

Laura A. Zander (Münster)

Blank Spaces and Hidden Figures – Rewriting the Gendered History of Science

Abstract

The history of science, or so it often seems, is at its core a compendium of brilliant individuals and their singular discoveries; individuals that have been almost exclusively western, white and male. Those tasked with filling in the blank spaces in the scholarship of scientific history have increasingly been forced to resort to the writing of counterhistories from different, and particularly differently gendered, perspectives, as they set about reclaiming forgotten female scientists and restoring their lost voices. The deplorable absence of women from the history of science is particularly poignant in the non-western world. Female scientists around the globe still face the double bind of gender prescription and racial discrimination; an intersectional effect that remains highly under-researched. In this article, I am not so much concerned with individual figures written out of history, as I am interested in the structures and processes – whether historical, social or academic – that underwrite this fragmentary historiography. Setting out on a meta-reflection on the historio-scientific discourse, I want to examine some of the difficulties surrounding dubious facts and questionable historiography, while also drawing attention to the significance of the historical myths and narrative framing that accompany, enable and promote the partial writing of the history of science.

1 A Fragmentary History

The history of science, or so it often seems, is at its core a compendium of brilliant individuals and their singular discoveries; individuals that have been almost exclusively western, white and male. It is a history written from the perspective of the "perceived masculinity of all scientific endeavour," whether "practical knowledge," "dedicated study" or "experimental activity," to the exclusion of 'feeling,' associated instead with femininity (Wagner & Wharton 2019: 404). Those tasked with filling in the blank spaces in the scholarship of scientific history have increasingly been forced to resort to the writing of counterhistories from different, and particularly differently gendered, perspectives.¹ In a similar vein, historians, scientists and philosophers have set about reclaiming forgotten female scientists – those hidden figures of science – and restoring their lost voices. A rich body of research explores the ways in which alleged scientific objectivity is both culturally bound and constructed, effectively marginalising non-male, non-white or non-western contributions. This is the case, for instance, in Julie Des Jardins' *The Madame Curie Complex: The Hidden History of Women in Science* (2010), which sets out not only to dismantle the myth of scientific discovery as congruent with the lone male genius, but to reframe the history of science by revealing the substantial contributions to the field made by women throughout history. In *Inferior: How Science Got Women Wrong – and the New Research That's Rewriting the Story* (2017) Angela Saini investigates the many long-established gender stereotypes that are regularly used to justify unequal treatment or discrimination within the fields of biology, psychology and anthropology. While both the latter works aim to rewrite the history of science as a whole, others focus on individual female scientists –

¹ In the *Postcolonial Science and Technology Studies Reader*, Harding restricts the scope of the term "counterhistories" to postcolonial rewritings that set out to revise the dominant histories from a non-western perspective. In this paper, I extend the scope of the term to also include rewritings of the history of science from a feminist perspective, because I find it conceptually applicable in all instances where dominant discourses are countered from a perspective, hitherto discriminated against.

works that include Dava Sobel's *The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars* (2016), Nathalia Holt's *Rise of the Rocket Girls: The Women Who Propelled Us, from Missiles to the Moon to Mars* (2016) and Margot Lee Shetterly's *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race* (2016) which has also been turned into an Oscar-nominated film. What these texts have in common, is a commitment to filling in the gaps in the fragmentary historiography of science, or perhaps more accurately to suggest alternative readings of the facts this history is based upon.² Meredith Ray suggests therefore, that it "is not women who are missing from the picture; it is our lens that must be adjusted to perceive them," whereas Nina Gelbart sees a need to "define science with more elasticity to take into account the many unconventional places and spaces" in which scientific women do crucial work. By bringing "margins to the centre," Gelbart says, numerous scientific women will automatically come "into focus" (Gelbart 2016: 116).

Studies that specifically address discrimination against women in science from non-western countries are far fewer in number, but they too offer highly interesting angles for a revised historiography. Valuable insight can be drawn from the essays in Sandra Harding's *The Postcolonial Science and Technology Studies Reader* (2011), in which Harding also tackles the issue of intersectional discrimination in the scientific discourse. The relations between sciences and technologies, colonialism, imperialism and their recent residues and resurrections have, according to Harding, remained largely unaddressed, a research gap that this volume quite clearly seeks to fill (Harding 2011: 7). Beyond Harding's anthology, there are also a few individual articles that deal with similar issues, such as Elizabeth McKinley's "Brown Bodies, White Coats: Postcolonialism, Maori Women and Science" (2005) or Margaret Gaida's "Search for the 'Missing' Actors" in her "Muslim Women and Science" (2016), where the author notes that gender has also been conspicuously absent from studies on early modern Islamic science and contemplates new ways of asking questions, identifying sources and using extant historiographical work to guide the search for missing voices in the history of science. Nevertheless, recent publications in this field have clearly focused on the western world, and much more research needs to be done to trace women in Eastern Europe, the Muslim world, India and China (Gelbart 2016: 119).

Emily Temple-Wood, Wikipedia editor, practicing physician and co-founder of the WikiProject Women Scientists (2012) is committed to countering the effects and causes of gender bias, which she addresses particularly through her articles on women in science. "None of us controls who tells our stories," she says, "but we do get to choose the stories we tell" (Temple-Wood 2017: 72). In such a vein, I want to shed new light on some of the blank spaces in scientific history. However, contrary to many of the intriguing works just mentioned, I am not so much searching for particular individuals lost to history; I am more interested in the structures and processes – whether historical, social or academic – that underwrite this gendered history. Setting out on a meta-reflection on the historio-scientific discourse, I want to reconsider not only some of the inadequate facts and biased historiography that have hitherto constituted the fragmentary state of the discourse, but also the significance of historical myths and narrative framing that accompany, enable and promote the partial writing of the history of science.

