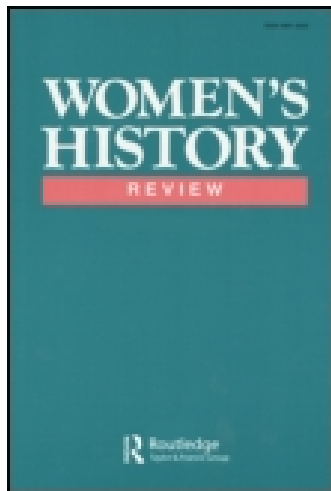


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Katharina Rowold ^a

^a London Guildhall University, United Kingdom

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The Many Lives and Deaths of Sofia Kovalevskaia: approaches to women's role in scholarship and culture in Germany at the turn of the twentieth century

KATHARINA ROWOLD

London Guildhall University, United Kingdom

ABSTRACT This article examines the ways in which the scientific work, life, and death of Sofia Kovalevskaia, the first female professor of mathematics in modern Europe, were represented in approaches to women's role in scholarship and culture in Germany at the turn of the twentieth century. Kovalevskaia's greatest scholarly successes and early death coincided with the period of most intense debate on women's admission to higher education in Germany, and her example came to be extensively discussed by supporters and opponents alike. The various ways in which the story of the woman mathematician was portrayed were symptomatic of what was at stake in the question of women's entry to university in the German Empire.

In 1889, the Russian-born Sofia Kovalevskaia [1] was appointed to a permanent professorship in mathematics at the University of Stockholm, a year after she had been awarded the prestigious Prix Bordin of the French Academy of Sciences. Kovalevskaia did not live long to enjoy this position: in 1891, at the age of forty-one, she died of pneumonia. Her story attracted a great amount of attention in turn-of-the-century Germany, the country where she had studied. The years that followed her appointment to the permanent professorship and her early death were the years of the most intense debates on women's admission to university in the German Empire. The woman professor of mathematics came to be continually invoked in these debates to the extent that her example was discussed in a debate on female education in the Prussian House of Deputies and appeared in a contemporary novel.[2] In recent years, there has been considerable feminist interest in the nineteenth-century mathematician, and her life and work have been explored

in detail.[3] Little attention, however, has been paid to the ways in which she was represented by her contemporaries and the roles her example played in debates on women's higher education. In Germany, women were admitted to university between 1900 and 1909 in a process that was preceded and accompanied by intense public debates. Questions about female nature and how it related to women's role in society and culture were central to these debates, as ideas on natural mental and physical differences between the sexes were integral to the middle-class ideological separation of spheres for men and women.[4] By the 1890s, the steady increase of women working for pay outside of the home and the growing activism of the women's movement increasingly questioned the certainty of gender boundaries.[5] In this context, the case of a recognised woman scientist came to play an important role in formulations of ideas on the female mind and body.

The struggle over women's higher education in the German Empire on many levels supposed a contest over the gendered meanings of *Bildung* (self-formation through education), culture, and scholarship, all key concepts for the social status and self-understanding of the educated middle class. Responses to the woman professor of mathematics reflected and were part of this contest. Other women scholars of the past were sometimes called upon in the education debates, but none was as frequently discussed as Sofia Kovalevskaia. Although there had been an earlier involvement of women in science, the processes of institutionalisation and professionalisation meant that by the mid-nineteenth century, women had been largely excluded.[6] Kovalevskaia's academic appointment in the 1880s was exceptional, and in Germany it came at a time when the women's movement started to systematically challenge women's exclusion from centres of higher learning. This, combined with the fact that some aspects of the mathematician's life, such as her early death, her occasional ill-health, and her unconventional married life, all highlighted in a biography that appeared soon after her death [7], related to some of the key questions and concerns that surrounded the issue of women's higher education, meant that her case was time and again invoked.

Perhaps surprisingly at first sight, it was not only supporters of women's higher education who used the mathematician's story to support their arguments; opponents frequently referred to her as a warning example of the dire consequences of women's entry to higher education and the professions. Less surprisingly, her life and work were also extensively discussed by a variety of feminists. In the recent literature, it is often assumed that the reaction of members of the women's movement to this first professor of mathematics was to celebrate her as an example of what women could achieve if conditions were right.[8] However, the responses of nineteenth-century German feminists to Sofia Kovalevskaia were far more

complex than that. The woman mathematician occupied an ambivalent place in many feminists' views on the female mind and women's cultural role.

The diverse approaches of feminists to women's role in the public sphere were crucially influenced by appropriations of the concept of *Bildung*. The word *Bildung*, as Fritz Ringer argued many years ago in his study of the ideologies prevalent among German professors, 'contained the single most important tenet' of what he called the mandarin tradition.[9] It also contained a key tenet of nineteenth-century German feminism, and continued to do so well into the twentieth century. The concept of *Bildung* was key to the emphasis of the nineteenth-century women's movement on access to education as a central aim: *Bildung* was to form women's character and thus give them the prerequisites for their contribution to shaping the public sphere. Yet, feminists combined the appropriation of the concept of *Bildung* in diverse ways with medico-scientific ideas on women's difference, arguing that women had gender-specific roles in the public sphere. Ann Taylor Allen has shown that the underlying maternalism of German feminism provided members of the women's movement with a rationale for women's involvement in the public sphere.[10] However, there were limits as to the roles that were thus conceptually opened for women, and for many feminists, the professional woman scholar proved to be a rather problematic figure. Feminists, grappling with the meanings of 'female culture' and with the relationship between 'spiritual', as well as biological, motherhood and scholarship, produced conflicting images of the scientist and mother, Sofia Kovalevskaia. The various ways in which the story of the woman mathematician was told were symptomatic of what was at stake in the question of women's entry to university. The concerns surrounding women's higher education were imprinted on portrayals of Kovalevskaia's work, life and death, and her mind and body became a battleground of conflicting interpretations.

Sofia Kovalevskaia and Women's Higher Education in Germany

Sofia Vaseline Korvin-Krukovskaia was born in 1850 in Moscow, as the daughter of an artillery officer and large landowner. She became interested in mathematics at an early age and was unusually extensively tutored in it. In 1868, as universities were closed to women in Russia, she contracted a 'fictitious' marriage with Vladimir Kovalevskii to be able to study abroad. Fictitious marriages were a common practice among Russian nihilists, as women could leave the country only with the consent of either their father or husband, and Kovalevskaia had embraced nihilism early on.[11] The couple soon travelled to Heidelberg, where Kovalevskaia audited mathematics courses with well-known researchers. In 1871, she moved to Berlin - the most important centre of mathematical research in Germany at

the time - to study under Karl Weierstraß, a world-famous mathematician. Her attempt to be admitted to the university was fruitless, though. In the event, she was tutored privately by Weierstraß.[12] Three years after having moved to Berlin, in 1874, she submitted no less than three separate research papers (to not take any chances) to the University of Göttingen and was awarded a doctoral degree *in absentia*.

