in women's future becomings, but it also shows how

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<sup>108</sup> Ibid., 360.

<sup>109</sup> Cited in Kochina (1985), 318. Her uncle was Alexander Kovalevskii.

<sup>110</sup> After Fufa's death in 1952, several recollections of her life with her mother were found and published and they are now in the Archive of the Russian Academy of Sciences. See Kochina (1983), 318.

<sup>111</sup> Sofia Vladimirovna Kovaleskaya [Fufa] (1951), 320.

<sup>112</sup> Ibid.

<sup>113</sup> Ibid.

<sup>114</sup> Koblitz, 'Career and Home Life in the 1880s: The Choices of Mathematician Sofia Kovalevskaja', in *Uneasy Careers and Intimate Lives: Women in Science, 1789, 1979*, edited by Pnina G. Abir-am and Dorinda Outram. (New Brunswick and London: Rutgers University Press, 1989), 187.

<sup>115</sup> Kovalevskaya (1978), 52.

intersectional differences among women have made such a huge difference in their emergence as subjects of science. This is how we come full circle to the genealogical project of interrogating the present, by excavating its historical conditions of possibility and re-imagining its future. As I have already noted in the beginning of the paper, memory work is crucial in freezing important events in the long process of becoming a woman mathematician.

## Memory works

In introducing an excellent volume on memory studies, Susannah Radstone and Bill Schwarz have argued that rather than being a single phenomenon or concept that can be encapsulated in some clear-cut definition, memory should instead be charted as a plane of practices, an open process with complex and diverse histories, epistemological fields and theoretical contexts.<sup>116</sup> Women's diverse histories in the field of science have created a complex assemblage of such diverse practices and open processes. What has been particularly critical in this bursting field of memory studies is its *material turn*, and in this context, it is Whitehead's notion of 'causal efficacy' in his overall philosophy of process that I want to deploy, by way of conclusion.

As a mode of perception, 'causal efficacy' emerges as 'the hand of the settled past in the formation of the present' for Whitehead.<sup>117</sup> It is easy to follow Whitehead's argument that 'causal efficacy' anchors experience in the past at the same time of dragging it into the present and throwing it into the future: 'the immediate present has to conform to what the past is for it'<sup>118</sup>, in our case women's relation to mathematical sciences. Time is important in the unfolding of this conformation. When we look at Kovalevskaya's becoming a mathematician, we can see how she needed time to realize herself as a scientist, since her immediate present as a young woman was conformed to the prejudices of the past. While she entered a long process of detaching herself from the anchors of the past, she had a very short time to disentangle herself from the constraints of motherhood. Indeed, if she had not died so young, she might have had transformed the image of being a mathematician and a single mother, a process that women scientists after her, have already initiated.

Causal efficacy comes from the outside, revealing the worldly conditions that we emerge from, while the notion of causation emerges not as a logical mode – the way we think about the world – but as a visceral, living mode, the way we live the world. As Michael Halewood succinctly puts it, causal efficacy 'points to the manner in which our material being *and* our beliefs and actions are always located within a realm of efficacy, of a passing-on of data, of reasons, of motion, of feeling'.<sup>119</sup> It is in this context that memory for Whitehead refers

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<sup>116</sup> Susannah Radstone and Bill Schwarz, 'Introduction: Mapping Memory' in *Memory: Histories, Theories, Debates*, edited by Susannah Radstone and Bill Schwarz, (New York: Fordham University Press, 2010), 7.

<sup>117</sup> Whitehead, *Symbolism: Its meaning and effect*. New York: Fordham University Press, 1958[1927]), 50.

<sup>118</sup> *Ibid.*, 36.

<sup>119</sup> Michael Halewood, *A. N. Whitehead and Social Theory*, (London: Anthem Press, 2013), 54–5, emphasis in the text.

to the persistence of the past in the present through the dynamic interplay of entities in the process of becoming, in short, memory as perception in the mode of causal efficacy: 'memory is perception relating to the data from some historic route of ultimate percipient subjects [...] leading up to [...] the memorising percipient'.<sup>120</sup> Apart from this passing reference in his major work *Process and Reality*, however, Whitehead has not expanded on memory. As I have discussed elsewhere at length<sup>121</sup>, it was Whitehead's student, philosopher Susan Langer, who took up missing threads from her teacher's analysis in bringing forward the notion of 'symbolic transformation'<sup>122</sup> that is in my analysis a crucial process in understanding transpositions of material and spatial mnemonic practices and events—the mathematical formulas in the nursery wall paper, or her mother's elegant dresses in Kovalevskaya's case—into language, art and culture. Memory work through excavating, reading and understanding women mathematician's auto/biographical documents is part of this process of symbolic transformation that can become part of future becomings.

In thus trying to think differently about the problem that well into the twenty-first century women are still marginalized in the field of mathematical sciences, either as students, teachers, researchers and academics, retracing and remembering Kovalevskaya's nineteenth century adventures in becoming the first woman professor in mathematics in modern Europe can enlighten our understanding about the difficulties of past/present entanglements and hopefully help us re-imagine the future.

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<sup>120</sup> Whitehead (1985), 120.

<sup>121</sup> See Maria Tamboukou, *Gendering the Memory of Work: women workers' narratives* (London: Routledge), particularly Chapter 5.

<sup>122</sup> Susanne, K. Langer, *Philosophy in a New Key: A Study in the Symbolism of Reason, Rite and Art* (New York: Mentor Books, 1951[1942]).

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