² This is not to say that all of these projects are alike in scientific, academic or literary merit.

2 Inadequate Facts

In 1874, pioneer U.S. astronomer Maria Mitchell wrote in her diary: "no woman should say, 'I am but a woman!'"

But a woman! What more can you ask to be? Born a woman – born with the average brain of humanity – born with more than the average heart – if you are mortal, what higher destiny could you have? No matter where you are nor what you are, you are a power – your influence is incalculable; personal influence is always underrated by the person. (Mitchell 1896: 184-8)

It is fair to say that Mitchell's stance is not widely shared in the scientific world – whether in the past or the present. Indeed, for many, Marie Curie remains virtually the only female natural scientist in history. "Women appear in scientific texts only as objects of study or as metaphors for the (feminine) nature that (masculine) science investigates," Londa Schiebinger thus claimed, in her seminal 1989 *The Mind Has No Sex?* Yet more recent research by Caroline Criado Perez indicates that in many instances women are not even considered as adequate *objects* of study. In *Invisible Women: Exposing Data Bias in a World Designed for Men* (2019), she delineates the ubiquitous gender bias in big data research. Whether in medical trials, car crash dummies or male-only rodents in clinical testing, there is a wide variety of fields where scientists choose to self-limit their research to male-only objects of inquiry.³

Women occupy a complicated position within the history of science, both in terms of material reality, as well as in its chronology. The questionable accuracy of historical sources or historians' biased perspectives are of course faced by all historiographic endeavours. But it is naturally much more complicated to trace the source of an unacknowledged historical fact, than of one acknowledged. Was it the lack of historical fact, the lack of historical records of the fact, the lack of transmission of the historical records, the lack of inclusion of the historical records into later studies, the distortion of such records, or the tainted perspective or problematic preconceptions of the researchers that led to any particular omission? In such a vein, Margaret Gaida underscores how misperceptions, prejudices and misunderstandings have contributed to the lack of research on women's contributions to the history of science and particularly so in the Islamic context. According to Gaida, the prevailing (if inaccurate) view of Islamic science as having declined and stagnated after the eleventh century has inhibited research in scientific endeavours in general and those of women in particular. Moreover, the difficulty of tracking down sources in the Islamic context results in the lack of any obvious starting points for new research; in the Muslim world, "no women are known to have authored scientific or philosophical texts for early modern times; no female names appear at all in the texts that have been subjected to historical examination" (Gaida 2016: 198). Gaida therefore suggests including a broader spectrum of sources such as images and paintings of women, private libraries, correspondence and dedications in order to help uncover the various interests of elite women in scientific or philosophical subjects and to locate women in the scientific discourse who have not authored specific texts. It could also be helpful to broaden the scope

³ The use of male rodents in clinical testing, for instance, is usually justified by the female hormonal cycle that might come to influence or interfere with the data produced in a certain clinical trial. Yet subsequently that also means that the female hormonal cycle is not taken into account in cases where it would influence the effect or tolerance to a drug.

of what historians consider "science" to include fields such as alchemy and astrology to identify previously omitted female scientists⁴ (Gaida 2016: 199).

To illustrate the difficulty of missing, or disparate records and the subsequent problem of evaluation, one might begin with a cursory glance at antiquity: As a principle, there were no female scientists. The few examples to the contrary remained either largely unacknowledged or were mythologised to such a degree, that they pose fanciful distortions that can hardly be viewed as historically accurate. A typical case in point is the Hellenistic philosopher, astronomer and mathematician Hypatia. Her entire scientific oeuvre, constructed in Roman Egypt of the fourth century was destroyed together with the library of Alexandria. Because of this deplorable loss, her scientific achievements remain uncertain, as does the question of whether she ultimately owed her fame to her scientific endeavours, or to her brutal murder. When Hypatia was later elevated to become the embodiment of scientific wisdom and beauty in various literary or film portrayals, these representations were, unfortunately, nothing but fiction.⁵

Although the source material for the nineteenth century is considerably better, more recent scientific history does not seem any less elusive on account of it.⁶ As a result, feminist historians alternate between viewing the nineteenth century as either the beginning or the end of female access to education and research. In *Hypatia's Heritage*, Margaret Alic declares that "at the end of the nineteenth century, for the first time in history, it became possible for a woman to join the scientific establishment," (Alic 1986: 191) while Nina Baym laments the fact that in the United States, "only one woman – Maria Mitchell [...] was recognised for her scientific achievement before the Civil War" (Baym 2002: 3). Nevertheless, on account of their only insufficiently contextualised nature, both of these hyperbolic framings seem debatable. Renée Bergland is aptly critical of their tunnel vision, and their respective failure to fully factor in the historical conditions. As Bergland much more instructively demonstrates, one can indeed consider the end of the nineteenth century as the first time in history when a woman could join the scientific establishment, but what Alic fails to mention is that the late nineteenth century was also the first time in history when there was a scientific establishment *at all*.