Despite her doctorate and a strong recommendation from Weierstraß, Kovalevskaia was unable to gain an academic position anywhere in Europe. She returned to Russia, gave up scientific research for some time and turned to writing fiction, an occupation that she continued throughout her life. At some point, she consummated her marriage and in 1878 gave birth to her only daughter. In 1881, she left Vladimir Kovalevskii and turned to mathematics again. Her husband, facing bankruptcy and prosecution for involvement in a stock swindle, committed suicide in 1883. The same year, Kovalevskaia was offered a temporary unpaid teaching post at the University of Stockholm after much effort by another of Weierstraß's pupils, Gustav Mittag-Leffler. In 1884, she was given a 5-year contract and a salary, and in 1889, she received a lifelong professorship, after she had been awarded the Prix Bordin of the French Academy of Sciences, one of the most prestigious of Academy awards, the year before. This same year, she met Maksim Kovalevskii, a distant relative of her late husband, whom she was probably about to marry when she died of pneumonia in 1891. According to her recent biographer, Ann Hibner Koblitz, by the time of her death Kovalevskaia was an accepted member of the Western mathematical community. She had received the Prix Bordin, she was a co-editor of a major scientific journal, *Acta Mathematica*, she knew many of the best-known mathematicians of her day, she organised conferences and was asked for letters of recommendation. Although her research was not path-breaking and she did not found a school of mathematics, by the time of her death, she was nevertheless, in the words of Koblitz, 'the equal of any male mathematician of her generation'.[13]

Regular matriculation at German universities became possible for women on the same terms as men only between 1900 and 1909.[14] Sofia Kovalevskaia was one of a number of women who audited courses at university in the late nineteenth century before they were officially opened to the female sex, and she was one of a handful who earned a doctoral degree. It was these women auditors and the gradual admission of women to university in other countries that fuelled discussion about female higher education in Germany before the 1890s. Although women's education had been the dominant preoccupation of the bourgeois women's movement from the time of its emergence in the 1860s, it was only in the last decade of the century - when Kovalevskaia had already been teaching for some years at the University of Stockholm - that university education became an issue of

priority. By then, the movement had split into the moderate and radical wings, the former focusing its attention on the opening of the medical faculties and the academic qualification of women teachers, and the latter pursuing the admission of women to all the university faculties. Women's associations resorted to petitioning individual regional parliaments and the *Reichstag*. As a result, the first debate on women's higher education in the *Reichstag* took place in March 1891, one month after Kovalevskaia's death. Higher education hence turned into a central preoccupation of the bourgeois women's movement. Socialist women's groups, however, considered it primarily to be a 'ladies' question' of little relevance to the majority of women. Nonetheless, there was interest and support for it among a number of Social Democrats, including the co-founder and leader of the SPD (Social Democratic Party), August Bebel. The socialist women's weekly, *Die Gleichheit*, edited by Clara Zetkin, regularly reported on events relating to female admission to the universities, and Zetkin herself engaged with the question extensively in some of her publications.[15] Socialist women and men thus contributed to the debates on female higher education.

Sofia Kovalevskaia and the Masculinity of Culture and Scholarship

Approaches to women's higher education in Germany acquired much of their dynamic from the cultural importance of the gendered concepts of *Bildung* (self-formation through education), *Wissenschaft* (scholarship) and *Kultur*, or culture. Throughout the nineteenth century, these concepts were key aspects in the self-understanding and social standing of the *Bildungsbürgertum*, or educated middle class. Notions of 'German culture' also had a central place in the developing concept of a German nation, the long-standing sense of supposed German cultural superiority only deepening with unification. Thus, much was at stake by introducing seemingly fundamental changes in the make-up of the central cultural institutions of nineteenth-century Germany by admitting women to them. The renown of German universities was identified with the men of the *Bildungsbürgertum*. In the dominant perception of a gendered mind-body relationship, men were thought to be more deductive, logical, productive, creative and capable of abstraction. Women were seen to be more concrete, intuitive, impulsive, receptive and reproductive. The qualities of the male mind made the men of the *Bildungsbürgertum* the agents of culture. Middle-class women's role was different: it was to maintain and reproduce cultural values by passing them on to the next generation. The prospect of women's entry to higher education raised fierce opposition on the grounds that cultural production was gendered. The most widely discussed pamphlets against women's admission to university all contended that men were the creators of *Kultur*, while women by nature could not contribute to it.[16]

The initiative by the women's movement to include women into the sphere of institutional learning in the 1890s came precisely at the time when there was growing concern among *Bildungsbürger* about contemporary conditions of university education and cultural life in general. Feeling threatened by the fast-paced social change that went hand in hand with rapid industrialisation, conservative critics construed it as an erosion of German 'culture', often tracing part of the blame for this 'crisis' to shortcomings of the universities. As 'the masses' and machines undermined traditional values and forms of life, higher education was becoming an article of mass consumption, and true *Bildung*, or individual cultivation, was giving way to expert knowledge.[17] According to critics, the added effect of including women into the realm of scholarship would decidedly lead to its 'weakening' and 'watering down'. The renown of German scholarship would become a thing of the past.[18] Women's admission was seen as a threat to the universities, and as such, to the future prosperity of the German nation. 'Our universities', the prominent legal historian and professor of law in Berlin, Otto von Gierke, proclaimed in 1897, 'are men's universities'. To admit women would have far-reaching consequences:

The heavy armoury of rigid scholarship will be excluded more and more from instruction, ... the way of thinking will become shallow. This would not be the old German university any more, not the distinguished school of male intellectual power, not the valiant fighter, who helped to gain the intellectual primacy of our nation.[19]

If such objections were voiced to women's admission to higher education, there were also *Bildungsbürger* who were in support of it. That not all *Bildungsbürger*, or indeed, university professors, were hostile to the prospect of women in academe was not in the least demonstrated by the support Sofia Kovalevskaia received from other mathematicians in Germany.[20] When a journalist from Berlin surveyed the opinion of over a hundred *Bildungsbürger*, most of them university professors, on 'the academic woman', it was mathematicians who were among the most favourable, and Sofia Kovalevskaia figured large in the explanations of their support.[21] Also outside the mathematical community, Kovalevskaia, the 'great mathematical genius', played an important role in asserting that women were capable of 'higher mental achievements'.[22]

But how did those who saw the female sex as lacking in abstract capacities and creative power approach the case of the successful woman mathematician? Kovalevskaia's mind certainly aroused enough interest to have her brain size measured.[23] According to some commentators, there was not much to discover though, as Kovalevskaia's achievements, like those of any other woman of learning of the past, were insignificant: 'They were good students, no more than that'.[24] Kovalevskaia's entire work, it was claimed, consisted essentially of carrying out Weierstraß's thoughts.[25]

According to Frederick Bettex, Kovalevskaia and other women who had become known for their learning and intellectual work, had never used their knowledge productively: 'none of them has opened new scientific ... horizons; ... none has changed the world with their scholarship; none has advanced human progress'.[26] Hence, it was true that however 'talented' and 'intelligent' a woman might be, she lacked creative power.[27]

But if women naturally had no inclination for the abstract sciences, then it remained to be explained why some women did turn to mathematics. Kovalevskaia's decision to follow her early interests and study pure mathematics was much influenced by the radical milieu she grew up in Russia, in particular, the nihilist belief in the equality of men and women and their deep attraction to and faith in science. As Ann Hibner Koblitz has pointed out, for Kovalevskaia and 'the other Russian scientists (men as well as women) who were educated in the 1860s and 1870s, science was creative, fruitful, beautiful, nurturing, diverse, welcoming of innovation, and intrinsically progressive and egalitarian'.[28] Yet, in turn-of-the-century Germany, there were other explanations at hand to account for her unusual career. One of the most comprehensive engagements with the question of why Kovalevskaia had chosen to become a mathematician was presented by the neurologist, Paul Julius Möbius. Nowadays, Möbius is perhaps best remembered for his notorious *On the Physiological Feeble-mindedness of Woman* (1900), but in his own time he was a recognised authority in his field. Sigmund Freud in 1909 included him in the initiators of 'modern history of psychotherapy' and the influential psychiatrist, Emil Kraepelin, placed him into his biographical collection of important German psychiatrists.[29] According to Möbius, women normally were incapable of understanding mathematical connections and 'felt a sort of loathing' for anything that had to do with numbers. Indeed, mathematics was the opposite of the feminine: women wanted to 'dissolve in boundless emotions', whereas '[m]asculine clarity' culminated in accuracy, i.e. numerical data. Hence, he proclaimed a 'mathematical woman' contrary to nature. When mathematical talent did occur in a woman, it was the result of a process of degeneration (*Entartung*).[30]

If the question about women's role in scholarship fed into anxieties about the decline of the *Bildungsbürgertum*, of which the increasing loss of the traditional identity of the university was a symptom, it also fed fears about the socio-biological decay of Imperial Germany which accompanied Germany's headlong leap into modernity, a leap, in the words of Paul Crook, 'into the world of big industry, big cities, a big army, new science, large geo-political ambitions, rapid and disorienting social and political change'.[31] As a biomedical mode of thinking gained increasing appeal in approaching social and political developments, the 'woman question' became part of concerns about degeneration threatening the nation. For Möbius, a prolific

degeneration theorist, it was clear that a woman with 'originally male talents and inclinations' was a symptom and source of degeneration.[32] It was only through pathological changes that women could acquire such talents. Sofia Kovalevskaia, according to Möbius, was a clear example of such a process.[33]