⁴ The scientific records are further complicated by the fact that the Muslim world produced no scientific academies analogous to those that developed in Europe in the seventeenth century; scientific activity tended to be centred at courts or observatories. Moreover, since the printing press was not fully exploited in the Islamic world until the eighteenth century, it is not clear how widely scientific ideas circulated (Gaida 2016: 201-2). Admittedly, however, the latter claim could also be said to apply to the European history of printing, so it is not necessarily as strong a reason as Gaida's argument might suggest at first glance.

⁵ Adaptations on Hypatia include Charles Leconte de Lisle's nineteenth century poem and drama *Hypatie et Cyrille* (1857), Charles Kingsley's 1853 novel *Hypatia or New Foes with an Old Face*, Umberto Eco's novel *Baudolino* (2000), and the 2009 Spanish film *Agora* starring Rachel Weisz. Hypatia is widely credited with the quote "Reserve your right to think, for even to think wrongly is better than not to think at all," which is ascribed to her all over the web. With all her works lost, this seems a bit odd. According to my research, the quote more likely originated in a book published in 1908 by Elbert Hubbard. Hubbard wrote a highly fictionalised essay on Hypatia, interwoven with his own comment, satire, made-up details such as her height and weight and featured various made-up quotes. More interesting still is that up until 2009, the Encyclopaedia Britannica argued that this very quotation, invented by Elbert Hubbard in the 1900s, incited the mob that subsequently murdered Hypatia in 415 CE.

⁶ The latter argument refers to the fact that it was the increasing institutionalisation of science that ended the relatively "free" and, in this sense, "uninhibited" access of individual wealthy women to science, replacing a largely privately organised education and privately owned laboratories with institutionalised venues and much more heavily restricted or regulated access to both.

Bergland also criticises Baym for a similarly warped portrayal; whereas she correctly points to Mitchell's unique position as a female astronomer, she neglects to mention that no man whatsoever had won the sort of international honours bestowed on Mitchell⁷ (Bergland 2008: 82).

Bergland, on the contrary, avers that women were structurally or strategically disadvantaged only during the course of the nineteenth century (Bergland 2008: 76). By recourse to Londa Schiebinger, she maintains that science was iconographically female before that, as it was consistently portrayed as female between the sixteenth and eighteenth century.⁸ However, does the visual imagery of science as female indicate any particularly high regard for female scientists? Bergland seems to think so and thus writes that in "1845, science was more identified with girls than with boys" (Bergland 2008: 77). Moreover, she follows Kathryn Neeley's position that Whewell's coinage of the word "scientist" in the *Quarterly Review* of 1834 was not merely meant to be non-gender specific but intended to actively include women⁹ (Neeley 2001: 3). I remain unconvinced, however. The conceptualisation of the muse as female, for instance, has certainly not resulted in poetry being considered a female profession. Nevertheless, I allow for Bergland's argument that "the general cultural consensus at the beginning of the nineteenth century was that studying nature was less radical – safer and more appropriate for females – than studying the classics, which might lead to political activism." As a result, it was precisely when science turned more radical and speculative with the discoveries of Darwin, Faraday, or Maxwell, that women were actively dissuaded from science (Bergland 2008: 77). The scientific revolutions of the nineteenth century sparked a climate of uncertainty; a climate in which male professionals felt increasingly threatened and came to adopt increasingly extreme measures to prove female ineptitude in the realm of science. This drastic institutional shift towards the last third of the nineteenth century is distinctly recorded in the writings of Edward Clarke, then-professor at Harvard Medical School. In *Sex in Education*, Clarke depicted the female uterus as a delicate organ with a voracious thirst for blood. Strenuous thinking, according to Clarke, caused women's brains to draw too much blood from their systems, causing their sexual organs to shrivel, thus turning them into "sterile, unwomanly creatures," "analogous to the sexless class of termites" (Clarke 1873: 139, 93). In Clark's distorted biologism, the new-found gender bias became inscribed into the scientific discourse. Once female inaptitude was no longer based on a social foundation,

⁷ While there were a few internationally recognised American scientists, Mitchell was the first American scientist to win an international award for scientific discovery and also one of the few antebellum scientists whose name is at all recognisable to historians of science – whether male or female.

⁸ Think for instance of Jan Luyken's frontispiece of Gerard Blaes, *Anatome animalium*, 26 × 21 cm, published by Johannes van Someren, Amsterdam, 1681.

⁹ This position is actively challenged in the historio-scientific discourse. While there seems to be agreement on the fact that the earliest written record of the word "scientist" appears in a 1834 review of Mary Somerville's *Connexion* by William Whewell, the text is not altogether unambiguous on the question of whether it was intended to include female professionals or to be limited to men and only happened to be introduced on a side note in the review of Somerville's work that Whewell – that much is certain – clearly admired (Whewell 1934: 54-68). While Renée Bergland and Kathryn Neeley appear convinced that Whewell meant to deliberately include women, the arguments to the contrary seem more convincing. See James Secord on the question of whether Mary Somerville was a scientist (Secord 2018: 48) and Sydney Ross for an elaborate history of the word's coinage, even if Ross does not explicitly reflect on the controversial question of gender (Ross 1962: 65-85).

professional discrimination was no longer a political choice but a physiological reality.

3 Biased Historiography

Gender-biased assumptions have barred women not only from scientific discourse, but also from a presence in the broader historical one. Since the 1970s or 80s, historians, scientists, philosophers and feminists have all dedicated their work to rewriting what I have termed the "gendered history of science." Female scholars such as Evelyn Fox Keller, Sandra Harding, Helen Longino and Ruth Hubbard have each criticised scientific histories for their gender bias and the blinkered view of female achievements. Their works have explored the ways in which an assumed "scientific objectivity" is both culturally constructed and bound and how the insights of standpoint theory may serve to reveal the impossibility of any truly objective approach.¹⁰ They further challenge conventional western epistemologies and philosophies of science, which are deeply invested in the notion of only one modernity and one "real" – that is western – science (Harding 2011: 6). Moreover, the few female scientists that are in fact visible are mere phenomena – exceptions; a view that perversely reinforces the stereotypical absence of ordinary women in science (Temple-Wood 2017: 70). Social historians and sociologists have repeatedly challenged historians to write about the ordinary scientists and technicians, instead of perpetuating a tradition of writing in which the history of science is reduced to the biographies of a few great men and their even greater ideas (Nye 2006: 323). Without a doubt, the demarcation between exceptional and ordinary has historically been quite strongly gender bound. Simon Flexner, Director of Laboratories at the Rockefeller Institute, likewise fell victim to such social conditioning. When he addressed the 1921 graduating class on the Scientific Career for Women, he distinguished two main kinds of scientific discovery. One depended on "genius" or "imaginative insight," and his examples were all men. The other discovery, dealing with predictable phenomena, demands "knowledge – often deep and precise – and method, but not the highest talent" (Flexner 1921: 97-105). The example he provided for the latter was, quite tellingly, none other than Marie Curie. But the problems inherent in rewriting this complicated history are not only the result of a lack of data or a lack of interest in the unacknowledged female scientists; they are also of a conceptual nature. Works that are overtly focused on writing history's forgotten scientists back into the discourse sometimes fall sadly short on cultural contexts. Shifting conceptions of gender identities or social contexts are omitted. Historical details are bent and twisted to fit the overall narrative. Wholly determined to celebrate female genius, they attempt to cover vast time scales, employ a history which is largely mythological in origin, or proceed by automatically taking the sorry plight of women as the central subject. A case in point here is *Hypatia's Heritage*, referred to above, and it was precisely such fallacies that led to Dorinda Outram's scathing critique of Alic's study. I would like to quote Outram's review at length here, because it comprehensively illustrates some of the issues at stake:

¹⁰ See for instance Evelyn Fox Keller's *Reflections on Gender and Science* (1985), Sandra Harding's *The Science Question in Feminism* (1986), Ruth Hubbard's *Biological Woman – The Convenient Myth: A Collection of Feminist Essays and a Comprehensive Bibliography* (1982) or her article on "Science, Facts and Feminism," (1988) and Helen Longino's *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry* (1990).

The road to hell, as we all know, is paved with good intentions. Few books in the history of science can have been written with better intentions than Margaret Alic's, whose avowed aim is to spot-light the contributions made by women scientists in the European West, throughout the ages. But the result has been to perpetrate an Inferno of pseudohistory, which will benefit neither the history of women, nor the history of science, and certainly not the writing of history in general. It seems to be only within the narrow limits of specialist 'feminist' publishers that a historical enquiry could be seriously published which could attempt, in the mid-1980s, to approach a theme as vast as the one sketched out by our author, by means of the narrative biographical approach. As we skip hectically from one great but forgotten (or plagiarized, or ignored, or victimized) woman to another, we encounter all the conventional figures [...]. The pantheon begins with goddesses and matriarchs of the pre-historic era of Europe, [...the] philosophers, midwives and physicians of the middle ages duly appear, followed by the Duchess of Newcastle, Lady Mary Wortley Montague, Caroline Herschel, the Marquise du Chatelet, Sophie Germain, Ada Lovelace [...] Sophia Kovalevsky, Jane Marcet and Mary Sommerville. (Outram 1987: 224)

Some of the issues raised here seem not at all limited to the case in point, but rather highlight much more fundamental challenges of the genre. From the outset, feminist historiography has always raised the question of scope. On the one hand, these studies attempt to be reasonably broad as they aim to frame the omission of female scientists as structural; a supra-temporal phenomenon within scientific discourse. As a result, some studies span far too broad a period of time to adequately account for individual cultural or contemporary historical contexts. Moreover, rewritings of history like to place emphasis on the individual suffering and incomparable achievement of their research subjects. In doing so, however, they often unnecessarily reinforce the victimhood of these female scholars or are tempted to attribute the particular fate of said women to their circumstances, rather than to the historical conditions at large. Another pitfall seems to be the inherent desire to offer tangible insights into the lives of the research objects. To this end, scientific approaches often tend to blur with biographical ones, or the scientific fidelity of a study is corrupted by its lamentable tendency of "automatically taking the woes of woman as its subject" (Outram 1987: 224). The overarching desire to emphasise a particular unique achievement apparently all too often leads to a lack of critical examination of the object of research, leading variously to excessive praise, false-credit, or attributing general scientific obstacles to women's research alone. This is not to say that the historiography of male genius in science is fundamentally more accurate, less one-sided, or devoid of political agenda. It is perhaps more to say that when one sets out to fill research gaps in order to conduct more objective and less biased research than any preceding study, scholars should not be surprised to be held to the high standards they set for themselves.