Cultural pessimists hence attributed the mathematician's 'unwomanly' mental capacities to degeneration. At the same time, theories were formulated in which her achievements were symptomatic of her 'sexually intermediate' nature, or inborn homosexuality. By the time of Kovalevskaia's death, a variety of European physicians had formulated theories on the congenital nature of homosexuality, or sexual inversion.[34] The emergence of sexology in the second half of the nineteenth century coincided with the rise of the organised women's movement, and ideas on female sexual inversion were inextricably bound up with the 'woman question'. The two intersected through the particular understanding of homosexuality as denoting the inversion of a whole range of gender attributes within an individual. Theories developed by sexologists were a way of thinking about the relationship between the gendered mind and body at a time when gender boundaries were shifting, and they were thus applied to explain the phenomenon of a female professor of mathematics.

Sexological ideas on homosexuality were first formulated as part of the wider discourse of degeneration. How much the 'woman question', and in particular the question of women's higher education, influenced ideas on sexual inversion can be seen in the assertion of foremost authority in the field, the Viennese psychiatrist and forensic expert, Richard von Krafft-Ebing, that women of the 'severe stages of degenerative homosexuality' manifested an inclination for the sciences and stood out for their intellect and enterprise.[35] The idea of homosexuality as a symptom of degeneration, however, was increasingly displaced at the end of the century by the theory that it resulted instead from a non-pathological developmental anomaly. According to this theory, which still retained a conception of 'normal' and 'abnormal' femininity, masculinity and sexuality, there occurred frequent anomalies in the gradual development of initially sexually indifferent human embryos into physically and mentally differentiated men and women.[36] This meant that there existed 'sexual intermediate types' in whom the sexual drive, as well as a variety of mental and physical characteristics, were, by birth, of the other sex.

For theorists of sexual intermediacy, Sofia Kovalevskaia was such a type. Thus, Magnus Hirschfeld, a physician and the founder of the Scientific-Humanitarian Committee in 1897, which aimed at the abolition of the criminalisation of 'unnatural vice' between men, declared that the 'disturbances' in the formation of fully developed men and women could include abnormalities in the formation of mental differences. Was not Sofia

Kovalevskaia proof that there could easily occur deviations in the 'mental sexual differences'?[37] It became a common conclusion for theorists of sexual intermediacy that Sofia Kovalevskaia had a 'homosexual disposition' [38], meaning that the mathematician's supposed innate male mental powers explained her scientific inclination and achievements.

Sofia Kovalevskaia and Female Culture

While Sofia Kovalevskaia was represented in a variety of ways that retained the association of scholarly and cultural creation with masculinity, some members of the women's movement approached the woman mathematician in light of the idea of a specifically female cultural contribution. Ideas on natural differences between the sexes were pervasive among all the strands of the women's movement - moderate, radical, and socialist (as well as the homosexual rights movement) - and most feminists thought that women would contribute something different from men to culture. This approach was by no means the exclusive territory of moderates, although it was they who, through the concept of 'spiritual motherhood', put most consistent emphasis on a specifically female cultural mission as the primary legitimation of women's participation in the public sphere in general and in the development of culture in particular.[39]

Ann Taylor Allen has shown that maternalism was centrally important to feminist ideology in Germany.[40] But so was the *Bildungsideal*: nineteenth-century feminism was crucially influenced by German idealism and neohumanism. The preoccupation of the bourgeois women's movement with education was centrally inspired by the aspiration of inscribing women into the idealist-neohumanist concept of *Bildung*. There was a conception that women's emancipation (however differently feminists interpreted what that entailed) would create for women the conditions for the perfection of their personalities. Whereas socialist feminists thought that these conditions would only exist under socialism, moderates and radicals believed that the conferral of certain rights (for moderates, the most important one was the right to education; radicals generally promoted a more comprehensive vision of emancipation but also saw *Bildung* as crucial) would lead to the cultivation of the inner self of women and the development of free personalities (*freie Persönlichkeiten*). This would create the conditions for women's participation in shaping the public sphere. The ideal of women's development into 'personalities' was hence adapted to a variety of different political and feminist agendas.

For most feminists, although there were some notable exceptions, the inscription of women into the ideal of *Bildung* did not mean that gender became of no consequence. Rather, it was combined in various ways with notions of essential gender difference. Most bourgeois feminists who

appropriated the concept of *Bildung* to include women did not think of including any women other than those of their own class and culture, though, thus adopting and participating in the elaboration of *Bildung* as a class constituting factor as well as an indicator of the 'superiority' of Europeans over so-called 'natural peoples' (*Naturvölker*) to claim rights for middle-class women. The mixture of inscribing women into the ideal of *Bildung* and of outlining a female contribution to culture which depended on ideas about women's natural difference from men shaped approaches to Sofia Kovalevskaia. At the height of the campaigns for women's access to university at the end of the nineteenth century, her scientific successes were sometimes invoked to support the argument that women could be capable of intellectual performances currently deemed far beyond their abilities.[41] However, precisely because Kovalevskaia's achievements were in an abstract science, she did not fit into the space that was created for women through the concept of 'female culture'.

The idea of female culture was strongly influenced by contemporary medico-scientific theories on gender difference. There was mostly an acceptance by those who developed this idea that men naturally had a greater tendency to be abstract, speculative, systematic and impersonal, and thus were more inclined to and capable of furthering scholarship.[42] Or, in the words of Marianne Weber, who was married to Max Weber and on the whole closest to the moderate position, the advancement of the 'cosmos of our knowledge' was men's, not women's, strength.[43] In this view, however, women's difference did not preclude their participation in cultural tasks. Rather, it was precisely because women, due to their maternal role, had a greater tendency to be personal and concrete and were more capable of empathy, altruism, compassion and love, that they could offer qualities which were needed outside of the home.[44] Women were different from men, but this did not mean that they should continue to be excluded from higher education and professional work.[45]

Ideas on the meanings and effects of women's specific cultural role varied. For moderates of the generation of Helene Lange during the late nineteenth century, the *gebildete* woman was to morally regenerate society and contribute to the solution of the 'social question'. This preoccupation continued into the next century, but there was a shift in emphasis and language. By the early twentieth century, the task of the educated woman was increasingly seen to be the redemption of the perceived 'crisis of culture', mentioned earlier. Feminists claimed that it was women who could solve this crisis, or, as the moderate Gertrud Bäumer put it, create a synthesis between 'culture' and 'civilisation'. [46] This view rested on a gendering of objectivity and subjectivity. According to Marianne Weber, one of the most important theorists of this cultural role, women were capable of redressing the supposed disintegration of the relationship between inner

cultivation and external, or objective, culture, as she called it, following the philosopher, Georg Simmel [47], because, in comparison to men, they were more interested in the personal-human than in objects. This meant that it was women who put their education at the service of the perfection of their personalities. Men's greater objectivity went hand in hand with their greater power to dissociate their lives from objective culture, which explained why 'many leading male minds, who perform the highest for objective culture, remain petty and worthless as personalities'. In this view, it was educated women, rather than men, who could embody the *Bildungsideal*. [48]

The idea of a female cultural role could also be linked to very different aspirations, though. A case in point was Lily Braun, the renegade from the aristocracy, who in the early 1890s became involved with the radical women's movement and then in 1895 joined the SPD. Braun, who embraced Bernstein's revisionism and always believed in the cooperation of the bourgeois and socialist women's movements, supported women's higher education and entry into the professions, as she thought that women's influence in areas of social reform would be a step towards the gradual emergence of socialism. [49]

One thing proponents of female culture had in common, however, was that Sofia Kovalevskaja's work in mathematics did not correspond to the role and image of women they promoted. In the eyes of Helene Lange, Sofia Kovalevskaja was a 'variation' of the female 'type', but not representative of it. [50] Marianne Weber and Lily Braun both cited the mathematician in their arguments that women's scholarly achievements would always be less significant than men's, as the female disposition gave them a different cultural role. Kovalevskaja, Weber thus claimed, was the only woman whose work in mathematics was of any significance, but even she did not appear as a 'star of leading greatness' amongst the 'mathematical minds'. [51] Lily Braun, for her part, in 1901 explained that 'injudicious supporters of the women's movement' tended to list women from Hypatia to Kovalevskaja to challenge the claim that the female sex had never produced any geniuses. However, according to Braun, it was clear that what was of interest in these women of science was not their oeuvre, but their personalities. [52] There was not a single learned woman, she pointed out some years later, who was equal to 'a Newton or Galilei, to a Spinoza or Kant'. [53] There were areas of scholarship where 'female genius' could possibly manifest itself. Marianne Weber, writing at the time when some states had already admitted women to their universities, thought that women would be able to contribute something significant to the humanities, and in particular, history. Unlike in the sciences, here women's greater subjectivity and capacity for empathy was an asset, potentially opening areas which men could not reach. [54] A woman's work in an abstract science, however, was not given significance in

the notion of 'female culture', because it contradicted its basic assumption that by nature women's cultural contribution was different from that of men.

Mathematics and the Life and Body of a Woman

Sofia Kovalevskaia's scientific work was thus assessed in light of differing perceptions of the relationship between gender and culture. However, it was not only her work that was much discussed: her life was of at least as much interest. Depictions of her life more often than not depended on the understanding, crystallised in the late eighteenth century, that love defined women's nature and their ideal role as wives and mothers. If proponents of the idea of female culture elaborated the view of the importance of love and attributes that derived from it in the female psyche to establish a role for women outside of the home, others claimed that women's 'innate' drive to centre their lives on love for husband and children was bound to conflict with their participation in the public sphere. It was this understanding which fuelled the most pervasive depiction of Sofia Kovalevskaia, in which the mathematician's dedication to the life of the intellect put tremendous strains on her psychological well-being as it put her in conflict with her emotional needs. As a consequence, she was said to have led an unhappy and peaceless life [55], torn between her dedication to her scientific work and an unanswered yearning for love.

It was the Swedish writer, Anna Carlotta Leffler, a friend of Kovalevskaia and the sister of her colleague, Gustav Mittag-Leffler, who first portrayed Kovalevskaia's life in this way in a biography that was translated into German in 1894.[56] According to Leffler's account, Kovalevskaia was unhappy and unfulfilled, longing in vain to love and be loved, and regretting to 'be scientifically gifted, because she was thus drawn into a sphere which could never afford her happiness'.[57] There were some attempts to paint an image of Kovalevskaia as having a far more positive relationship with her work [58] and Leffler herself in her biography stated that her book was not intended as an objective description of her friend's life, but as a 'poem', a fictionalised account.[59] Nonetheless, numerous subsequent biographical sketches of the mathematician relied heavily on Leffler's account.

The image of Kovalevskaia's life as unhappy and unfulfilled, if initially drawn by Leffler, received its most important boost in Germany by the publication of Laura Marholm's *Das Buch der Frauen* in 1895. According to Marholm, a writer and essayist much concerned with the 'woman question', Kovalevskaia was a 'victim of her times'. She belonged to a new type of woman that had appeared in the late nineteenth century - the 'brainy woman' - indeed, she was the greatest triumph of this type. But despite her doctoral degree and her professorship, 'despite everything she was a woman'. Torn between her intellect and the 'dark basis' of her womanly

nature, she spent her life languishing.[60] Marholm's book stirred up much controversy, with the most hostile reaction coming from the women's movement. Feminists with such different views as Minna Cauer, Helene Lange, and Hedwig Dohm were outspoken in their condemnation.[61] But Marholm's depiction of Kovalevskaia found support in other quarters. Max Runge, professor of gynaecology at the University of Göttingen, thus used Marholm's narrative of Kovalevskaia's life as the prime example for his theory that 'woman is tied to eternal laws from which she cannot escape'. Woman's vocation was to be a wife and mother, and everything else 'lies more or less outside her sphere'.[62] There was disagreement with this conclusion [63], but the image of the woman professor, unhappily torn between her unfulfilled desire for love and her dedication to mathematics, was widely reproduced, including by supporters of the women's movement.[64]

The question of combining 'intellectual work' (*geistige Arbeit*) (that is, a career in the professions or arts) with the 'life of a woman', by which heterosexual love and motherhood was meant, was of considerable interest to feminists in the early twentieth century.[65] As there was a feminist preoccupation with whether a combination of the two led to emotional conflict, much interest was also shown by feminists in the life of the famous woman mathematician and the light it could shed on the question. Symptomatic of this preoccupation was a widely read book, published in 1901 by Adele Gerhard & Helene Simon, on *Motherhood and Intellectual Work*. [66] Adele Gerhard, a writer and member of the SPD, was married with two children. Her friend, Helene Simon, only joined the SPD during the First World War. She was a member of the Fabian Society, which she had joined when studying economics at the University of London. Unlike Gerhard, she had no children and never married. Their joint book was an inquiry into the 'important problem of the relationship of higher intellectual work with the physical nature of woman and the function and tasks of motherhood which arise from it'. It was based on the experiences of past and present, mostly middle-class, women artists, scientists, essayists, journalists and political activists.[67] The authors justified their focus on middle-class women by arguing that in 'a different economic order' (they never used the word 'socialism' in the book) [68], motherhood would be valued economically and mothers would be relieved of the necessity to work for a living. However, they wanted to investigate the situation of women who engaged in certain occupations because they were driven by an 'imperative mental urge'. [69]

One of the objects of their enquiry was Sofia Kovalevskaia. The authors' conclusion in their study was that the female constitution did not hinder intellectual or artistic creation [70], but that motherhood created emotional conflicts. The absorption required by the task of motherhood and

that required by 'higher intellectual work', according to the authors, made a harmonious combination of both impossible.[71] The mathematics professor was a case in point. She had, according to Gerhard & Simon, neglected her only daughter: Sofia 'dearly loved the little girl, whom she often abandoned. But a mother's deeper sense of responsibility seems to have been absent in her'. The daughter always yearned in vain for the attention of her mother. Not only that, but Kovalevskaia's inability to harmonise her mathematical gift with the rest of her personality led to a life of unhappiness.[72] For Gerhard & Simon, the life of Kovalevskaia, the 'mathematical genius', apparently unhappy and neglecting a mother's responsibilities, was thus representative of an unsolvable conflict between intellectual work and motherhood. But this did not mean that she should not have devoted her life to mathematics. The authors thought that 'exceptionally talented' women should not forego their cultural contribution for the sake of motherhood. The others, however, should realise that there existed no 'higher mental occupation, than that of the mother'.[73]

There were different interpretations of Kovalevskaia's life, however, as it often depended on the way feminists approached the question of motherhood and career. Helene Lange, for instance, agreed with Gerhard & Simon's basic conclusions in the book, but she disagreed on one point: their account of Kovalevskaia's relationship with her daughter. Lange thought that the combination of career and motherhood was fraught with difficulties and should generally be avoided, but she also believed that *Bildung* turned women into better mothers. She thus asserted that in the limited time Kovalevskaia spent with her daughter, she gave her more tenderness, more understanding and spiritual guidance than those mothers who, even if they only concentrated on their children, did not stimulate them spiritually.[74]