The inherently worthy aim of re-inscribing forgotten women scholars into scientific historiography is further complicated by the often-problematic interactions of gender and racial discrimination. It sometimes seems as if the inclusion of individual female scientists into the canon comes at the price of accepting a eurocentrist and individualist bias, not to mention an unwarranted preference for western scientific epistemologies over indigenous knowledge systems. As Harding writes, much western "feminist work, like much of the larger science studies movement in which it is embedded, is unaware of the counterhistories, the successes of indigenous knowledge, or the arguments for valuing multiple science traditions – a world of sciences" (Harding 2011: 17). The prevalent tendency to

treat race and gender discrimination as mutually exclusive categories or isolated phenomena is problematic in various ways. Kimberle Crenshaw was one of the first scholars to examine the troublesome effects of demarginalising women at the crossroads of race and sex in a seminal essay that set out to confront the race and gender blindness of U.S. law (Crenshaw 1989: 139-67). In effect, Crenshaw argued, black women were excluded from feminist theory and antiracist policy discourse because both are predicated on a discrete set of experiences that often do not accurately reflect the interaction of race and gender and thus marginalise those who are burdened on multiple levels, while ultimately obscuring claims that cannot be understood as resulting from one single distinct source of discrimination (Crenshaw 1989: 140). More recent studies echo Crenshaw's argument, underscoring the fact that gender never functions in isolation, but always interacts with other powerful social relations factors, such as race and class (Harding 2011: 13). Various dominant social discourses that discriminate against certain groups are "deeply imbricated" into each other in that "colonialism, imperialism, and male supremacy have persistently represented gender in racial or colonial terms, and racial and colonial relations in gender terms" (Harding 2011: 12). While feminism is still often perceived by formerly colonial societies as an elitist western import,¹¹ it appears imperative to view both racial and gender discrimination as contributing factors in the historical fragmentation of science. Any feminist historiography that aims to escape male supremacist histories should therefore also meet the challenges of western-supremacist histories without succumbing to their various prevailing historical myths; myths of progressive triumph, exceptionalism, modernisation and objectivism; myths that have been so deeply ingrained into the eurocentric perspective of scientific history, that they have become almost impossible to recognise.

4 Historical Myths and Narrative Framing

Whereas scientific discourse is most frequently perceived as driven by rational forces and objective rendering, feminist and postcolonial readings, among others, have revealed the discourse as inherently biased and value ridden. At its core lies a triumphalist view that assumes that "the history of Western scientific and technological work consists only of a parade of admirable discoveries and inventions," a historic myth that wishes to ascribe any harmful outcomes in the course of scientific achievements, whether they be environmental destruction, global warming, militarism, or colonialism itself – as unrelated to science or technology and instead "caused by the ignorance and bad politics of political leaders and the public that they court" (Harding 2011: 6). This is closely connected to the notion of western exceptionalism that assumes that "the West alone is capable of accurate understandings of the regularities of nature and social relations and their underlying causal tendencies." Convinced of a singular world, with a single internal order, "only one science is capable of understanding that order" and naturally only one societal model is capable of producing that science – the western one – a prevalent view that "has reigned in philosophy of science as the unity-of-science thesis" (Harding 2011: 6). Although there is no scientific justification to expect that any scientific advancements in collective knowledge stemming from non-western paradigms or social systems should be empirically or predictively less adequate, western ethnocentrism has construed non-western knowledge processes as

¹¹ Cf. Harding 2011: 17.

"pseudoscientific," "protoscientific," or merely "unscientific," a view that induces Colin Scott to ask, if it is "Science for the West" and "Myth for the Rest?" (Scott 2011: 175). Deeply rooted in enlightenment, modernisation theory, with its unequivocal belief in the beneficial powers of scientific rationalism came to replace traditional religion, myths and superstitions about nature and social relations, thereby undermining the complexity and sophistication of indigenous knowledge – knowledge systems that came to be considered expendable by modernity's new dogmas (Harding 2011: 2, 10).

The mythological renderings of consistent progress, exceptionalism, modernisation and objectivism have thus inhibited the writing of a more accurate account of the history of science. The subsequent eurocentric vision of the historical discourse has both diffused and assimilated the rich scientific and technological heritage of non-western actors, whether from Asia or the Middle East. Closely bound to such historical mythologising were the societal ideals that made female scientists vulnerable to exclusion. The ideological connection of modernity to progress, which in turn is linked to triumphant and exceptionalist myths not only perfectly underwrites a historical period of political domination and geographical expansion, but also underscores a supposed paradigm of ideal society, clearly structured by gender hierarchies. The late nineteenth century is therefore the specific moment in history where manly heroism became equated with scientific quests, and the accumulation of scientific knowledge became likewise equated with virile, masculine values.¹² This paragon of the heroic male pioneer naturally excluded women from the picture, a fact that becomes all too obvious when one compares the narrative rendering of female and male scientists in the nineteenth and early twentieth century.