It was radicals who thought it was possible, and indeed necessary for women's personal self-fulfilment, and for many, also the good of the 'race', to harmoniously combine heterosexual fulfilment, motherhood, and career.[75] This aspiration of combining career and love was reflected in how radicals saw Sofia Kovalevskaia's life. From this point of view, the problem with Kovalevskaia's life was not that she combined a career with 'the life of a woman', but that the latter had remained unsatisfactory as she had never found true love, not because of her scientific work, but because of the men in her life.[76] Helene Stöcker, who later became the leader of the *Bund für Mutterschutz* and promoter of a 'new ethic', thus proclaimed in 1897 when she herself was auditing at the University of Berlin, 'what a strange sensation was created when Mrs Marholm made the great discovery that the occupation as mathematician or any occupation does not lead to a woman's complete and full happiness. But - who has ever said it did?'[77] In Stöcker's view, the aim of the women's movement was not to replace a one-sided emotional life with a one-sided working life. Women's emancipation

was about being able to combine being a free personality and a loving woman at the same time. For this, mental and economic independence, love and motherhood, were all indispensable.[78]

Sofia Kovalevskaia's life was thus said to hold clues about the psychological implications for a woman of having a career, clues which were interpreted in accordance with and presented as proof of specific viewpoints on the issue. According to some, however, her life could also tell tales about the physical consequences for a woman of engaging in scholarship. It was often claimed that Kovalevskaia's dedication to scientific work interfered with her bodily well-being, leading to illness and even to her death. In turn-of-the-century Germany, she was upheld as proof that too much brainwork undermined a woman's health, an idea which by then had gained currency and was accompanied by the theory that this acquired ill-health would be passed on to the next generation.

Kovalevskaia herself once met Herbert Spencer, the English evolutionist and philosopher who played a key role in developing the theory that women's reproductive function hindered their mental development in comparison to men, and that the expenditure of the same amount of energy on mental work would result in all kinds of bodily malfunctions. When travelling with her husband in England in 1869, she was invited to one of George Eliot's Sunday gatherings, where the novelist instigated an argument between her and Spencer about women's mental powers.[79] Kovalevskaia on this occasion strongly disagreed with Spencer. Nevertheless, she did not dismiss the possibility of acquiring ill health through mental overexertion and passing it on to the next generation. When her daughter was born in 1878, she commented to a friend, 'Thanks heavens I had not completely lost my strength in the study of mathematics; now at least, my little girl will inherit fresh intellectual capabilities'.[80]

Kovalevskaia indeed seems to have worked herself to exhaustion on a number of occasions.[81] Her life came to be depicted as a series of alternating states of complete absorption in mental work to the exclusion of everything else, including attention to bodily needs, such as sleep and food. These periods of 'overstrain', which 'cruelly assailed her strength', were followed by periods of mental and physical exhaustion.[82] This, Paul Julius Möbius declared, was a particularly clear example that 'health and outstanding talent coexist with difficulties in a woman'. Kovalevskaia was 'nervous to a high degree; passionate excitements made her prematurely old and ill'.[83]

It was not only Kovalevskaia's health that was used to demonstrate the dire consequences of too much mental exertion in a woman, but also her death. After her death, it was pointed out by her colleague, Gustav Mittag-Leffler, amongst others, that she had died of a cold which turned into a 'violent pleurisy' that 'defied all the arts of the doctors'.[84] Nonetheless, her

early death was turned into conclusive proof that women should not 'try to become men'. The woman professor of mathematics had paid the ultimate price for her transgressive behaviour: she had died of 'mollification of the brain, or in any case of the consequences of mental overexertion'.^[85] In other accounts, Kovalevskaia's death was not so much induced by physical causes – the mismanagement of vital forces – but by the inner torment stemming from her 'unwomanly' life. According to her biographer, Anna Carlotta Leffler, 'it was not merely the fatal microbes that settled on her lungs', but her inability to harmonise her life of emotions and her life of the mind ultimately caused her death ^[86], a claim which was also made by Laura Marholm and Max Runge.^[87] The implications were clearly spelled out by a speaker in the Prussian House of Deputies in a debate on reforming girls' education:

You cannot imagine a more brilliant talent for the exact sciences, than this woman possessed. Well now, what is her life? Shattered nerves, a shattered domestic life, and early death: these are the consequences of an immense learning that goes beyond the female sphere and does not make its possessor happy.^[88]

The belief that the early death of the woman mathematician exemplified the injury to women's health by too much mental exertion did not go unchallenged, particularly by radicals, who so strongly believed in the combination of motherhood and career. Thus, Hedwig Dohm ridiculed Laura Marholm's depiction in which Kovalevskaia did 'not – as the doctors claimed – die of a severe cold', but of the 'dry, consuming heat ... of the sex'.^[89] Helene Stöcker, in response to the speech in the Prussian House of Deputies, pointed out that numerous male thinkers had suffered nervous disorders or died early. Was this not the case with Kleist, Hölderlin and Nietzsche? But in any case, Kovalevskaia had died of a simple influenza – something which could also happen to the 'dullest and most philistine person'.^[90]

Conclusion

In the early years of the 'second wave' women's movement, Sofia Kovalevskaia was reclaimed as a 'great woman of science' ignored by conventional histories of science, before interest in the nineteenth-century mathematician turned more towards analyses of the role of gender in scientific research.^[91] But her story had already attracted extensive attention in turn-of-the-century Germany among supporters and opponents of the women's movement alike. Different approaches to the question of women's relationship to culture and scholarship, fuelled by the campaigns for female entry to higher education, were imprinted onto portrayals of the work, life and death of the nineteenth-century mathematician.

The case of the successful and recognised woman mathematician caused considerable alarm, as it questioned the certainty of natural differences between the male and female mind. A woman who furthered scholarship in an abstract science potentially challenged the conception that different natural aptitudes of the sexes constituted the basis upon which middle-class social organisation was erected. It also challenged the gendering of creativity and capacity for abstraction, closely tied up with the key position that scholarship and culture held in concepts of the 'German nation', and in the self-understanding and social status of the educated middle class. At the time when segments of the middle class felt threatened by the changes in the social and political order generated by the effects of rapid industrialisation, the figure of the woman mathematician questioned the fundamental principle of the 'natural' order, feeding already growing concerns about the erosion of gender boundaries. Anxieties fuelled by the figure of this woman scientist were contained by insisting that Kovalevskaia's work was not really productive, but rather reproductive, or at least insignificant, if compared with the heights of male achievement. Reflecting the increasing appeal of biomedical thinking, the challenge that Kovalevskaia posed to contemporary notions of natural gender difference was diluted by theories which biologically defeminised her, and presented her inclination for the sciences as the result of a process of degeneration or attributed it to her 'sexual intermediate' nature. If not that, her entry into the sphere of scholarship was portrayed as having been bought at the price of unhappiness, ill health and death.

Images of Sofia Kovalevskaia created by turn-of-the-century German feminists were similarly complex. Kovalevskaia occupied a very different position from the one she held in twentieth-century feminist historians' rediscovery of the 'great women of the past'. She was sometimes called upon as proof that women had the necessary mental capacities to go to university, so vociferously challenged, but this occurred comparatively seldomly. Feminists who appropriated the *Bildungsideal* and integrated it with notions of natural female difference to claim that women had a gender-specific cultural role showed much ambivalence towards this woman who made her mark in a field associated with masculine mental attributes, as this disputed the basis of their central assumption. Other feminists, who believed that there existed fundamental difficulties in combining motherhood and career, presented her as an example of these difficulties. Feminists who promoted the combination of career, love and motherhood, on the other hand, did not see her as the embodiment of their vision of the 'new woman' either, because she allegedly failed to combine 'the life of a woman' with her successful career, which, in their view, was bound to have left her unfulfilled and unhappy. Advocating women's engagement in professional work, they did, however, challenge the claim that Kovalevskaia had died as a result of

her dedication to scientific work. The figure of Sofia Kovalevskaia hence generated a multitude of images. These images were less indicative of the mathematician's work and life than they were of the concerns, anxieties, and expectations that surrounded the question of women's admission to university and were so deeply rooted in the cultural context of the German Empire.

Acknowledgements

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Notes

- [1] There is wide variation in the spelling of Kovalevskaia's name. The spelling used in this article comes from Ann Hibner Koblitz's biography (1993 reprint edition), *A Convergence of Lives: Sofia Kovalevskaia – scientist, writer, revolutionary* (New Brunswick: Rutgers University Press; first published 1983, Boston: Birkhauser).
- [2] Preußisches Haus der Abgeordneten (30 April 1898) *Stenographische Berichte*, p. 2277; Ernst von Wolzogen (1899) *Das dritte Geschlecht*, p. 93 (Berlin: A. Weichert).
- [3] See Lynn M. Osen (1974) *Women in Mathematics* (Cambridge, MA: MIT Press) and Margaret Alic (1986) *Hypatia's Heritage: a history of women in science from antiquity to the late nineteenth century* (London: The Women's Press). For biographies, see Koblitz, *A Convergence of Lives*; Cordula Tollmien (1995) *Fürstin der Wissenschaft: Die Lebensgeschichte der Sofja Kowalewskaja* (Weinheim: Beltz); and Wildrich Tuschmann & Peter Hawig (1993) *Sofja Kowalewskaja: Ein Leben für die Mathematik und Emanzipation* (Basel: Birkhäuser). For further studies, see Ann Hibner Koblitz (1987) Career and Home Life in the 1880s: the choices of mathematician Sofia Kovalevskaia, in Pnina G. Abir-Am & Dorinda Outram (Eds) (1987) *Uneasy Careers and Intimate Lives: women in science, 1789-1979*, pp. 172-190 (New Brunswick: Rutgers University Press); Anna Maria Stuby (1992) 'Ich war Assistent, und blieb es noch lange ...': kritische Überlegungen zum Verhältnis Frau und Mathematik, mit einer Fallstudie über Sofja Kovalewskaja, in Anne Schlüter (Ed.) *Pionierinnen, Feministinnen, Karrierefrauen? Zur Geschichte des Frauenstudiums in Deutschland*, pp. 41-61 (Pfaffenweiler: Centaurus); and Cordula Tollmien (1997) Zwei erste Promotionen: Die Mathematikerin Sofja Kowalewskaja und die Chemikerin Julia Lermontowa, in Renate Tobies (Ed.) *Aller Männerkultur zum Trotz: Frauen in Mathematik und Naturwissenschaften*, pp. 83-129 (Frankfurt a. M.: Campus). For an examination of the impact of Kovalevskaia's work on mathematics, see Linda

- Keen (Ed.) (1987) *The Legacy of Sonya Kovalevskaya* (Providence, RI: American Mathematical Society). For autobiographical sketches, see Sonja Kowalewska (1897) *Jugenderinnerungen*, trans. Louise Flachs-Fokschaneanu (Berlin: S. Fischer) and Sofia Kowalewsky (1901) *Autobiographische Skizze*, trans. Sophie von Adelung, *Deutsche Rundschau*, 108, pp. 118-126.
- [4] Karin Hausen (1981) Family and Role-division: the polarisation of sexual stereotypes in the nineteenth century – an aspect of the dissociation of work and family life, in Richard J. Evans & W.R. Lee (Eds) *The German Family: essays on the social history of the family in nineteenth- and twentieth-century Germany*, pp. 51-83 (London: Croom Helm); Claudia Honegger (1991) *Die Ordnung der Geschlechter: die Wissenschaften vom Menschen und das Weib, 1750-1850* (Frankfurt a. M.: Campus); and Ute Frevert (1995) *'Mann und Weib, und Weib und Mann': Geschlechter-Differenzen in der Moderne* (Munich: C.H. Beck).
- [5] John C. Fout (1992) Sexual Politics in Wilhelmine Germany: the male gender crisis, moral purity, and homophobia, *Journal of the History of Sexuality*, 2, p. 391. For the wider European context, see Chandak Sengoopta (1996) The Unknown Weininger: science, philosophy and cultural politics in fin-de-siècle Vienna, *Central European History*, 29, pp. 453-493; and Elaine Showalter (1992 reprint edition) *Sexual Anarchy: gender and culture at the fin de siècle* (London: Virago; first published 1990, New York: Viking).
- [6] Londa Schiebinger (1989) *The Mind Has No Sex? Women in the Origins of Modern Science* (Cambridge, MA: Harvard University Press).
- [7] Anna Carlotta Leffler (1894) *Sonja Kovalevsky, was ich mit ihr zusammen erlebt habe and was sie mir ueber sich selbst mitgeteilt hat*, trans. Heinrich von Lenk. The English translation was published a year later. See Leffler (1895) *Sonya Kovalevsky: a Biography and Sisters Rajevsky, being an account of her life by Sonya Kovalevsky*, trans. A de Furuhielm & A.M. Clive Bayley. Subsequent citations refer to the English edition.
- [8] See, for instance, Koblitz, *A Convergence of Lives*, p. 7 and Karen Offen (2000) *European Feminisms, 1700-1950: a political history*, p. 176 (Stanford: Stanford University Press).
- [9] Fritz K. Ringer (1990 reprint edition) *The Decline of the German Mandarins: the German academic community, 1890-1933*, p. 87 (Hanover, NH: Wesleyan University Press; first published 1969, Cambridge, MA: Harvard University Press).
- [10] Ann Taylor Allen (1991) *Feminism and Motherhood in Germany, 1800-1914* (New Brunswick: Rutgers University Press). For the politics of maternalism beyond Germany, see Seth Koven & Sonya Michel (Eds) (1993) *Mothers of a New World: maternalist politics and the origins of the welfare state* (New York: Routledge).
- [11] Nihilism emerged in the 1860s in Russia. Although vague in its definition, the term was applied by friends and foes alike to young intellectuals who

repudiated the social and political structures of tsarist Russia. Nihilists strongly believed in the equality of men and women, and had much faith in the natural sciences and in the power of education to cure social ills. See Richard Stites (1978) *The Women's Liberation Movement in Russia: feminism, nihilism and bolshevism* (Princeton: Princeton University Press). Kovalevskaia remained an adherent of the movement throughout her life. This, however, was hardly ever mentioned by any of the German commentators on her life, with a few notable exceptions, such as the biographical sketch by her friend, the Social Democrat Georg Vollmar. See G. Vollmar (1891) Sonja Kowalewski, *Die Neue Zeit*, 9, pp. 841-845.

- [12] Koblitz, *A Convergence of Lives*, pp. 100-101.
- [13] Ann Hibner Koblitz (1987) Changing Views of Sofia Kovalevskaia, in Keen, *The Legacy of Sonya Kovalevskaya*, p. 55. See also Roger Cooke (1987) Sonya Kovalevskaya's Place in Nineteenth-century Mathematics, in *ibid.*, p. 17.
- [14] Baden was the first state to open its universities to women in 1900, Bavaria followed in 1903, Württemberg in 1904, Saxony in 1906, Thuringia in 1907, Esse, Alsace Lorraine and Prussia in 1908, and Mecklenburg was last in 1909. For the history of women's higher education, see James C. Albisetti (1988) *Schooling German Girls and Women: secondary and higher education in the nineteenth century* (Princeton: Princeton University Press); Elke Kleinau & Claudia Opitz (Eds), *Geschichte der Mädchen- und Frauenbildung*, vol. 2 (Frankfurt a. M.: Campus); *Vom Vormärz bis zur Gegenwart*, ; and Claudia Huerkamp (1996) *Bildungsbürgerinnen: Frauen im Studium und in akademischen Berufen, 1900-1945* (Göttingen: Vandenhoeck & Ruprecht).
- [15] Clara Zetkin (1902) *Geistiges Proletariat, Frauenfrage und Sozialismus* (Berlin: Vorwärts). For a discussion of socialist women's approaches to education, see Marianne Friese (1996) *Bildungskonzepte der Arbeiterbewegung*, in Kleinau & Opitz *Geschichte der Mädchen- und Frauenbildung*, vol. 2, *Vom Vormärz bis zur Gegenwart*, pp. 230-247.
- [16] E. Albert (1895) *Die Frauen und das Studium der Medizin* (Wien: Alfred Hölder); Max Runge (1896) *Das Weib in seiner Geschlechtsindividualität* (Berlin: Julius Springer); and P.J. Möbius (1900) *Ueber den physiologischen Schwachsinn des Weibes* (Halle: Carl Marhold).
- [17] Ringer, *The Decline of the German Mandarins*, pp. 253-258.
- [18] F[rederick] Bettex (1897) *Mann und Weib*, pp. 172-173.
- [19] Otto Gierke, in Arthur Kirchhoff (Ed.) (1897) *Die akademische Frau: Gutachten hervorragender Universitätsprofessoren, Frauenlehrer und Schriftsteller über die Befähigung der Frau zum wissenschaftlichen Studium und Berufe*, p. 24 (Berlin: Hugo Steinitz).
- [20] Kovalevskaia herself only mentioned once facing opposition from a mathematician: when E.E. Kummer voted against her admission to the University of Berlin in 1870. See Koblitz, *A Convergence of Lives*, p. 245.