A case in point is Caroline Herschel, German-born British astronomer and sister of William Herschel, who discovered eight comets in her lifetime. Herschel self-fashioned her role within the field of science exactly in accordance with the received value systems of her contemporaries: "I am nothing. I have done nothing at all; all I am, all I know, I owe to my brother. I am only the tool which he has shaped to his use – a well-trained puppy-dog would have done as much"¹³ (Herschel 1876: ix). Now, I do not want to argue that Caroline's brilliant discoveries were falsely attributed to her brother, but in the course of scientific historiography, the question of scientific excellence has more often than not also become a question of narratological framing, a fact that can be observed if one juxtaposes Herschel's self-deprecating modesty with Corrado Segre's portrayal of his own work as mathematician in the early twentieth century:

¹² The myth of an original western science "that owes no intellectual, methodological, or technological debts to any other society (apart from the safely ancient Greeks)" is not itself ancient. According to John M. Hobson, it was constructed largely in the late nineteenth century, precisely at the time when European powers were expanding, solidifying and justifying their growing empires and colonial projects around the world. This conceptualisation is mirrored in an explicit or implicit denial that European expansion and the development of modern sciences in Europe had any significant causal relations to each other, concealing the fact that many discoveries could not have been developed without the access to nature provided by colonial expansion and to what degree the development of the European empire in turn blocked the scientific development of other cultures (Hobson 2011: 34-5).

¹³ Herschel's work as a scientist was mocked in the well-known caricature, "The Female Philosopher, Smelling Out the Comet," hand-coloured etching, 24.9 × 18 cm, published by R. Hawkins, Soho, London, 2 February 1790.

Many times a scientific truth is placed as it were on a lofty peak, and to reach it we have at our disposal at first only hard paths along perilous slopes whence it is easy to fall into the abysses where dwells error; only after we have reached the peak by these paths is it possible to lay out safe roads which lead there without peril. (Segre 1904: 453)

The work of the mathematician, traditionally imagined as mostly dull and dreary, is here transformed into a dangerous, heroic adventure – thanks to the alpine metaphor. Segre's self-fashioning through the imagery and rhetoric of expeditionary heroism is not a singular case. Another example is Pettenkofer's experiment of ingesting a laboratory culture of cholera bacilli:

Even if I be mistaken and this experiment that I am making imperils my life, I shall look death quietly in the face, for what I am doing is no frivolous or cowardly act of suicide, but I shall die in the service of science as a soldier perishes on the field of honor. [...] Man, who wants to occupy a higher position than the beasts, must be ready to sacrifice even life and health on behalf of higher and more ideal goods! (Wieninger 1987: 176-8)

By portraying his experiment as a life-threatening endeavour to which he subjects himself in heroic self-sacrifice, Pettenkofer turns an ultimately inconclusive experiment into a grand tale of scientific discovery. And scholarship – for the most part – has willingly adopted this view. Such narrative framing simply allows for a better story. When browsing through the history of science, it becomes evident that it is not so much the activity itself, or the specific type of research that justifies a particular narrative framing or reading, but rather the subjective view of the researcher in question. Within the field of medical self-experimentation, the case of Mary Goldberger, who agreed to be injected with the blood of a woman who was dying of pellagra, provides an equally good example. She is one of only two women Lawrence Altman features in his book *Who Goes First? The Story of Self-Experimentation in Medicine*. In his view, she was certainly no heroine, but rather a faithful wife who simply supported her husband's hypothesis: "This was an act of faith," Altman says, "it took no courage" (Altman 1987: 244).

In her illuminating study "Objectivity or Heroism? On the Invisibility of Women in Science," Naomi Oreskes illustrates the extent to which the omission of women from science can be attributed to a gender-based objective rationale within scientific discourse, that fails to recognise epistemologies of a more situated or fragmentary nature¹⁴ (Oreskes 1996: 87-8). She contrasts male-oriented epistemologies of alleged objectivism with instances in which objective female scientific work is either obscured or devalued by a similarly fashionable ideology of scientific heroism (Oreskes 1996: 90). Oreskes thus provides various instances where male scientists were deliberately reframed as public heroes by invoking adventurous qualities such as "bravery, physical strength, and danger" in their scientific endeavours – qualities that conspicuously often sprang from fanciful and stylised re-rendering, rather than facts. By demonstrating the unique quality of individual scientists, their heroism served as a symbol to authenticate scientific discovery (Oreskes 1996: 99, 101). Ultimately, gendered physicality became the prerequisite for scientific achievement. Scientific reasoning along biological lines served to discourage female scientists, while the broader historiographic discourse equally

¹⁴ Oreskes cites Donna Haraway's "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," (1988); Sandra Harding's *The Science Question in Feminism* (1986), and her *Whose Science? Whose Knowledge? Thinking from Women's Lives* (1991).

centred upon gendered biology to constitute successful masculinity as grounds for male superiority. It is precisely because the erroneous depiction of the heroic researcher is still so very seductive, that it is crucial for scientists as well as historians to regard these criteria as not necessarily epistemological, but ideological categorisations.

All of this is not to say that the range of arguments and cases presented here is not in itself limited to a very deliberate selection of examples, and I am quite aware that my account can neither be fully objective nor sufficiently contextualised in view of the sheer scope of varying historical conditions. It is safe to say that broader generalisations about the practice of science and the respective recording thereof remain problematic; maybe some of the issues are therefore best contemplated anecdotally. What can be determined from this survey, however, is that a range of influential rhetoric affects the history of science and that the latter can therefore hardly be regarded as an impartial discourse. Ultimately, it is perhaps this heightened sensitivity towards some of the difficulties inherent in any attempt at accurate scientific historiography – particularly in relation to gender and postcolonial realities – that may provide a tentative path towards a better scholarly practice.