- [21] Prof. Dr. Rudolf Sturm, Prof. Dr. Wangering and Prof. Dr. G. Weyer, in Kirchhoff, *Die akademische Frau*, pp. 242, 243, 248ff. In Kirchhoff's survey, about half of the participants expressed themselves in favour of women's admission to higher education, although only a small minority did so without any reservations. About a third of those surveyed resolutely objected to the prospect of 'the academic woman'. Overall, there was no marked difference between the response of natural scientists and humanities professors. Other than the mathematicians, it was writers who were in their great majority favourably inclined to go ahead with the opening of higher education to women.
- [22] Otto Dornblüth (1897) *Die geistigen Fähigkeiten der Frau*, pp. 45, 13 (Rostock: Wilh. Werther). See also M. Kronfeld (1895) *Die Frauen und die Medizin: Professor Albert zur Antwort. Zugleich eine Darstellung der ganzen Frage*, p. 36 (Wien: Carl Konegen).
- [23] Her brain was only weighed after it had been in alcohol for four years. It was estimated that at the time of her death, although less in absolute terms, in relation to body size her brain weighed more than that of her contemporary, Hermann von Helmholtz. See Gustaf Retzius (1900) *Das Gehirn des Mathematikers Sonja Kovalewsky in biologischen Untersuchungen* (Stockholm), cited in H.Z. Mozans (1913) *Woman in Science: with an introductory chapter on woman's long struggle for things of the mind*, pp. 124-125 (London and New York: D. Appleton).
- [24] P.J. Möbius (1907 reprint edition) Ueber die mathematischen Weiber, in *Ueber die Anlage zur Mathematik*, p. 93 (Leipzig: Johann Ambrosius Barth; first published 1900).
- [25] Ibid., pp. 89, 93. Ann Hibner Koblitz has discussed how this view also became increasingly prevalent amongst mathematicians during the twentieth century. There was a process by which the high regard that Kovalevskaja mostly received from her colleagues during her lifetime was increasingly supplanted by an image of her as an unoriginal thinker after her death. See Koblitz, 'Changing Views', pp. 64ff.
- [26] Bettex, *Mann und Weib*, p. 140.
- [27] Ibid., p. 52.
- [28] Koblitz, *A Convergence of Lives*, p. xxiv.
- [29] Francis Schiller (1982) *A Möbius Strip: fin-de-siècle neuropsychiatry and Paul Möbius*, p. 3 (Berkeley: University of California Press).
- [30] Möbius, 'Ueber die mathematischen Weiber', pp. 91-92.
- [31] Paul Crook (1994) *Darwinism, War and History: the debate over the biology of war from 'The Origins of Species' to the First World War*, p. 82 (New York: Cambridge University Press). For degeneration theory in Germany, see Paul Weindling (1989) *Health, Race and German Politics between National Unification and Nazism, 1870-1945* (Cambridge: Cambridge University Press).

- [32] P.J. Möbius (1907) Geschlecht und Entartung, in *Beiträge zur Lehre von den Geschlechts-Unterschieden*, pp. 320-333 (Halle: Carl Marhold).
- [33] Möbius, 'Ueber die mathematischen Weiber', p. 92.
- [34] For the concept of sexual inversion, see, for instance, George Chauncey Jr (1982-83) From Sexual Inversion to Homosexuality: medicine and the changing conceptualization of female deviance, *Salmagundi*, 58, pp. 114-146; and Gert Hekma (1994) 'A Female Soul in a Male Body': sexual inversion as gender inversion in nineteenth-century sexology, in Gilbert Herdt (Ed.) *Third Sex, Third Gender: beyond sexual dimorphism in culture and history*, pp. 213-239 (New York: Zone Books).
- [35] Richard von Krafft-Ebing (1894 reprint edition) *Psychopathia Sexualis mit besonderer Berücksichtigung der conträren Sexualempfindung: Eine klinisch-forensische Studie*, pp. 281-282 (Stuttgart: Ferdinand Enke, 9th revised edition; first published 1886).
- [36] Chandak Sengoopta (1992) Science, Sexuality and Gender in the Fin-de-Siècle: Otto Weininger as Baedeker, *History of Science*, 30, p. 257.
- [37] M. Hirschfeld-Charlottenburg (1899) Die objective Diagnose der Homosexualität, *Jahrbuch für sexuelle Zwischenstufen unter besonderer Berücksichtigung der Homosexualität*, 1, p. 21. On Hirschfeld, see James D. Steakley (1997) *Per scientiam ad justitiam: Magnus Hirschfeld and the sexual politics of innate homosexuality*, in Vernon A. Rosario (Ed.) *Science and Homosexualities*, pp. 133-154 (New York: Routledge).
- [38] See Anna Rüling (1905) Welches Interesse hat die Frauenbewegung an der Lösung des homosexuellen Problems? *Jahrbuch für sexuelle Zwischenstufen*, 7, p. 144; and Otto Weininger (1980 reprint edition) *Geschlecht und Charakter: Eine prinzipielle Untersuchung*, p. 83 (München: Matthes & Seitz; first published 1903).
- [39] For the concept of spiritual motherhood, see Irene Stoehr (1983) 'Organisierte Mütterlichkeit': zur Politik der deutschen Frauenbewegung um 1900, in Karin Hausen (Ed.) *Frauen suchen ihre Geschichte: historische Studien zum 19. und 20. Jahrhundert*, pp. 221-249 (München: C.H. Beck).
- [40] Allen, *Feminism and Motherhood in Germany*.
- [41] See, for instance, A. Bernau (1893) *Darf die Frau denken?* p. 11 (Minden: Wilhelm Köhler); Helene Lange (1896/97) Intellektuelle Grenzlinien zwischen Mann und Frau, *Die Frau*, 4, p. 327; Marie von Wilm (1902) *Mann und Weib: Beleuchtung des so benannten Bettexschen Buchs nebst eigenen Betrachtungen über dies Thema*, p. 31 (Berlin: L. Oehmigke).
- [42] Lange, 'Intellektuelle Grenzlinien zwischen Mann und Frau', p. 327; Helene Lange (1889) *Frauenbildung*, p. 89 (Berlin: L. Oehmigke).
- [43] Marianne Weber (1919 reprint edition) Die Beteiligung der Frau an der Wissenschaft, in *Frauenfragen und Frauengedanken: Gesammelte Aufsätze*, p. 7 (Tübingen: J.C.B. Mohr; first published 1904).
- [44] Lange, 'Intellektuelle Grenzlinien zwischen Mann und Frau', p. 327.