5 Conclusion

There can be no doubt that a lot has changed since Caroline Herschel's self-rendering as "nothing." On the one hand, much has been done in terms of education. Women have easier access to it, at least in the larger part of the world. Scientific institutions no longer systematically prevent women from entering or even from achieving greatness in their respective fields. Academic journals and publishers have – again to a certain degree – done their share to allow for a diverse academic output. And gender bias by male scientists no longer goes unnoticed – as became clear in the 2015 controversy surrounding noble prize laureate Tim Hunt.¹⁵

The various authors who have set out to write forgotten female scientists back into the history books have succeeded in reinstating absent scientists and allowed silenced voices to speak – again to a degree. And yes, some laws have been changed to reduce gender bias in scientific data, especially in terms of clinical trials. Nevertheless, 90 percent of biomedical research still goes into treating diseases that affect only 10 percent of the world's population. And while heart disease is still the number-one cause of death of U.S. women, only a third of clinical trial subjects in cardiovascular research are female, and less than a third of those that do include women, report results by sex (DiChristina 2017: 9).

¹⁵ 2001 Nobel laureate Sir Tim Hunt addressed female journalists and scientists at a lunch at the World Conference of Science Journalists (WCSJ) in Seoul in the following words: "It's strange that such a chauvinist monster like me has been asked to speak to women scientists. Let me tell you about my trouble with girls. Three things happen when they are in the lab: you fall in love with them, they fall in love with you, and when you criticise them, they cry. Perhaps we should make separate labs for boys and girls? Now, seriously, I'm impressed by the economic development of Korea. And women scientists played, without a doubt, an important role in it. Science needs women, and you should do science, despite all the obstacles, and despite monsters like me" (Whipple & Waterfield 2015: n.p.). In consequence of this statement, Tim Hunt was forced to resign from his position as honorary professor with the University College of London and from several prestigious science boards and committees. The controversy continued after he publicly apologised for causing offence rather than for the view he presented in the statement. Nevertheless, there is an opposing position that considers the real scandal to be one of irresponsible journalism magnified by social media frenzy that not only ruined Hunt's career but led to him being banned from future cancer research and perhaps ultimately to the deaths of thousands of women.

There is much that remains to be done, and perhaps it is not only the role of scientists to change the narrative, but also for the humanities to utilise their resources to assist in rewriting science in a more balanced manner and to allow for counter histories or "herstories" to be told. Narratology, textual criticism, rhetoric and postcolonial theory – suited for and well-versed in debunking hidden power-relations or laying bare master narratives, can perhaps challenge some of the biased practices still at work. Maybe factual and fictional accounts of the history of science can help to recover those lost voices and fill their absences. Since it is fiction that allows for a variety of versions, distinct voices and multiple perspectives, the fictional rewriting of scientific history can certainly facilitate a broadening of scope. Margaret Rossiter – another pioneer in the complicated project of rewriting the gendered history of science – made a similar argument some thirty years ago. Rossiter was writing about the systematic undervaluing of women's contributions to science – a phenomenon she called the Matilda effect: "A better and less contentious explanation [...] than any provided by the sociology of science" Rossiter claimed, "comes from the field of literary criticism."¹⁶ What Rossiter was referring to, was Joanna Russ' systematic critique of the many ways women's contributions to literature have been neglected – whether consciously or not. On the cover of her 1983 study *How to Suppress Women's Writing* Russ featured the following list of attempts to write women out of literary history, a list that appears just as revealing today and aptly framed for the gendered history of science:

She didn't write it. (But if it's clear she did the deed. . .) She wrote it, but she shouldn't have. (It's political, sexual, masculine, feminist.) She wrote it but look what she wrote about. (The bedroom, the kitchen, her family. Other women!) She wrote it, but she wrote only one of it. ("Jane Eyre. Poor dear, that's all she ever. . .") She wrote it, but she isn't really an artist, and it isn't really art. (It's a thriller, a romance, a children's book. It's sci fi!) She wrote it, but she had help. (Robert Browning. Branwell Brontë. Her own "masculine side.") She wrote it, but she's an anomaly. (Woolf. With Leonard's help....)

She wrote it BUT. . .¹⁷

Bibliography

- Alic, Margaret (1986): *Hypatia's Heritage: A History of Women in Science from Antiquity through the Nineteenth Century*. Boston, MA: Beacon Press.
- Altman, Lawrence (1998): *Who Goes First? The Story of Self-Experimentation in Medicine*. Berkeley: University of California Press.
- Baym, Nina (2002): *American Women of Letters and the Nineteenth-Century Sciences: Styles of Affiliation*. New Brunswick, NJ: Rutgers University Press.

¹⁶ In her article, Rossiter traces a long history of systematic dislocation of credit and provides numerous examples of women who were overlooked due to a disproportionate focus on their male collaborators or husbands. She also gives conclusive examples taken from scientific biographies or dictionaries that purposefully exclude women. The systematic underrecognition of women in the history of science is what Rossiter called the "Matilda effect" in analogy of the better-known "Matthew effect" in science. The latter denotes the fact that eminent scientists are given disproportionate credit in cases of collaboration or of independent multiple discoveries.

¹⁷ See Russ (1983): n.p. The quotation is set in italics to save some features of the design of the original which appeared on the cover of Russ' book.