- [45] Helene Lange (1889) *Die ethische Bedeutung der Frauenbewegung*, pp. 4, 12 (Berlin: L. Oehmigke).
- [46] Gertrud Bäumer (1909) *Die Frauenbewegung und die Zukunft unserer Kultur*, p. 13 (Berlin: W. Moser).
- [47] Georg Simmel (1984 reprint edition) *Female Culture*, in Guy Oakes (Ed.) *Georg Simmel: on women, sexuality and love*, p. 65 (New Haven: Yale University Press; first published 1911).
- [48] Weber, 'Die Beteiligung der Frau an der Wissenschaft', pp. 7-9.
- [49] Lily Braun (1901) *Die Frauenfrage: ihre geschichtliche Entwicklung und wirtschaftliche Seite*, pp. 206-207 (Leipzig: S. Hirzel). For Braun, see Alfred G. Meyer (1985) *The Feminism and Socialism of Lily Braun* (Bloomington: Indiana University Press).
- [50] Lange, 'Intellektuelle Grenzlinien zwischen Mann und Frau', p. 327.
- [51] Weber, 'Die Beteiligung der Frau an der Wissenschaft', p. 4.
- [52] Braun, *Die Frauenfrage*, p. 205.
- [53] Lily Braun (1908) Das geistige Leben des Weibes, in R. Koßmann & Jul. Weiß (Eds) *Mann und Weib: ihre Beziehungen zueinander und zum Kulturleben der Gegenwart*, vol. 1, p. 266 (Stuttgart: Union Deutsche Verlagsgesellschaft).
- [54] Weber, 'Die Beteiligung der Frau an der Wissenschaft', p. 5.
- [55] See, for instance, Möbius, 'Ueber die mathematischen Weiber', p. 94.
- [56] Leffler, *Sonya Kovalevsky*.
- [57] *Ibid.*, p. 84. Her more recent biographer, Ann Hibner Koblitz, strongly disagrees with this interpretation of Kovalevskaja's life. According to her, Kovalevskaja managed to merge career and private life satisfactorily, if not ideally. See Koblitz, 'Career and Home Life in the 1880s', p. 190.
- [58] See, for instance, Marie von Bunsen (1897) Sonja Kowalevsky: Eine biographische Skizze, *Westermanns illustrierte deutsche Monatshefte*, 82, p. 221; and Maria Mendelson (1897) Briefe von Sophie Kowalewska, *Neue Deutsche Rundschau*, 8, pp. 589-614.
- [59] Koblitz, *A Convergence of Lives*, p. 278.
- [60] Laura Marholm (1895) *Das Buch der Frauen: zeitpsychologische Portraits*, introduction, pp. 160-161, 163 (Paris: Albert Langen).
- [61] For Cauer's and Lange's reaction to the book, see Susan Brantly (1991) *The Life and Writings of Laura Marholm*, pp. 107-109 (Basel: Helbing & Lichtenheim). For Hedwig Dohm's reaction, see (1902) *Die Antifeministen: Ein Buch der Verteidigung* (Berlin: Ferd. Dümmler).
- [62] Runge, *Das Weib in seiner Geschlechtsindividualität*, pp. 15-17.
- [63] See Anna E. (1897) Das Weib in seiner Geschlechtindividualität: Entgegnungen auf die gleichnamige Broschüre von Prof. Max Runge, *Deutsche Medizinische Wochenschrift*, 23, p. 141; and Albert Moll, in Kirchhoff *Die akademische Frau*, pp. 136-137.

- [64] See Harald Höfding (1895/6) Die Frauenfrage und die Teilung der Arbeit, *Die Frau*, 3, p. 5, and Weyer, in Kirchhoff *Die akademische Frau*, pp. 252-255.
- [65] Allen, *Feminism and Motherhood in Germany*, pp. 163ff.
- [66] Adele Gerhard & Helene Simon (1901) *Mutterschaft und geistige Arbeit: Eine psychologische und soziologische Studie. Auf Grundlage einer internationalen Erhebung mit Berücksichtigung der geschichtlichen Entwicklung* (Berlin: Georg Reimer).
- [67] *Ibid.*, p. iii.
- [68] Sabine Klöhn (1982) *Helene Simon, 1862-1947: deutsche und britische Sozialreform und Sozialgesetzgebung im Spiegel ihrer Schriften und ihr Wirken als Sozialpolitikerin im Kaiserreich und in der Weimarer Republik*, p. 250 (Frankfurt a. M.: Peter Lang).
- [69] Gerhard & Simon, *Mutterschaft und geistige Arbeit*, p. 6.
- [70] *Ibid.*, pp. 311-312.
- [71] *Ibid.*, p. 319.
- [72] *Ibid.*, p. 220-223.
- [73] *Ibid.*, pp. 323-324. For discussions of reviews of the book by social-democratic and bourgeois feminists, see Klöhn, *Helene Simon*, pp. 250ff.
- [74] Helene Lange (1900/01) *Mutterschaft und geistige Arbeit*, *Die Frau*, 8, p. 476.
- [75] Allen, *Feminism and Motherhood in Germany*, pp. 163ff.
- [76] Ellen Key (1908) *Drei Frauenschicksale*, pp. 67-69 (Berlin: S. Fischer). Key, who knew Kovalevskaia, had claimed ten years earlier, before she had become involved with the *Bund für Mutterschutz*, that Kovalevskaia had paid for the 'suffocation of the woman in her' with which she had gained the 'full development of her mathematical genius' with her unhappiness. See Ellen Key (1911 reprint edition) *Missbrauchte Frauenkraft: ein Essay*, p. 66 (Berlin: S. Fischer; first published 1898).
- [77] Helene Stöcker (1906) Unsere Umwertung der Werte, in *Die Liebe und die Frauen*, p. 8 (Minden: J.C.C. Brun; first published 1897).
- [78] *Ibid.*, pp. 9, 14; Helene Stöcker (1906) Die Hauswirtschaft als Beruf, in *Die Liebe und die Frauen*, p. 60 (first published 1902).
- [79] Sonja Kowalewska (1896) Erinnerungen an George Eliot, trans. Louise Flachs-Fokschanau, *Das Magazin für Litteratur*, 65, pp. 1390-1391.
- [80] Quoted in Koblitz, *A Convergence of Lives*, p. 138.
- [81] *Ibid.*, pp. 102, 211, 213.
- [82] Leffler, *Sonya Kovalevsky*, pp. 25-26; Marholm, *Das Buch der Frauen*, pp. 148-149, 157, 187.
- [83] Möbius, 'Ueber die mathematischen Weiber', p. 92.
- [84] G. Mittag-Leffler (1893) Sophie Kovalevsky: notice biographique, *Acta Mathematica*, 16 (1893), p. 387. See also Weyer, in Kirchhoff *Die*

- akademische Frau*, p. 250; Mendelson, 'Briefe', p. 613; von Bunsen, 'Sonja Kowalevsky', p. 213; and Vollmar, 'Sonja Kowalewski', p. 842.
- [85] E[lsbeth] von der Decken (1897) *Die gebildete Frau und die neue Zeit: Eine Gabe an die deutschen Frauen*, p. 46 (Göttingen: Vandenhoeck & Ruprecht). This claim was reproduced in the second edition of Bettex (1900 reprinted edition) *Mann und Weib* (Leipzig), cited in Wilm, *Mann und Weib*, p. 32.
- [86] Leffler, *Sonja Kovalevsky*, p. 164.
- [87] Marholm, *Das Buch der Frauen*, p. 142. See also Runge, *Das Weib in seiner Geschlechtsindividualität*, p. 15.
- [88] Preußisches Haus der Abgeordneten (30 April 1898) *Stenographische Berichte*, p. 2277.
- [89] Dohm, *Die Antifeministen*, p. 95.
- [90] Helene Stöcker (1906) Das Mädchengymnasium im Preußischen Abgeordneten Haus, in *Die Liebe und die Frauen*, p. 55. Marie von Wilm pointed out that Kovalevskaja had died of pneumonia, not mollification of the brain. See Wilm, *Mann und Weib*, p. 33.
- [91] See, for instance, Osen, *Women in Mathematics* and Alic, *Hypatia's Heritage*.

KATHARINA ROWOLD is a lecturer in European History in the Department of Politics and Modern History, London Guildhall University, Calcutta House, Old Castle Street, London E1 7NT, United Kingdom (rowold@lgu.ac.uk). She has compiled a volume of nineteenth-century articles, published as *Gender and Science: late nineteenth-century debates on the female mind and body* (Thoemmes, 1996). She is currently working on a comparative study of ideas on female nature, as reflected and developed in debates on women's access to university education in Britain, Germany and Spain from 1860 to 1914.

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