- Bergland, Renée L. (2008): "Urania's Inversion: Emily Dickinson, Herman Melville, and the Strange History of Women Scientists in Nineteenth-Century America", in: *Signs* 34 (1), 75–99.
- Clarke, Edward Hammond (1873): *Sex in Education*. Boston: James R. Osgood and Company.
- Criado Perez, Caroline (2019): *Invisible Women: Exposing Data Bias in a World Designed for Men*. London: Chatto & Windus.
- Des Jardins, Julie (2010): *The Madame Curie Complex: The Hidden History of Women in Science*. New York: The Feminist Press at the City University of New York.
- DiChristina, Mariette (2017): "This Is Not A Women's Issue. Why the New Science of Sex & Gender Matters for Everyone", in: *Scientific American* 317 (3), 30–31.
- Flexner, Simon (1921): "The Scientific Career for Women", in: *Scientific Monthly* 13, 97–105.
- Fox Keller, Evelyn (1985): *Reflections on Gender and Science*. New Haven: Yale University Press.
- Gaida, Margaret (2016): "Muslim Women and Science: The Search for the 'Missing' Actors", in: *Early Modern Women*, 11 (1), 197–206.
- Gelbart, Nina (2016): "Adjusting the Lens: Locating Early Modern Women of Science", in: *Early Modern Women: An Interdisciplinary Journal* 11 (1), 116–127.
- Haraway, Donna (1988): "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective", in: *Feminist Studies* 14, 575–599.
- Harding, Sandra (1986): *The Science Question in Feminism*. Ithaca, NY: Cornell University Press.
- Harding, Sandra (1991): *Whose Science? Whose Knowledge? Thinking from Women's Lives*. Ithaca, NY: Cornell University Press.
- Harding, Sandra (2011): *The Postcolonial Science and Technology Studies Reader*. Durham, NC: Duke University Press.
- Herschel, Caroline (1876): *Memoir and Correspondence*. Edited by Mary Herschel. New York: Appleton.
- Hobson, John M. (2011): "Discovering the Oriental West." In: Harding, Sandra G. (ed.): *The Postcolonial Science and Technology Studies Reader*. Durham, NC: Duke University Press.
- Holt, Nathalia (2016): *Rise of the Rocket Girls: The Women Who Propelled Us, from Missiles to the Moon to Mars*. New York: Little, Brown and Company.
- Hubbard, Ruth, ed. (1982): *Biological Woman – The Convenient Myth: A Collection of Feminist Essays and a Comprehensive Bibliography*. Cambridge, MA: Schenkman.
- Hubbard, Ruth (1988): "Science, Facts and Feminism", in: *Hypatia* 3 (1), 5–17.

- Longino, Helen (1990): *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton, NJ: Princeton University Press.
- McKinley, Elizabeth (2005): "Brown Bodies, White Coats: Postcolonialism, Maori Women and Science", in: *Discourse: Studies in the Cultural Politics of Education* 26 (4), 481–496.
- Mitchell, Maria (1896): *Maria Mitchell: Life, Letters and Journals*. Compiled by Phebe Mitchell Kendall. Boston, MA: Lee and Shepard.
- Neeley, Kathryn A. (2001): *Mary Somerville: Science, Illumination, and the Female Mind*. New York: Cambridge University Press.
- Nye, Mary Jo (2006): "Scientific Biography: History of Science by Another Means?", in: *Isis* 97 (2), 322–329.
- Oreskes, Naomi (1996): "Objectivity or Heroism? On the Invisibility of Women in Science", in: *Osiris* 11, 87–113.
- Outram, Dorinda (1987): "Margaret Alic. Hypatia's Heritage: A History of Women in Science from Antiquity to the Late Nineteenth Century", in: *The British Journal for the History of Science* 20 (2), 224–225.
- Rossiter, Margaret W. (1993): "The Matthew Matilda Effect in Science", in: *Social Studies of Science* 23 (2), 325–341.
- Ross, Sydney (1962): "Scientist. The Story of a Word", in: *Annals of Science* 18 (2), 65–85.
- Russ, Joanna (1983): *How to Suppress Women's Writing*, Austin: University of Texas Press.
- Saini, Angela (2017): *Inferior: How Science Got Women Wrong – and the New Research That's Rewriting the Story*. Boston, MA: Beacon Press.
- Schiebinger, Londa (1991): *The Mind Has No Sex? Women in the Origins of Modern Science*. Cambridge, MA: Harvard University Press.
- Scott, Colin (2011): "Science for the West, Myth for the Rest?", in: Harding, Sandra G. (ed.), *The Postcolonial Science and Technology Studies Reader*. Durham, NC: Duke University Press, 175–197.
- Secord, James (2018): "Mary Somerville's Vision of Science", in: *Physics Today* 71 (1), 46–52.
- Segre, Corrado (1904): "On Some Tendencies in Geometric Investigations", in: *Bulletin of the American Mathematical Society* 10, 442–468.
- Shetterly, Margot Lee (2016): *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race*. New York: William Morrow.
- Sobel, Dava (2016): *The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars*. New York: Viking.
- Temple-Wood, Emily (2017): "The Blogger and the Trolls", in: *Scientific American* 317 (3), 70–71.
- Wagner, Darren N. / Wharton, Joanna (2019): "The Sexes and the Sciences", in: *Journal for Eighteenth-Century Studies* 42 (4), 399–413.

- Whewell, William (1834): "Review of *On the Connexion of the Physical Sciences*. By Mrs. Somerville", in: *Quarterly Review* 51, 54–68.
- Whipple, Tom / Waterfield, Bruno (2015): "Leaked Transcript Shows 'Sexist' Scientist Was Joking", in: *The Sunday Times*, June 24.
- Wieninger, Karl (1987): *Max von Pettenkofer*. Munich: Hugendubel.